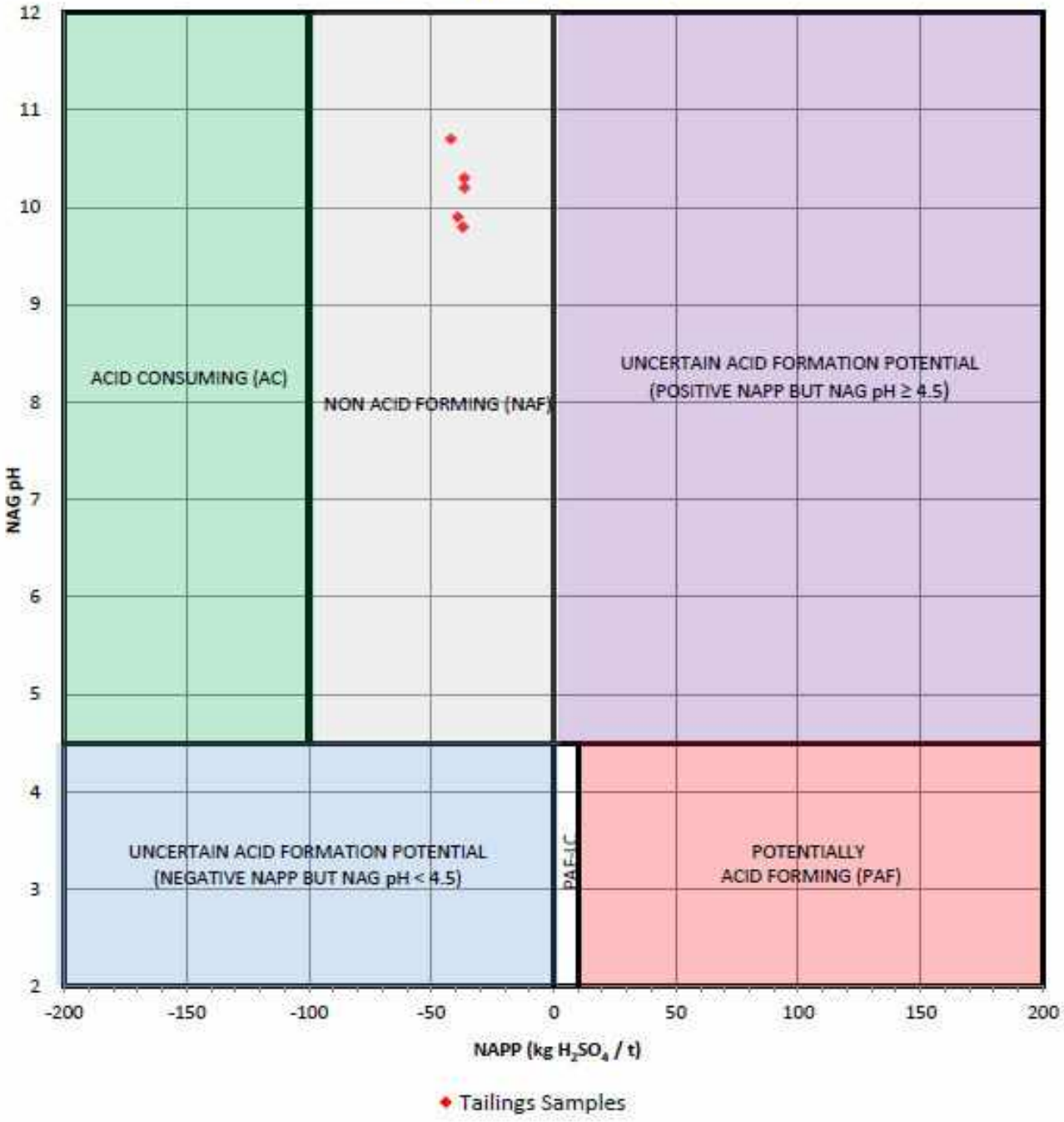
FIGURE

Acid Formation Potential



Acid Formation Potential	NAPP (kg H_2SO_4 / t)	NAG pH
Potentially Acid Forming (PAF)	>10	<4.5
Potentially Acid Forming - Low Capacity (PAF - LC)	0 to 10	<4.5
Non Acid Forming (NAF)	Negative	≥4.5
Acid Consuming (AC)	Less than - 100	≥4.5
Uncertain	Positive	≥4.5
	Negative	<4.5

APPENDIX A

Testwork Methods and Interpretation Principles

A. TESTWORK METHODS

A.1 ACID BASE ACCOUNTING

Acid base accounting (ABA) assesses a sample's potential to form acid from the oxidation of sulfides and the ability to neutralise acid by the dissolution of minerals, especially carbonates, contained in the sample. The test work methods used were based on the ABA methodology defined in the Mine Environment Neutral Drainage (MEND) Acid Rock Drainage Prediction Manual (Ref. 1) and Guidelines for Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia (Ref. 2), as detailed below.

Total carbon and total inorganic carbon were determined by LECO induction furnace, with infrared detection.

Total sulfur was determined by LECO induction furnace, with infrared detection. Sulfate sulfur was determined by HCl digest with ICP detection. Knight Piésold has developed its own classification for sulfur content which has used in this memorandum report as provided in Table A.1.

Table A.1: Sulfur Classification System

Sulfur content (%)	Classification
<0.01%	Extremely low
0.01 to 0.1%	Very low
0.1 to 0.3%	Low
0.3% to 0.5%	Moderate
0.5% to 2%	High
2% to 5%	Very High
>5%	Extremely High

Acid Neutralising Capacity (ANC) was determined by digestion in a standard solution of HCl, followed by back titration with NaOH to determine the amount of acid consumed. The technique used was based on Sobek et al (Ref. 3), however, a siderite correction step has been added to the method, after Stewart et al (Ref. 4). Knight Piésold has developed its own classification for ANC which has used in this memorandum report as provided in Table A.2.

Table A.2: ANC Classification System

ANC content (kgH_2SO_4/t)	Classification
<0.3	Extremely low
0.3 to 3	Very low
3 to 10	Low
10 to 15	Moderate
15 to 60	High
60 to 150	Very High
>150	Extremely High

The results of the ABA test work are used to calculate the Maximum Potential Acidity (MPA) which is a measure of the maximum amount of sulfuric acid which can be produced

from the total oxidation of all sulfides within the sample, assuming all sulfide is present as pyrite.

The maximum potential acidity of the samples was calculated using the following formula:

MPA (kg H_2SO_4/t) = (Total S (%) – Sulfate S (%)) x 30.6

The Net Acid Producing Potential (NAPP) is the balance between the Maximum Potential Acidity and the Acid Neutralising Capacity. A negative NAPP indicates that there is an excess neutralising capacity and a positive NAPP indicates there is excess potential acidity. The NAPP was calculated using the following formula.

NAPP (kg H_2SO_4/t) = MPA (kg H_2SO_4/t) – ANC (kg H_2SO_4/t)

A.2 NET ACID GENERATION

Net Acid Generation (NAG) test work is a direct measure of the sample's ability to produce acid through sulfide oxidation. The addition of hydrogen peroxide to samples causes rapid oxidation of the contained sulfides to produce sulfuric acid.

The procedure employed is based upon the Static NAG Test (Ref. 5 and Ref. 6). The static NAG test involves the addition of 250 mL of 15% hydrogen peroxide to 2.5 g of pulverised sample. The sample is allowed to react overnight prior to heating for a period of three hours. Once the sample has cooled the pH of the sample is measured prior to titration back to pH 4.5 and 7 to determine the acidity produced by the oxidation reactions.

A.3 ACID FORMING POTENTIAL

The acid formation potential of a sample is calculated based on the acid base accounting, i.e., the balance between a sample's ability to produce acid from the oxidation of sulfide minerals (MPA) and the sample's ability to neutralise acid by the dissolution of alkaline minerals contained within the sample (ANC).

Historically a safety margin was applied to ratio between the ANC and MPA to allow for variability in the rates of acid production and neutralisation processes and the potential for geographic separation of the acid producing and acid neutralising phases. This safety margin was generally set by industry at 2 in North America and 3 in Australia.

With recent advances in the understanding and acceptance of the NAG test there has been a move away from this method of classifying materials based solely on the ANC and MPA as these calculated parameters do not take into consideration the true availability of acid producing and acid neutralising phases.

Knight Piésold prefers to utilise the results of the acid base accounting in combination with the NAG testing results to classify the acid formation potential of materials. Knight Piésold's classification system is summarised in Table A.3. It is based on the Australian Government publication; Managing Acidic and Metalliferous Drainage (Ref. 7) and is broadly similar to the classification system contained within the AMIRA ARD Test Handbook (Ref. 8), which is advocated by the Global Acid Rock Drainage Guidelines (Ref. 9).

Table A.3: Acid Formation Potential Classification System

Acid Formation Potential Class	NAPP (kg H_2SO_4 /t)	NAG pH
Potentially Acid Forming (PAF)	>10	<4.5
Potentially Acid Forming – Low Capacity (PAF-LC)	0 to 10	<4.5
Non-Acid Forming (NAF)	Negative	≥4.5
Acid Consuming (AC)	Less than -100	≥4.5
Uncertain (UC)	Positive	≥4.5
	Negative	<4.5

A.4 PASTE pH AND ELECTRICAL CONDUCTIVITY

Measurement of paste pH and electrical conductivity of the samples was conducted using the methods of "near-saturated Paste pH analysis" as defined in the MEND prediction manual (Ref. 10) whereby a paste where water does not pond on the surface or the material appear dry was produced, with the precise water to solid weight ratio is varied to create the near saturated material. This is intended to replicate near saturated condition that match the pore water chemistry and solution ratio during a leaching event. The pH and EC were measured using a calibrated electrode probe meter.

The soil pH and salinity were classified based on the classification system provided in tables A.4 and A.5.

Table A.4: pH Classification System

pH	Classification
< 5	Strongly Acidic
5 to 6	Acidic
6 to 6.5	Slightly Acidic
6.5 to 7	Very Slightly Acidic
7 to 7.5	Very Slightly Alkaline
7.5 to 8	Slightly Alkaline
8 to 9	Alkaline

Table A.5: EC Classification System (Ref. 11)

EC (mS/cm)	Classification
<2	Non-saline
2-4	Slightly Saline
4-8	Moderately Saline
8-16	Highly Saline
16-32	Severely Saline
>32	Extremely Saline

A.5 MULTI-ELEMENT ANALYSIS OF SOLIDS

A.5.1 Geochemical Enrichments

Multi-element analysis of the tailings solids was conducted to assess element enrichments within the sample. The four acid digestion method used results in near total digestion of the sample to assess the whole rock geochemistry.

Multi-element analysis results were compared to average crustal abundances to calculate the geochemical abundance indices. The Geochemical Abundance Index (GAI) quantifies an assay result for a particular element in terms of average crustal abundance.

The GAI is calculated from the following formula:

$$\mathbf{GAI = Log_2 (C_n / (1.5 \times B_n))}$$

Where:
Cn = measured concentration of element in sample
Bn = average crustal abundance (Bowen, Ref. 12)

The GAI is expressed on a scale of 0 to 6, with 0 indicating that the element concentration is less than or similar to average crustal abundance, and a GAI of 6 indicating an element concentration of more than 96 times the average crustal abundance. The enrichment ranges for GAIs are as follows:

- GAI = 0 represents <3 times crustal abundance.
- GAI = 1 represents 3 to 6 times crustal abundance.
- GAI = 2 represents 6 to 12 times crustal abundance.
- GAI = 3 represents 12 to 24 times crustal abundance.
- GAI = 4 represents 24 to 48 times crustal abundance.
- GAI = 5 represents 48 to 96 times crustal abundance.
- GAI = 6 represents more than 96 times crustal abundance.

Knight Piésold has assigned an arbitrary scale to the GAI, with indices of 0 and 1 being classified as “not enriched”, an index of 2 being classed as “slightly enriched”, indices of 3 and 4 being classed as “significantly enriched” and indices of 5 and 6 being classified as “highly enriched”.

A.5.1 Soil Quality Screening for Closure Planning

The multi-element analysis results were also compared to guideline concentrations for soil quality based on risk to human health and ecology for preliminary assessment of possible closure requirements, such as construction of engineered cover systems or limiting land use / access.

The Australian National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013 (Ref. 13) has been used to assess risk to human health, based on an assumed ‘recreational’ closure land use. This assumes the final landform will comprise public open space such as parks and playing fields rather than undeveloped public open space where the potential for exposure will be lower. However, these values assume that no planting of crops for human consumption will occur.

To assess ecological risk, the U.S. Environmental Protection Agency Ecological Soil Screening Levels (Eco-SSLs) (Ref. 14) have been applied. These values apply to sites where terrestrial organisms may be exposed directly or indirectly to contaminated soil. The Eco-SSL values for mammalian wildlife have been adopted for this study. The Eco-SSLs do not provide guideline values for Sulfur, Sulfate or Phosphorous. Therefore, the former National Environment Protection (Assessment of Site Contamination) Measure (NEPC, 1999) (Ref. 15) ecological investigation levels for these substances have been included for reference purposes in the absence of other more applicable ecological assessment criteria.

The Netherlands Ministry of Housing, Spatial Planning and the Environment (VROM) has developed a series of soil-screening values for contaminated sites as part of the Dutch Soil Protection Act (VROM 2000) (Ref. 16). Soil quality is assessed and managed using target and intervention values which are independent of land use. Soils with contaminant

concentrations below target values are considered to be at no risk and no restrictions on their use have been set. Soils with contaminant concentrations exceeding the intervention values require remediation as a matter of urgency, as the functional properties of the soil for humans, plant and animal life is seriously impaired or threatened. Therefore, for preliminary screening purposes, the intervention values have been applied in this study. For certain substances where intervention values have not been set, so-called “indicative levels for serious contamination” have been provided. These have also been included in this study, where appropriate.

The establishment of these soil quality screening values is to allow for evaluation only and it is not implied by production of these values that the project will be required to meet these reference levels or that these reference levels should be used as the regulatory framework.

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APPENDIX B

Tabulated Multi-element Results

4 Acid Digest ICP OES/MS Assay Result

Element	Ag	Al	As	Ba	Be	Bi	C	Ca	Cd	Co	Cr	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Se	Sn	Sr	Th	U	V	Zn
Sample	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
FY26	0.13	78647	1683.9	444.6	0.98	0.2	2300	17339	0.04	18.9	468	31	25300	8976	7468	338	55	42877	275	355	7.5	1600	0.52	0.5	0.6	339.62	4.08	1.08	64	34
FY28	0.19	78986	1920.2	511.4	0.99	0.12	2700	16228	0.05	16.2	491	19	19700	10391	6147	252	58.1	41739	285	354	9.7	1800	0.56	0.5	0.7	347.66	4.62	1.21	49	28
FY29	0.23	81823	1820.9	535.1	1.23	0.16	2700	14530	0.03	17.2	474	32	21000	11734	5632	301	52.3	34309	274	356	16.4	1800	0.73	0.7	0.9	282.24	6.29	1.52	60	43
FY30	0.18	80362	1730.8	464.2	1	0.14	2300	14521	0.04	21	522	23	23400	9303	8227	286	55.9	41491	305	336	9.1	1600	0.69	0.6	0.7	327.74	4.47	1.2	58	34
FY31	0.16	81984	683.7	391.7	1.01	0.11	2800	18198	0.06	21.1	536	38	30300	7653	7411	462	63.7	42748	327	421	10.3	1000	0.45	0.5	0.7	377.23	4.28	1.17	95	56

Average Crustal Abundance

Element	Ag	Al	As	Ba	Be	Bi	C	Ca	Cd	Co	Cr	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Se	Sn	Sr	Th	U	V	Zn
Average Crustal Abundance (ppm)	0.07	82000	1.5	500	2.6	0.048	480	41000	0.11	20	100	50	41000	21000	23000	950	1.5	23000	80	1000	14	260	0.20	0.05	2.2	370	12	2.4	160	75

Geochemical Abundance Indices

Sample	Ag	Al	As	Ba	Be	Bi	C	Ca	Cd	Co	Cr	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Se	Sn	Sr	Th	U	V	Zn
FY26	0	0	6	0	0	1	1	0	0	0	1	0	0	0	0	0	4	0	1	0	0	2	0	2	0	0	0	0	0	0
FY28	0	0	6	0	0	0	1	0	0	0	1	0	0	0	0	0	4	0	1	0	0	2	0	2	0	0	0	0	0	0
FY29	1	0	6	0	0	1	1	0	0	0	1	0	0	0	0	0	4	0	1	0	0	2	1	3	0	0	0	0	0	0
FY30	0	0	6	0	0	0	1	0	0	0	1	0	0	0	0	0	4	0	1	0	0	2	1	3	0	0	0	0	0	0
FY31	0	0	6	0	0	0	1	0	0	0	1	0	0	0	0	0	4	0	1	0	0	1	0	2	0	0	0	0	0	0

APPENDIX C

Laboratory Reports

MINERALS
TEST REPORT

CLIENT

RORY SPLETTER
KNIGHT PIESOLD PTY LIMITED
36 Cordelia Street
SOUTH BRISBANE, QLD 4101
AUSTRALIA

JOB INFORMATION

JOB CODE	: 752.0/2315582
NO. SAMPLES	: 5
NO. ELEMENTS	: 79
CLIENT ORDER NO.	: PE801-00137 (Job 1 of 1)
SAMPLE SUBMISSION NO.	: PE801-00137/51 L23003
PROJECT	: MUNGARI
SAMPLE TYPE	: Various
DATE RECEIVED	: 08/08/2023
DATE TESTED	: 25/08/2023 - 13/10/2023
DATE REPORTED	: 13/10/2023
DATE PRINTED	: 13/10/2023

REPORT NOTES

[redacted]

SIGNIFICANT FIGURES

It is common practice to report data derived from analytical instrumentation to a maximum of two or three significant figures. Some data reported herein may show more figures than this. The reporting of more than two or three figures in no way implies that figures beyond the least significant digit have significance.

For more information on the uncertainty on individual reported values, please contact the laboratory.

MEASUREMENT OF UNCERTAINTY

Measurement of uncertainty estimates are available for most tests upon request.

SAMPLE STORAGE

All solid samples (assay pulps, bulk pulps and residues) will be stored for 60 days without charge. Following this samples will be stored at a daily rate until clients written advice regarding return, collection or disposal is received. If storage information is not supplied on the submission, or arranged with the laboratory in writing the default will be to store the samples with the applicable charges. Storage is charged at $4.00 per m3 per day, expenses related to the return or disposal of samples will also be charged. Current disposal costs including packaging in a Class2 waste disposal facility is charged at $175.00 per m3.

Samples received as liquids, waters or solutions will be held for 60 days free of charge then disposed of, unless written advice fo return or collection is received.

LEGEND	X	= Less than Detection Limit		NA	= Not Analysed
	SNR	= Sample Not Received		UA	= Unable to Assay
	LNR	= Lab Not Received		>	= Value beyond Limit of Method
	DTF	= Result still to come		+	= Extra Sample Received Not Listed
	I/S	= Insufficient Sample for Analysis			

UNITS	ppm for Solid Samples	= mg/Kg
	ppb for Solid Samples	= µg/Kg
	ppm for Liquid Samples	= mg/L
	ppb for Liquid Samples	= µg/L

ELEMENTS	Au	Ag	Ag	Al	Al	ANC
UNITS	mg/Kg	ppm	mg/Kg	ppm	mg/Kg	kgH2SO4/t
DETECTION LIMIT	0.01	0.05	0.1	50	1	1
DIGEST	NAGx/	4A/	NAGx/	4A/	NAGx/	ANCx/
ANALYTICAL FINISH	MS	MS	MS	OE	OE	VOL
SAMPLE NUMBERS						
0001 FY26	<0.01	0.13	<0.1	7.86%	70	44
0002 FY28	<0.01	0.19	<0.1	7.90%	119	42
0003 FY29	<0.01	0.23	<0.1	8.18%	144	42
0004 FY30	<0.01	0.18	<0.1	8.04%	52	42
0005 FY31	<0.01	0.16	<0.1	8.20%	122	45
CHECKS						
0001 FY31	<0.01	0.27	<0.1	8.17%	141	47
STANDARDS						
0001 OREAS 293		<0.05		2.14%		
0002 AMIS0268						
0003 OREAS 279						
0004 NAG Std 3	<0.01		0.9		141	
0005 ANC-5						99
BLANKS						
0001 Control Blank	<0.01	<0.05	<0.1	<50	<1	0

ELEMENTS	As	As	B	Ba	Ba	Be
UNITS	ppm	mg/Kg	mg/Kg	ppm	mg/Kg	ppm
DETECTION LIMIT	0.5	1	1	0.1	0.1	0.05
DIGEST	4A/	NAGx/	NAGx/	4A/	NAGx/	4A/
ANALYTICAL FINISH	MS	MS	OE	MS	MS	MS
SAMPLE NUMBERS						
0001 FY26	1683.9	110	9	444.6	0.7	0.98
0002 FY28	1920.2	86	<1	511.4	0.6	0.99
0003 FY29	1820.9	72	<1	535.1	0.4	1.23
0004 FY30	1730.8	86	<1	464.2	1.4	1.00
0005 FY31	683.7	27	3	391.7	0.7	1.01
CHECKS						
0001 FY31	694.2	36	2	398.4	0.8	0.96
STANDARDS						
0001 OREAS 293	3.5			273.9		0.76
0002 AMIS0268						
0003 OREAS 279						
0004 NAG Std 3		<1	<1		1.7	
0005 ANC-5						
BLANKS						
0001 Control Blank	<0.5	<1	<1	<0.1	<0.1	<0.05

ELEMENTS	Be	Bi	Bi	C	C-Acinsol	C-CO3
UNITS	mg/Kg	ppm	mg/Kg	%	%	%
DETECTION LIMIT	0.1	0.01	0.01	0.01	0.01	0.01
DIGEST	NAGx/	4A/	NAGx/		C71/	
ANALYTICAL FINISH	MS	MS	MS	/CSA	CSA	/CALC
SAMPLE NUMBERS						
0001 FY26	<0.1	0.20	<0.01	0.23	<0.01	0.23
0002 FY28	<0.1	0.12	<0.01	0.27	<0.01	0.27
0003 FY29	<0.1	0.16	<0.01	0.27	0.01	0.26
0004 FY30	<0.1	0.14	<0.01	0.23	<0.01	0.23
0005 FY31	<0.1	0.11	<0.01	0.28	<0.01	0.28
CHECKS						
0001 FY31	<0.1	0.13	<0.01	0.28	0.01	0.27
STANDARDS						
0001 OREAS 293		0.17				
0002 AMIS0268				1.16		
0003 OREAS 279					0.23	
0004 NAG Std 3	0.3		<0.01			
0005 ANC-5						
BLANKS						
0001 Control Blank	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01

ELEMENTS	Ca	Ca	Cd	Cd	Ce	Ce
UNITS	ppm	mg/Kg	ppm	mg/Kg	ppm	mg/Kg
DETECTION LIMIT	50	1	0.02	0.1	0.01	0.01
DIGEST	4A/	NAGx/	4A/	NAGx/	4A/	NAGx/
ANALYTICAL FINISH	OE	OE	MS	MS	MS	MS
SAMPLE NUMBERS						
0001 FY26	1.73%	2907	0.04	<0.1	24.36	<0.01
0002 FY28	1.62%	3364	0.05	<0.1	27.28	<0.01
0003 FY29	1.45%	3309	0.03	<0.1	42.21	<0.01
0004 FY30	1.45%	3592	0.04	<0.1	30.94	<0.01
0005 FY31	1.82%	2185	0.06	<0.1	27.14	<0.01
CHECKS						
0001 FY31	1.82%	2198	0.08	<0.1	27.46	<0.01
STANDARDS						
0001 OREAS 293	5057		0.06		19.92	
0002 AMIS0268						
0003 OREAS 279						
0004 NAG Std 3		5115		1.6		0.46
0005 ANC-5						
BLANKS						
0001 Control Blank	<50	23	<0.02	<0.1	<0.01	<0.01

ELEMENTS	Co	Co	ColourChange	Cr	Cr	Cs
UNITS	ppm	mg/Kg	NONE	ppm	mg/Kg	ppm
DETECTION LIMIT	0.1	0.1	0	5	1	0.05
DIGEST	4A/	NAGx/	ANCx/	4A/	NAGx/	4A/
ANALYTICAL FINISH	MS	MS	QUAL	OE	OE	MS
SAMPLE NUMBERS						
0001 FY26	18.9	-0.0	Yes	468	9	0.45
0002 FY28	16.2	-0.0	Yes	491	9	0.50
0003 FY29	17.2	-0.0	Yes	474	9	0.73
0004 FY30	21.0	-0.0	Yes	522	10	0.49
0005 FY31	21.1	-0.0	Yes	536	8	0.52
CHECKS						
0001 FY31	21.4	-0.0	Yes	528	8	0.54
STANDARDS						
0001 OREAS 293	3.1			45		3.09
0002 AMIS0268						
0003 OREAS 279						
0004 NAG Std 3		4.0			<1	
0005 ANC-5						
BLANKS						
0001 Control Blank	<0.1	0.0		<5	<1	<0.05

ELEMENTS	Cs	Cu	Cu	Dy	Er	Eu
UNITS	mg/Kg	ppm	mg/Kg	mg/Kg	mg/Kg	mg/Kg
DETECTION LIMIT	0.005	1	1	0.01	0.01	0.01
DIGEST	NAGx/	4A/	NAGx/	NAGx/	NAGx/	NAGx/
ANALYTICAL FINISH	MS	OE	OE	MS	MS	MS
SAMPLE NUMBERS						
0001 FY26	<0.005	31	<1	<0.01	<0.01	<0.01
0002 FY28	<0.005	19	<1	<0.01	<0.01	<0.01
0003 FY29	<0.005	32	<1	<0.01	<0.01	<0.01
0004 FY30	<0.005	23	<1	<0.01	<0.01	<0.01
0005 FY31	<0.005	38	<1	<0.01	<0.01	<0.01
CHECKS						
0001 FY31	<0.005	38	<1	<0.01	<0.01	<0.01
STANDARDS						
0001 OREAS 293		10				
0002 AMIS0268						
0003 OREAS 279						
0004 NAG Std 3	<0.005		5	0.25	0.14	0.39
0005 ANC-5						
BLANKS						
0001 Control Blank	<0.005	<1	<1	<0.01	<0.01	<0.01

ELEMENTS	Fe	Fe	Final-pH	Fizz-Rate	Ga	Ga
UNITS	%	mg/Kg	NONE	NONE	ppm	mg/Kg
DETECTION LIMIT	0.01	1	0.1	1	0.05	0.1
DIGEST	4A/	NAGx/	ANCx/	ANCx/	4A/	NAGx/
ANALYTICAL FINISH	OE	OE	MTR	QUAL	MS	MS
SAMPLE NUMBERS						
0001 FY26	2.53	<1	1.8	2	19.81	0.3
0002 FY28	1.97	1	1.5	2	20.42	0.4
0003 FY29	2.10	1	1.3	2	20.75	0.4
0004 FY30	2.34	<1	1.4	2	19.99	0.3
0005 FY31	3.03	<1	1.4	2	20.08	0.3
CHECKS						
0001 FY31	3.02	2	1.5	2	20.10	0.4
STANDARDS						
0001 OREAS 293	0.95				5.57	
0002 AMIS0268						
0003 OREAS 279						
0004 NAG Std 3		2049				<0.1
0005 ANC-5			1.5			
BLANKS						
0001 Control Blank	<0.01	<1	1.3		<0.05	<0.1

ELEMENTS	Gd	Ge	Ge	Hf	Hf	Hg
UNITS	mg/Kg	ppm	mg/Kg	ppm	mg/Kg	mg/Kg
DETECTION LIMIT	0.01	0.1	0.1	0.05	0.01	0.01
DIGEST	NAGx/	4A/	NAGx/	4A/	NAGx/	NAGx/
ANALYTICAL FINISH	MS	MS	MS	MS	MS	MS
SAMPLE NUMBERS						
0001 FY26	<0.01	1.1	<0.1	2.78	<0.01	<0.01
0002 FY28	<0.01	1.0	<0.1	2.85	<0.01	<0.01
0003 FY29	<0.01	1.2	<0.1	3.09	<0.01	<0.01
0004 FY30	<0.01	1.0	<0.1	2.83	<0.01	<0.01
0005 FY31	<0.01	1.0	<0.1	2.76	<0.01	<0.01
CHECKS						
0001 FY31	<0.01	1.0	<0.1	2.60	<0.01	<0.01
STANDARDS						
0001 OREAS 293		1.0		0.75		
0002 AMIS0268						
0003 OREAS 279						
0004 NAG Std 3	0.17		<0.1		<0.01	<0.01
0005 ANC-5						
BLANKS						
0001 Control Blank	<0.01	<0.1	<0.1	<0.05	<0.01	<0.01

ELEMENTS	Ho	In	In	K	K	La
UNITS	mg/Kg	ppm	mg/Kg	ppm	mg/Kg	ppm
DETECTION LIMIT	0.01	0.01	0.01	20	10	0.01
DIGEST	NAGx/	4A/	NAGx/	4A/	NAGx/	4A/
ANALYTICAL FINISH	MS	MS	MS	OE	OE	MS
SAMPLE NUMBERS						
0001 FY26	<0.01	0.02	<0.01	8976	1202	12.98
0002 FY28	<0.01	0.01	<0.01	1.04%	1227	14.83
0003 FY29	<0.01	0.02	<0.01	1.17%	1176	23.11
0004 FY30	<0.01	0.01	<0.01	9303	1138	16.99
0005 FY31	<0.01	0.02	<0.01	7653	1390	15.03
CHECKS						
0001 FY31	<0.01	0.03	<0.01	7636	1405	15.14
STANDARDS						
0001 OREAS 293		0.02		7509		9.77
0002 AMIS0268						
0003 OREAS 279						
0004 NAG Std 3	0.05		<0.01		1622	
0005 ANC-5						
BLANKS						
0001 Control Blank	<0.01	<0.01	<0.01	33	<10	<0.01

ELEMENTS	La	Li	Li	Lu	Mg	Mg
UNITS	mg/Kg	ppm	mg/Kg	mg/Kg	ppm	mg/Kg
DETECTION LIMIT	0.01	0.1	0.1	0.005	20	10
DIGEST	NAGx/	4A/	NAGx/	NAGx/	4A/	NAGx/
ANALYTICAL FINISH	MS	MS	MS	MS	OE	OE
SAMPLE NUMBERS						
0001 FY26	<0.01	6.7	0.1	<0.005	7468	<10
0002 FY28	<0.01	7.0	<0.1	<0.005	6147	<10
0003 FY29	<0.01	8.3	<0.1	<0.005	5632	<10
0004 FY30	<0.01	8.0	<0.1	<0.005	8227	<10
0005 FY31	<0.01	8.0	<0.1	<0.005	7411	<10
CHECKS						
0001 FY31	<0.01	7.9	<0.1	<0.005	7397	<10
STANDARDS						
0001 OREAS 293		26.4			1984	
0002 AMIS0268						
0003 OREAS 279						
0004 NAG Std 3	0.25		0.8	0.019		2916
0005 ANC-5						
BLANKS						
0001 Control Blank	<0.01	<0.1	<0.1	<0.005	<20	<10

ELEMENTS	Mn	Mn	Mo	Mo	Na	Na
UNITS	ppm	mg/Kg	ppm	mg/Kg	ppm	mg/Kg
DETECTION LIMIT	1	1	0.1	0.1	20	10
DIGEST	4A/	NAGx/	4A/	NAGx/	4A/	NAGx/
ANALYTICAL FINISH	OE	OE	MS	MS	OE	OE
SAMPLE NUMBERS						
0001 FY26	338	<1	55.0	1.3	4.29%	2557
0002 FY28	252	<1	58.1	1.2	4.17%	1677
0003 FY29	301	<1	52.3	1.1	3.43%	1659
0004 FY30	286	<1	55.9	1.2	4.15%	2270
0005 FY31	462	<1	63.7	1.2	4.27%	3774
CHECKS						
0001 FY31	457	<1	63.7	1.2	4.25%	3793
STANDARDS						
0001 OREAS 293	105		2.0		5286	
0002 AMIS0268						
0003 OREAS 279						
0004 NAG Std 3		705		<0.1		47
0005 ANC-5						
BLANKS						
0001 Control Blank	<1	<1	<0.1	<0.1	32	14

ELEMENTS	NAG	NAGpH	NAG(4.5)	Nb	Nb	Nd
UNITS	kgH2SO4/t	NONE	kgH2SO4/t	ppm	mg/Kg	mg/Kg
DETECTION LIMIT	1	0.1	1	0.05	0.05	0.01
DIGEST	NAGx/	NAGx/	NAGx/	4A/	NAGx/	NAGx/
ANALYTICAL FINISH	VOL	MTR	VOL	MS	MS	MS
SAMPLE NUMBERS						
0001 FY26	0	9.9	0	2.29	0.11	<0.01
0002 FY28	0	10.3	0	2.13	0.08	<0.01
0003 FY29	0	10.2	0	3.16	<0.05	<0.01
0004 FY30	0	9.8	0	2.06	0.07	<0.01
0005 FY31	0	10.7	0	2.50	<0.05	<0.01
CHECKS						
0001 FY31	0	10.9	0	2.29	<0.05	<0.01
STANDARDS						
0001 OREAS 293				3.92		
0002 AMIS0268						
0003 OREAS 279						
0004 NAG Std 3	25	2.5	22		<0.05	0.23
0005 ANC-5						
BLANKS						
0001 Control Blank	3	5.4	0	<0.05	<0.05	<0.01

ELEMENTS	Ni	Ni	P	P	Pb	Pb
UNITS	ppm	mg/Kg	ppm	mg/Kg	ppm	mg/Kg
DETECTION LIMIT	1	1	50	10	0.5	2
DIGEST	4A/	NAGx/	4A/	NAGx/	4A/	NAGx/
ANALYTICAL FINISH	OE	OE	OE	OE	MS	MS
SAMPLE NUMBERS						
0001 FY26	275	<1	355	<10	7.5	<2
0002 FY28	285	<1	354	<10	9.7	<2
0003 FY29	274	<1	356	<10	16.4	<2
0004 FY30	305	<1	336	<10	9.1	<2
0005 FY31	327	<1	421	<10	10.3	<2
CHECKS						
0001 FY31	325	<1	415	<10	10.7	<2
STANDARDS						
0001 OREAS 293	11		224		9.0	
0002 AMIS0268						
0003 OREAS 279						
0004 NAG Std 3		9		<10		393
0005 ANC-5						
BLANKS						
0001 Control Blank	<1	<1	<50	<10	<0.5	<2

ELEMENTS	Pd	NAG(7.0)	pH Drop	Pr	Pt	Rb
UNITS	mg/Kg	kgH2SO4/t	NONE	mg/Kg	mg/Kg	ppm
DETECTION LIMIT	0.01	1	0.1	0.005	0.01	0.05
DIGEST	NAGx/	NAGx/	ANCx/	NAGx/	NAGx/	4A/
ANALYTICAL FINISH	MS	VOL	MTR	MS	MS	MS
SAMPLE NUMBERS						
0001 FY26	<0.01	<1	3.4	<0.005	<0.01	25.20
0002 FY28	<0.01	<1	3.4	<0.005	<0.01	28.89
0003 FY29	<0.01	<1	3.4	<0.005	<0.01	36.33
0004 FY30	<0.01	<1	3.4	<0.005	<0.01	25.68
0005 FY31	<0.01	<1	3.5	<0.005	<0.01	23.47
CHECKS						
0001 FY31	<0.01	<1	3.5	<0.005	<0.01	23.51
STANDARDS						
0001 OREAS 293						46.20
0002 AMIS0268						
0003 OREAS 279						
0004 NAG Std 3	<0.01	25		0.054	<0.01	
0005 ANC-5						
BLANKS						
0001 Control Blank	<0.01	3		<0.005	<0.01	<0.05

ELEMENTS	Rb	Re	Re	Ru	S	S
UNITS	mg/Kg	ppm	mg/Kg	mg/Kg	%	ppm
DETECTION LIMIT	0.1	0.002	0.01	0.01	0.01	50
DIGEST	NAGx/	4A/	NAGx/	NAGx/		4A/
ANALYTICAL FINISH	MS	MS	MS	MS	/CSA	OE
SAMPLE NUMBERS						
0001 FY26	<0.1	0.006	<0.01	0.01	0.16	1705
0002 FY28	<0.1	0.006	<0.01	<0.01	0.18	1840
0003 FY29	<0.1	0.007	<0.01	<0.01	0.18	1843
0004 FY30	<0.1	0.005	<0.01	<0.01	0.16	1696
0005 FY31	<0.1	0.011	<0.01	<0.01	0.10	1071
CHECKS						
0001 FY31	<0.1	0.006	<0.01	<0.01	0.10	1048
STANDARDS						
0001 OREAS 293		<0.002				401
0002 AMIS0268					1.27	
0003 OREAS 279						
0004 NAG Std 3	<0.1		<0.01	<0.01		
0005 ANC-5						
BLANKS						
0001 Control Blank	<0.1	<0.002	<0.01	<0.01	<0.01	<50

ELEMENTS	S	Sb	Sb	Sc	Sc	Se
UNITS	mg/Kg	ppm	mg/Kg	ppm	mg/Kg	ppm
DETECTION LIMIT	10	0.05	0.05	0.1	1	0.5
DIGEST	NAGx/	4A/	NAGx/	4A/	NAGx/	4A/
ANALYTICAL FINISH	OE	MS	MS	OE	OE	MS
SAMPLE NUMBERS						
0001 FY26	1360	0.52	0.21	6.5	<1	<0.5
0002 FY28	1459	0.56	0.22	4.8	<1	<0.5
0003 FY29	1447	0.73	0.23	6.5	<1	0.7
0004 FY30	1365	0.69	0.23	6.5	<1	0.6
0005 FY31	777	0.45	0.07	9.6	<1	<0.5
CHECKS						
0001 FY31	762	0.47	0.07	9.5	<1	<0.5
STANDARDS						
0001 OREAS 293		0.26		2.3		<0.5
0002 AMIS0268						
0003 OREAS 279						
0004 NAG Std 3	17040		0.07		<1	
0005 ANC-5						
BLANKS						
0001 Control Blank	<10	<0.05	<0.05	<0.1	<1	<0.5

ELEMENTS	Se	Si	Sm	Sn	Sn	Sr
UNITS	mg/Kg	mg/Kg	mg/Kg	ppm	mg/Kg	ppm
DETECTION LIMIT	2	5	0.01	0.1	0.1	0.05
DIGEST	NAGx/	NAGx/	NAGx/	4A/	NAGx/	4A/
ANALYTICAL FINISH	MS	OE	MS	MS	MS	MS
SAMPLE NUMBERS						
0001 FY26	<2	1340	<0.01	0.6	<0.1	339.62
0002 FY28	<2	1142	<0.01	0.7	<0.1	347.66
0003 FY29	<2	856	<0.01	0.9	<0.1	282.24
0004 FY30	<2	975	<0.01	0.7	<0.1	327.74
0005 FY31	<2	1359	<0.01	0.7	<0.1	377.23
CHECKS						
0001 FY31	<2	1422	<0.01	0.7	<0.1	378.79
STANDARDS						
0001 OREAS 293				1.4		42.98
0002 AMIS0268						
0003 OREAS 279						
0004 NAG Std 3	<2	457	0.09		<0.1	
0005 ANC-5						
BLANKS						
0001 Control Blank	<2	<5	<0.01	<0.1	<0.1	<0.05

ELEMENTS	Sr	Ta	Ta	Tb	Te	Te
UNITS	mg/Kg	ppm	mg/Kg	mg/Kg	ppm	mg/Kg
DETECTION LIMIT	0.05	0.01	0.01	0.005	0.2	0.1
DIGEST	NAGx/	4A/	NAGx/	NAGx/	4A/	NAGx/
ANALYTICAL FINISH	MS	MS	MS	MS	MS	MS
SAMPLE NUMBERS						
0001 FY26	7.41	0.38	0.01	<0.005	1.5	<0.1
0002 FY28	7.92	0.30	<0.01	<0.005	1.5	<0.1
0003 FY29	6.97	0.28	<0.01	<0.005	1.2	<0.1
0004 FY30	7.50	0.18	<0.01	<0.005	1.4	<0.1
0005 FY31	8.79	0.22	<0.01	<0.005	0.6	<0.1
CHECKS						
0001 FY31	8.82	0.19	<0.01	<0.005	0.7	<0.1
STANDARDS						
0001 OREAS 293		0.54			<0.2	
0002 AMIS0268						
0003 OREAS 279						
0004 NAG Std 3	11.10		<0.01	0.037		<0.1
0005 ANC-5						
BLANKS						
0001 Control Blank	<0.05	<0.01	<0.01	<0.005	<0.2	<0.1

ELEMENTS	Th	Th	Ti	Ti	Tl	Tl
UNITS	ppm	mg/Kg	ppm	mg/Kg	ppm	mg/Kg
DETECTION LIMIT	0.01	0.01	5	1	0.02	0.02
DIGEST	4A/	NAGx/	4A/	NAGx/	4A/	NAGx/
ANALYTICAL FINISH	MS	MS	OE	OE	MS	MS
SAMPLE NUMBERS						
0001 FY26	4.08	<0.01	2218	<1	0.14	<0.02
0002 FY28	4.62	<0.01	1852	<1	0.18	<0.02
0003 FY29	6.29	<0.01	2119	<1	0.28	<0.02
0004 FY30	4.47	<0.01	1947	<1	0.16	<0.02
0005 FY31	4.28	<0.01	3055	<1	0.17	<0.02
CHECKS						
0001 FY31	4.37	<0.01	2876	<1	0.17	<0.02
STANDARDS						
0001 OREAS 293	4.29		1117		0.28	
0002 AMIS0268						
0003 OREAS 279						
0004 NAG Std 3		0.10		<1		2.57
0005 ANC-5						
BLANKS						
0001 Control Blank	<0.01	<0.01	<5	<1	<0.02	<0.02

ELEMENTS	Tm	U	U	V	V	W
UNITS	mg/Kg	ppm	mg/Kg	ppm	mg/Kg	ppm
DETECTION LIMIT	0.01	0.01	0.01	1	2	0.1
DIGEST	NAGx/	4A/	NAGx/	4A/	NAGx/	4A/
ANALYTICAL FINISH	MS	MS	MS	OE	OE	MS
SAMPLE NUMBERS						
0001 FY26	<0.01	1.08	<0.01	64	7	45.2
0002 FY28	<0.01	1.21	<0.01	49	3	51.2
0003 FY29	<0.01	1.52	<0.01	60	3	27.6
0004 FY30	<0.01	1.20	<0.01	58	4	30.5
0005 FY31	<0.01	1.17	<0.01	95	12	272.8
CHECKS						
0001 FY31	<0.01	1.21	<0.01	97	12	276.1
STANDARDS						
0001 OREAS 293		2.39		18		2.4
0002 AMIS0268						
0003 OREAS 279						
0004 NAG Std 3	0.02		0.66		<2	
0005 ANC-5						
BLANKS						
0001 Control Blank	<0.01	<0.01	<0.01	<1	<2	<0.1

ELEMENTS	W	Y	Y	Yb	Zn	Zn
UNITS	mg/Kg	ppm	mg/Kg	mg/Kg	ppm	mg/Kg
DETECTION LIMIT	0.1	0.05	0.05	0.01	1	1
DIGEST	NAGx/	4A/	NAGx/	NAGx/	4A/	NAGx/
ANALYTICAL FINISH	MS	MS	MS	MS	OE	OE
SAMPLE NUMBERS						
0001 FY26	3.6	6.92	<0.05	<0.01	34	<1
0002 FY28	2.2	5.18	<0.05	<0.01	28	<1
0003 FY29	1.3	8.29	<0.05	<0.01	43	<1
0004 FY30	2.1	6.84	<0.05	<0.01	34	<1
0005 FY31	7.0	9.63	<0.05	<0.01	56	<1
CHECKS						
0001 FY31	7.5	9.54	<0.05	<0.01	55	<1
STANDARDS						
0001 OREAS 293		4.64			22	
0002 AMIS0268						
0003 OREAS 279						
0004 NAG Std 3	<0.1		1.72	0.12		449
0005 ANC-5						
BLANKS						
0001 Control Blank	<0.1	<0.05	<0.05	<0.01	1	<1

ELEMENTS	Zr	Zr
UNITS	ppm	mg/Kg
DETECTION LIMIT	0.1	0.1
DIGEST	4A/	NAGx/
ANALYTICAL FINISH	MS	MS
SAMPLE NUMBERS		
0001 FY26	101.3	<0.1
0002 FY28	95.7	<0.1
0003 FY29	104.6	<0.1
0004 FY30	91.5	<0.1
0005 FY31	91.8	<0.1
CHECKS		
0001 FY31	85.9	<0.1
STANDARDS		
0001 OREAS 293	25.0	
0002 AMIS0268		
0003 OREAS 279		
0004 NAG Std 3		<0.1
0005 ANC-5		
BLANKS		
0001 Control Blank	<0.1	<0.1

METHOD CODE DESCRIPTION

Method Code Date Tested	Analysing Laboratory NATA Laboratory Accreditation	NATA Scope of Accreditation
/CALC **28/09/23 06:33**	Intertek Genalysis Perth **3244 3237** No digestion or other pre-treatment undertaken. Results Determined by calculation from other reported data.	*
/CSA **13/10/23 09:25**	Intertek Genalysis Perth **3244 3237** Induction Furnace Analysed by Infrared Spectrometry	**ENV_W061(Per), MPL_W161(Adl)**
4A/MS **25/09/23 18:46**	Intertek Genalysis Perth **3244 3237** Multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids in Teflon Tubes. Analysed by Inductively Coupled Plasma Mass Spectrometry.	**MPL_W002, MS_IM_001(Per), *(Adl)**
4A/OE **25/09/23 18:46**	Intertek Genalysis Perth **3244 3237** Multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids in Teflon Tubes. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.	**MPL_W002, ICP_IM_001(Per), *(Adl)**
ANCx/MTR **27/09/23 15:03**	Intertek Genalysis Perth **3244 3237** Acid Neutralizing Capacity Digestion Procedure. Analysed with Electronic Meter Measurement	**ENV_W035**
ANCx/QUAL **27/09/23 15:03**	Intertek Genalysis Perth **3244 3237** Acid Neutralizing Capacity Digestion Procedure. Analysed by Qualitative Inspection	**ENV_W035**
ANCx/VOL **27/09/23 15:03**	Intertek Genalysis Perth **3244 3237** Acid Neutralizing Capacity Digestion Procedure. Analysed by Volumetric Technique.	**ENV_W035**
C71/CSA **27/09/23 10:42**	Intertek Genalysis Perth **3244 3237** Digestion by hot acid(s) and Induction Furnace Analysed by Infrared Spectrometry	**ENV_W063**

METHOD CODE DESCRIPTION

Method Code Date Tested	Analysing Laboratory NATA Laboratory Accreditation	NATA Scope of Accreditation
NAGx/MS **27/09/23 10:02**	Intertek Genalysis Perth **3244 3237** Net Acid Generation Extraction of samples with H2O2 Analysed by Inductively Coupled Plasma Mass Spectrometry.	**ENV_W036**
NAGx/MTR **27/09/23 10:02**	Intertek Genalysis Perth **3244 3237** Net Acid Generation Extraction of samples with H2O2 Analysed with Electronic Meter Measurement	**ENV_W036**
NAGx/OE **27/09/23 10:02**	Intertek Genalysis Perth **3244 3237** Net Acid Generation Extraction of samples with H2O2 Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.	**ENV_W036**
NAGx/VOL **27/09/23 10:02**	Intertek Genalysis Perth **3244 3237** Net Acid Generation Extraction of samples with H2O2 Analysed by Volumetric Technique.	**ENV_W036**

* Denotes not on Scope of Accreditation

SOILWATER CONSULTANTS

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MEMO

[redacted]	COMPANY:	KNIGHT PIESOLD PTY LTD	
	PROJECT TITLE:	TSF COVER SYSTEM - MATERIALS CHARACTERISATION	
DATE: 5 July 2019	PROJECT & DOCUMENT NO:	JN0677	001
SUBJECT: Materials Characterisation - Summary and Discussion of Results			

Dean,

This memo summarises and discusses the test results obtained for the various tailings and proposed cover materials submitted to Soilwater in May 2019. The samples submitted were obtained from the Marandoo (Iron Ore) and Mungari (Gold) Mines and are listed in Table 1. The testing undertaken on the various materials is provided in Table 2.

Table 1: Samples submitted to Soilwater for material characterisation

ID	Minesite	Replicates	Material Description
Proposed Cover Materials			
Cap Material 1	Marandoo Mine	Sample 1 Sample 2 Sample 3	Red lateritic material, typical of the upper soil profile in the Pilbara
Cap Material 2	Mungari	Zone C 1 Zone C 2 Zone C 3	Pallid to slightly mottled saprolite, typical of the regolith profile dervied from ultramafic parent rocks
Cap Material 3	Mungari	1	Blasted underground rock, ultramafic
Tailings Materials			
Tailings 1a	Mungari	1	Dark grey to black, ultrafine clay (supplied in green bag)
Tailings 1b		1	Dark olive green to grey, silty loam (suuplied in green bag)
Tailings 2	Mungari	1 2	Tank 8 Discharge, Not Screened (supplied in buckets)
Tailings 3	Marandoo Mine	1	Brown, ultrafine clay (MDD Thickener Underflow)

Table 2: Testing completed on the submitted samples

Samples	Replicates	SWCC †	Particle Density	PSD ‡ (Pipette)	Gravel Content	Gravel Fractionation	Saturated Hydraulic Conductivity
Proposed Cover Materials							
Cap Material 1	Sample 1	✓	✓	✓	✓	✓	✓
	Sample 2	✓	✓	✓	✓	✓	✓
	Sample 3	✓	✓	✓	✓	✓	✓
Cap Material 2	Zone C1	✓	✓	✓	✓	-	✓
	Zone C2	✓	✓	✓	✓	-	✓
	Zone C3	✓	✓	✓	✓	-	✓
Cap Material 3	Fresh Rock	-	-	-	✓	✓	-
Tailings Materials							
Mungari	Tailings 1a	✓	✓	✓	-	-	✓
	Tailings 1b	✓	✓	✓	-	-	✓
	Tailings 2	✓	✓	✓	-	-	✓
Marandoo	Tailings 3	✓	✓	✓	-	-	✓

† SWCC = Soil Water Characteristic Curve; ‡ PSD = Particle Size Distribution

Summary and Discussion of Results

Gravel Content and Size Distribution

The gravel content and size distribution are presented in Table 3, The gravel content within the proposed Marandoo cover system materials is primarily < 26.5 mm, with a relatively even distribution down to 2.36 mm. This size distribution, along with the overall gravel content (Table 3), will likely result in these ironstone capping materials being relatively resistant to erosion and thus they represent ideal cover system materials, particularly on sloping surfaces.

The fresh rock contains a relatively even distribution of particle sizes, and thus is ideal for use as a capillary break or for incorporation into a cover material to help stabilise and prevent erosion from occurring.

Table 4 and Figure 1. The results show that the proposed cover system materials contain a range of gravel contents, with the ironstone capping materials from the Marandoo Mine containing 21 – 45 % gravel (>2.36 mm soil fraction). The oxide cover materials from the Mungari Mine contain appreciably less gravels, with <10 % gravels recorded, and together their high silt and clay fraction they are not suitable for use as a cover material on sloping surfaces, and should only be used on flat surfaces.

Table 3: Gravel contents for the tailings and proposed cover system materials

ID	Replicates	Description	Size Fraction (%)	
			>2.36mm	<2.36mm
Cap Material 1	Sample 1	Red Lateritic loam	30	70
	Sample 2		21	79
	Sample 3		45	55
Cap Material 2	Zone C 1	Saprolite	5	95

	Zone C 2		8	92
	Zone C 3		1	99
Cap Material 3	1	Fresh Rock	100	0
Tailings 1a	1	Dark Grey to Black Tailings	0	100
Tailings 1b	1	Dark Olive Grey Tailings	0	100
Tailings 2	1	Grey 'Salty' Tailings	0	100
	2		0	100
Tailings 3	1	Brown Clay	0	100

The gravel content within the proposed Marandoo cover system materials is primarily < 26.5 mm, with a relatively even distribution down to 2.36 mm. This size distribution, along with the overall gravel content (Table 3), will likely result in these ironstone capping materials being relatively resistant to erosion and thus they represent ideal cover system materials, particularly on sloping surfaces.

The fresh rock contains a relatively even distribution of particle sizes, and thus is ideal for use as a capillary break or for incorporation into a cover material to help stabilise and prevent erosion from occurring.

Table 4: Gravel size distribution proposed cover system materials

Size Fraction (mm)	% of Sample			
	Cap Material 1			Cap Material 3
	Sample 1	Sample 2	Sample 3	(Fresh Rock)
>125	1	0	1	4
100	1	0	1	5
90	0	1	0	8
75	0	0	1	15
53	3	5	2	3
37.5	4	8	2	7
26.5	8	7	6	10
19.0	9	2	8	7
.0	2	5	6	5
13.2	2	12	15	6
9.5	7	5	10	6
6.7	8	16	25	10
4.75	25	19	13	6
2.36	30	20	10	8

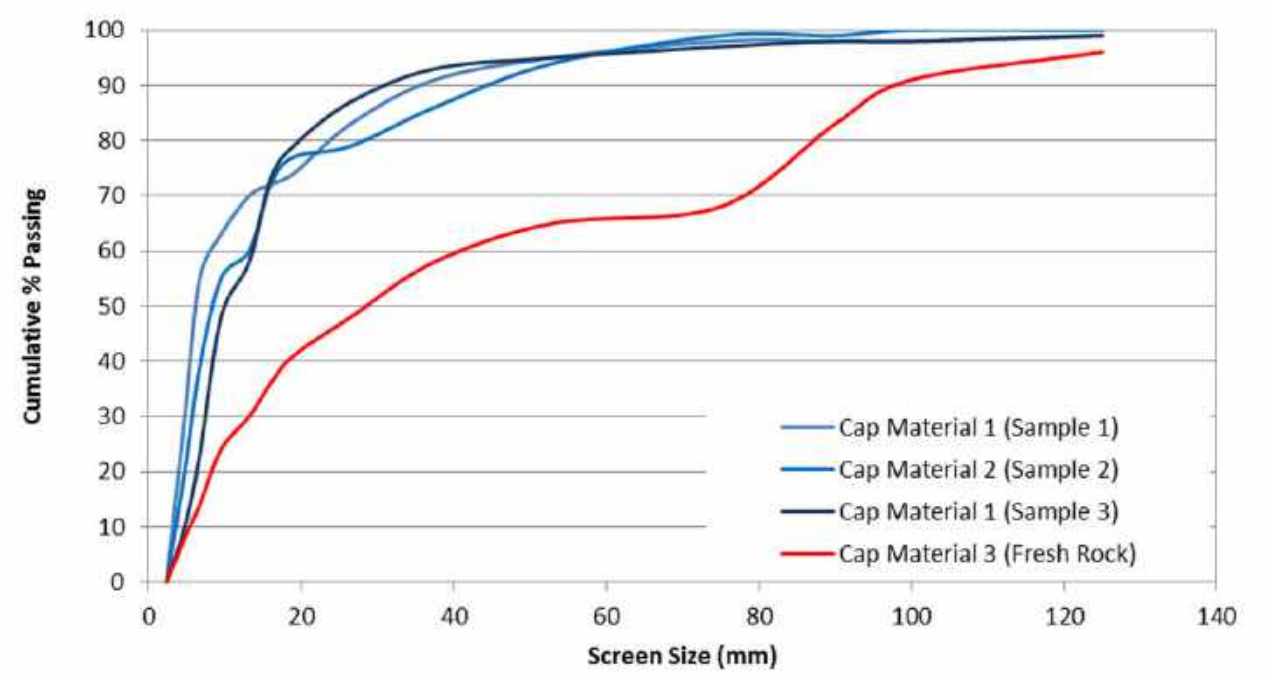


Figure 1: Gravel size distribution for the proposed cover system materials

Particle Size Distribution

The particle size distibution for the various cover system and tailings materials are presented in Table 5. All of the proposed cover system materials are classified as Loams, with the ironstone materials from the Marandoo Mine considered Sandy Loams, whilst the oxide materials from the Mungari Mine considered Clay Loams. In contrast, the tailings materials are generally classified as Clay Loams to Clays, with > 55 % Silt + Clay fractions.

Table 5: Particle size distribution of the cover system and tailings materials

ID	Replicate	Particle Size Distribution*			Texture
		% Sand	% Silt	% Clay	
Cap Material 1	Sample 1	58	17	25	Sandy Clay Loam
	Sample 2	62	25	13	Sandy Loam
	Sample 3	55	20	25	Sandy Clay Loam
Cap Material 2	Zone C 1	46	19	35	Clay Loam - Silty Clay Loam
	Zone C 2	55	15	30	Sandy Clay Loam
	Zone C 3	42	31	27	Clay Loam
Cap Material 3	1	-	-	-	-
Tailings 1a	1	8	48	44	Medium Clay
Tailings 1b	1	14	51	35	Silty Clay Loam
Tailings 2	1	32	39	29	Clay Loam
	2	45	32	23	Loam
Tailings 3	1	4	38	58	Heavy Clay

* Sand represents the >20µm size fraction, Silt represents the 20 - 2µm size fraction, whilst Clay represents the <2µm fraction

Particle Density

The particle density data for the various materials tested are presented in Table 6. As expected the particle density of the materials is influence by the Silt + Clay content, with the more sandy ironstone cover materials having a particle density around 2.65 g/cm^3, whilst the more clayey oxide cover materials has an average particle density of 2.44 g/cm^3. The relatively clayey tailings materials have an average particle density of 2.3 g/cm^3 reflecting the high clay (kaolinite) content.

Table 6: Particle density values for the various cover system and tailings materials tested

ID	Replicates	Description	Particle Density (g/cm3)
Cap Material 1	Sample 1	Red Lateritic loam	2.66
	Sample 2		2.68
	Sample 3		2.61
Cap Material 2	Zone C 1	Saprolite	2.38
	Zone C 2		2.59
	Zone C 3		2.35
Cap Material 3	1	Fresh Rock	-
Tailings 1a	1	Dark Grey to Black Tailings	2.22
Tailings 1b	1	Dark Olive Grey Tailings	2.28
Tailings 2	1	Grey 'Salty' Tailings	2.32
	2		2.36
Tailings 3	1	Brown Clay	2.2

Saturated Hydraulic Conductivity

The saturated hydraulic conductivity values obtained for the various materials are presented in Table 7. The saturated permeability of the ironstone cover materials averages 0.93 m/day (or 1.1×10^{-5} m/s), whilst the more clayey oxide cover materials have an average permeability of 0.5 m/day (or 5.8×10^{-6} m/s). The saturated hydraulic conductivity of the various tailings materials varies from 0.01 m/day to 0.17 m/day, with an average of 0.08 m/day (or 9.3×10^{-7} m/s).

Table 7: Saturated hydraulic conductivity for the various cover system and tailings materials

ID	Replicates	Description	Ksat	
			m/d	m/s
Cap Material 1	Sample 1	Red Lateritic loam	0.9	1.04E-05
	Sample 2		1.1	1.27E-05
	Sample 3		0.8	9.26E-06
Cap Material 2	Zone C 1	Saprolite	0.6	6.94E-06
	Zone C 2		0.6	6.94E-06
	Zone C 3		0.3	3.47E-06
Cap Material 3	1	Fresh Rock	-	-
Tailings 1a	1	Dark Grey to Black Tailings	0.01	1.16E-07
Tailings 1b	1	Dark Olive Grey Tailings	0.06	6.94E-07
Tailings 2	1	Grey 'Salty' Tailings	0.15	1.74E-06
	2		0.17	1.97E-06
Tailings 3	1	Brown Clay	0.01	1.16E-07

When the above saturated hydraulic conductivity data is combined with the water retention data presented below, the derived Hydraulic Conductivity Function (HCF) is shown in Figure 2. As can be seen, the permeability of all materials decreasing significantly as they dry, such that at field capacity the permeability of the materials has dropped to between 10^{-7} and 10^{-8} m/s, whilst the clayey tailings from the Marandoo Mine has a permeability of around10^{-13} m/s.

These results have important implications when it comes to the hydraulic functioning of the cover system and of the tailings during closure. For the cover materials, the appreciable decrease in permeability as the materials dry means that infiltration-excess overland flow or temporary ponding will occur with rainfall events > 8 mm/day, and if these materials are located on sloping surfaces, with erosion protection, it will likely result in considerable erosion occurring.

For the tailings material, the significant drop in permeability as it dries or dewaters to field capacity means that it will take a considerable period of time to drain-down, and even at field capacity there is still appreciable tailings liquor available for upward capillary movement, and thus the risks to closure due to salinisation of the cover system will remain for a prolonged period of time.

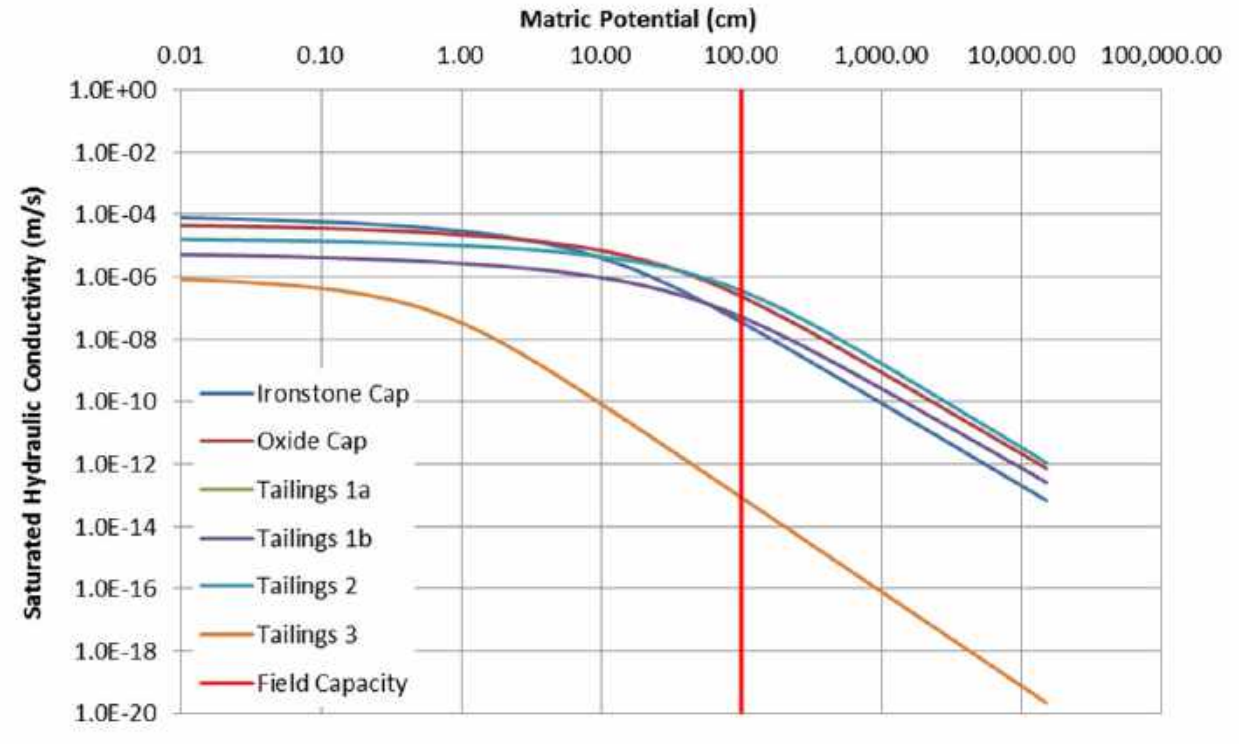


Figure 2: Hydraulic Conductivity Function (HCF) for the various cover and tailings materials

Water Retention Properties

The water retention properties for the various cover system and tailings materials, and the derived van Genuchten parameters are provided in Table 8 and Table 9.

The water retention data shows that the Plant Available Water Content (PAWC) for the ironstone and oxide cover materials averages 180 mm/m and 137 mm/m, respectively. Given these values, and knowing the transpiration rates of various rehabilitation species, these PAWC will only support small shrubs in rehabilitation if a 1 m deep cover system is reconstructed.

Table 8: Water retention data for the various cover and tailings materials

ID	Replicates	Particle Density (g/cm3)	Bulk Density (g/cm3)	Matric Suction (cm)				
				0	100	330	1,000	15,000
Cap Material 1	Sample 1	2.66	1.65	0.38	0.23	0.19	0.14	0.07
	Sample 2	2.68	1.65	0.38	0.21	0.17	0.13	0.05
	Sample 3	2.61	1.65	0.37	0.28	0.21	0.17	0.06
Cap Material 2	Zone C 1	2.38	1.5	0.37	0.32	0.28	0.24	0.18
	Zone C 2	2.59	1.5	0.42	0.34	0.31	0.25	0.21
	Zone C 3	2.35	1.5	0.36	0.33	0.31	0.26	0.19
Cap Material 3	1	-		-	-	-	-	-
Tailings 1a	1	2.22	1.4	0.37	0.3	0.28	0.22	0.19
Tailings 1b	1	2.28	1.4	0.39	0.35	0.31	0.28	0.19
Tailings 2	1	2.32	1.4	0.40	0.35	0.3	0.24	0.17
	2	2.36	1.4	0.41	0.36	0.31	0.27	0.19
Tailings 3	1	2.2	1.4	0.36	0.31	0.28	0.23	0.2

Table 9: Derived van Genuchten parameters for the various cover and tailings materials

ID	Replicates	Derived van Genuchten paramaters			
		α	n	θs	θr
Cap Material 1	Sample 1	0.072	1.232	0.38	0
	Sample 2	0.089	1.255	0.384	0
	Sample 3	0.018	1.296	0.367	0
Cap Material 2	Zone C 1	0.017	1.241	0.37	0.112
	Zone C 2	0.027	1.299	0.42	0.165
	Zone C 3	0.008	1.197	0.36	0.079
Cap Material 3	1	-	-	-	-
Tailings 1a	1	0.024	1.309	0.369	0.152
Tailings 1b	1	0.014	1.228	0.386	0.151
Tailings 2	1	0.009	1.367	0.396	0.125
	2	0.014	1.207	0.407	0.085
Tailings 3	1	1.016	1.409	0.363	0.178

Should you have any queries regarding this report, please do not hesitate to contact us.

Yours sincerely,

Knight Piésold
CONSULTING

MEMORANDUM

To:	**La Mancha Resources Australia Pty Ltd**	**Date:**	5th July 2013
[redacted]		**Our Ref:**	PE13-00546
		KP File Ref.:	**PE801-00137/05 AL M13011**
cc:		**From:**	[redacted]

RE: MUNGARI PROJECT – TAILINGS PHYSICAL AND GEOCHEMICAL TESTING

La Mancha Resources is investigating the development of the Mungari Gold Project located 20km west of Kalgoorlie, Western Australia. The project will incorporates both the White Foil and Frog's Leg orebodies. The project development will require a Tailings Storage Facility (TSF) to store the tailings product. This memo discusses the physical and geochemical testwork of a laboratory generated sample.

1. SAMPLE DESCRIPTIONS AND TESTWORK

Two 20L buckets of slurry samples labelled Frogs Leg Composite and White Foil Composite were supplied by La Mancha Resources to the Knight Piésold (KP) laboratory in October 2011. The samples will be referred to as the Frogs Leg and White Foil tailings for this memo. The sample was prepared at approximately 47% solids

The following tests were carried out on the samples received:

i. Classification tests to determine:
   - Particle size distribution of the tailings;
   - Supernatant liquor density;
   - Liquid and plastic limits of the tailings solids;
   - Tailings solids particle density.

ii. Undrained and drained sedimentation tests;
iii. Air drying tests;
iv. Permeability tests;
v. High strain consolidation tests;
vi. Geochemical Characterisation.

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.

2. PHYSICAL TESTING

The following discusses the physical testing results for the tailings samples. Predicted tailings behaviour is discussed in Section 3; however, it should be noted that field results are also dependent on the processing plant operation, layout and design of the proposed storage facilities and blending of the different ore types.

2.1 CLASSIFICATION TESTING

Classification testing was completed by SGS Australia 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 2.1. The SGS Australia laboratory test reports are presented in Appendix A.

Table 2.1: Classification testing – results and relevant standards

Test	Frogs Leg	White Foil	AS1289
Particle Density	2.82	2.84	3.5.1 (1995)
Supernatant Density	1.12	1.12	(hydrometer)
Supernatant pH	7.7	7.8	(pH meter)
Liquid Limit (%)	-	-	3.1.2 (1995)
Plastic Limit (%)	NP	NP	3.2.1 (1995)
Plasticity Index (%)	NP	NP	3.3.1 (1995)

* NP – Non Plastic

The particle size analysis was completed in accordance with AS1289 3.6.3 - 2003. The measured particle size distribution is presented in Table 2.2 and the grading curve for the sample is shown on Figure 2.1.

Table 2.2: Particle size distribution

Fraction	Particle Size (µm)	Percent Passing (%)	
		Frogs Leg	White Foil
Sand	600	100	100
	200	97	97
Silt	75	80	81
	20	41	40
	6	21	19
Clay	2	10	9

Using the Unified Soil Classification System (Geotechnical Site Investigations, AS1726-1993), both samples can be classified as silt with sand (ML). Both samples P_{80} is around 75µm.

2.2 SEDIMENTATION TESTS

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 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 2.2 to 2.5. Table 2.3 presents a summary of the measured sedimentation data.

Table 2.3: 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
Frogs Leg	Undrained	44.4	56	-	1	1.18	1.39	2.2
	Drained	46.2	43	24	1	1.45	0.88	2.3
White Foil	Undrained	45.0	57	-	1	1.21	1.33	2.4
	Drained	44.7	38	28	1	1.40	1.02	2.5

The tests indicate that both samples have similar settling characteristics. The tailings samples have moderate settling speed characteristics. The sample released approximately 56% of the water in slurry to supernatant for the undrained case, reducing to 40% supernatant release for the drained case. There is an approximately 19% increase in the settled density, increasing from 1.2 t/m^3 to 1.4 t/m^3. The settled densities achieved are moderate, with a resulting void ratio of approximately 1.

2.3 AIR DRYING TESTS

Air drying tests were carried out on slurry samples to determine the effect of air drying on 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.

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 tests are presented in figures 2.6 to 2.9 and are summarised in Table 2.4.

Table 2.4: Results of air drying tests

Sample	Moisture Content at Breakaway Point (%MC)	Dry Density at Breakaway Point (t/m3)	Limiting Saturation Value (%Sat)	Final Dry Density (t/m^3)	Figures
Frogs Leg	40	1.45	90	1.55	2.6, 2.7
White Foil	40	1.50	80	1.55	2.8, 2.9

The two tailings samples achieved higher dry densities of around 1.55 t/m^3 over a drying time of approximately 15 days at an evaporation rate of 7.5mm/day. The formation of a significant salt layer slowed down the rate of evaporation from the sample. The air drying tests increased the final dry density by only 10% above the drained sedimentation test. This indicates the tailings initial settlement provides the majority of the dry density result over the space of only a few days, with air drying providing a slight improvement in density over a much longer period.

2.4 PERMEABILITY TESTS

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. Results are summarised in Table 2.5 and presented in figures 2.10 and 2.11.

Table 2.5: Permeability test results

Sample	Test Type	Dry Density (t/m^3)	Permeability (m/s)
Frogs Leg	Falling Head	1.50	4.0×10^{-7}
	Consolidation Test	1.31 1.36 1.40	5.3×10^{-6} 1.0×10^{-6} 4.0×10^{-7}
White Foil	Falling Head	1.41	7.5×10^{-7}
	Consolidation Test	1.19 1.25 1.30	5.5×10^{-5} 7.9×10^{-7} 3.7×10^{-7}

These results represent the permeability of saturated tailings prior to additional consolidation due to additional deposition loading or air-drying. In the range of expected settled densities, the permeability of both the tailings is similar at approximately 4×10^{-7} m/s.

2.5 CONSOLIDATION TESTS

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. 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 and the variation in permeability with density for the test is presented in figures 2.10 and 2.11 and the results of the consolidation tests are summarised in Table 2.6.

Table 2.6: Consolidation test results

Sample	Dry Density (t/m^3)	Stress Range (kPa)	Coeff. of Consolidation C_V (m^2/y)	Coeff.of Volume Decrease M_V (m^2/kN)	Comp. Index C_C
Frogs Leg	1.28 – 1.40	1.55 – 4.95	110	0.02	0.37
White Foil	1.17 – 1.30	1.33 – 4.55	56	0.03	0.44

Results indicate that the samples have moderate compressibility and will consolidate quickly.

3. GEOCHEMISTRY

3.1 GEOCHEMISTRY TESTWORK

3.1.1 Acid Base Accounting

Acid base accounting (ABA) assesses the sample's potential to form acid from oxidation of sulfides and the ability to neutralise acid by the dissolution of minerals, especially carbonates, contained in the sample.

The ABA test work was conducted by Genalysis, Perth. Total sulfur, total carbon and total inorganic carbon were determined by LECO induction furnace, with infrared detection. Sulfate sulfur was determined by 10% Na_2CO_3 extraction, with $BaSO_4$ precipitation. The test work methods used are based on the ABA methodology defined in the Mine Environment Neutral Drainage (MEND) Acid Rock Drainage Prediction Manual (Ref. 1) and Guidelines for Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia (Ref. 2).

Acid Neutralising Capacity (ANC) was determined by digestion in a standard solution of HCl, followed by back titration with NaOH to determine the amount of acid consumed. The technique used was based on Sobek *et al.* (Ref. 3).

The results of the ABA test work are used to calculate the Maximum Potential Acidity (MPA) which is a measure of the maximum amount of sulfuric acid which can be produced from the total oxidation of all sulfides within the sample, assuming all sulfide is present as pyrite.

3.1.2 Static Net Acid Generation

Static Net Acid Generation (NAG) test work is a direct measure of the sample's ability to produce acid through sulfide oxidation. The addition of hydrogen peroxide to samples causes rapid oxidation of the contained sulfides to produce sulfuric acid.

NAG test work was conducted by Genalysis. The procedure employed is based upon the Static NAG Test (Ref. 4 & 5). Fifteen percent hydrogen peroxide solution was adjusted to pH 4.5 before addition to the samples. The samples were then left to stand overnight at room temperature before pH measurement. The samples are then boiled for 2 to 3 hours and allowed to cool before being made back up to 250 mL followed by pH measurement and titration to pH 7.0.

3.1.3 Acid Formation Potential

The acid formation potential of a sample is calculated based on the acid base accounting, i.e. the balance between a sample's ability to produce acid from the oxidisation of sulfide minerals (Maximum Potential Acidity, MPA) and the sample's ability to neutralise acid by the dissolution of alkaline minerals contained within the sample (Acid Neutralising Capacity, ANC). The balance between the MPA and the ANC is termed the Net Acid Producing Potential (NAPP), where a negative NAPP indicates an excess of acid neutralising capacity and the positive NAPP indicates an excess potential acidity.

Historically a safety margin was applied to ratio between the ANC and MPA to allow for variability in the rates of acid production and neutralisation processes and the potential for geographic separation of the acid producing and acid neutralising phases. This safety margin was generally set by industry at 2 in North America and 3 in Australia.
With recent advances in the understanding and acceptance of the NAG test there has been a move away from this method of classifying materials based solely on the ANC and

MPA as these calculated parameter do not take into consideration the true availability of acid producing and acid neutralising phases.
Knight Piésold prefers to utilise the results of the Acid Base Accounting in combination with the NAG testing results to classify the acid formation potential of materials. Knight Piésold's classification system is given in Table 3.1 and is based on the Australian Government's guidelines on Managing Acidic and Metalliferous Drainage (Ref. 6) and is broadly similar to the classification system contained within the AMIRA ARD Test Handbook (Ref. 7), which is advocated by the Global Acid Rock Drainage Guidelines (Ref. 8).

Table 3.1: Acid Formation Potential Classification System

Acid Formation Potential Class	NAPP (kg H_2SO_4 /t)	NAG pH
Potentially Acid Forming (PAF)	>10	<4.5
Potentially Acid Forming – Low Capacity (PAF-LC)	0 to 10	<4.5
Non Acid Forming (NAF)	Negative	≥4.5
Acid Consuming (AC)	Less than -100	≥4.5
Uncertain (UC)	Positive	≥4.5
	Negative	<4.5

3.1.4 Multi Element Analysis

Multi-element analysis of the samples was conducted to assess elemental enrichments within the samples. The testing was conducted by Genalysis in Perth. The acid digestion method employed resulted in near total digestion of the samples to assess the geochemistry of the samples

Multi-element analysis results were compared to the average crustal abundance to give the geochemical abundance indices. The Geochemical Abundance Index (GAI) quantifies an assay result for a particular element in terms of average crustal abundance. The GAI is calculated from the following formula:

$$GAI = Log_2 (C_n / (1.5 \times B_n))$$

Where:
Cn = measured concentration of element in sample
Bn = average crustal abundance (Bowen, (Ref. 9))

The GAI is expressed on a scale of 0 to 6, with 0 indicating the concentration of the element is less than or similar to average crustal abundance. A GAI of 3 corresponds to a 12 fold increase above the average crustal abundance, and so forth up to a GAI of 6 which represents a 96 fold increase or greater.

Knight Piésold has assigned an arbitrary scale to the GAI with indices of 0 and 1 being unenriched, indices of 2 being classified as slightly enriched, indices of 3 and 4 being classed as significantly enriched and indices of 5 and 6 being classified as highly enriched.

3.1.5 Supernatant Water Quality

Characterization of the tailings supernatant was conducted to assess the potential for the supernatant to cause environmental impacts to surface water or near surface

groundwater. These tests differ from the multi-element tests in that they only record the readily soluble elements whereas the multi-element tests give the total elemental enrichment of the tailings solids.

The supernatant characterisation was conducted at Genalysis Laboratories in Perth. A sample of slurry was sent to the laboratory. The pH and the conductivity of the slurry were measured and the bottles left to stand for a minimum of 3 hours. The supernatant was siphoned off and filtered through 0.45 µm membrane before preservation of the solution by acid addition prior to analysis. The analysis was by Inductively Coupled Plasma Mass Spectrometry or Inductively Coupled Plasma Optical Emission Spectrometry depending on the element being analysed and the detection limits required.

The supernatant water quality test results were compared to a set of reference water quality standards, which are detailed in the following section.

3.1.6 Reference Water Quality Standards

To allow assessment of the results of the supernatant analysis a set of reference values has been established. These reference values were compiled from internationally accepted guidelines for water quality for release from mining operations (IFC environmental, health and safety guidelines (Ref. 10 & 11) and the ANZECC water quality guideline for livestock drinking water (Ref. 12). The use of several guidelines is required as no single guideline contains target concentrations for all parameters. Where a target concentration for a specific element is at different levels in more than one guideline the lowest concentration has been adopted. These reference values are given in Table 3.2.

The establishment of these reference water quality values is to allow for evaluation only and it is not implied by production of the reference water quality values that the Mungari project will be required to meet these reference levels or that these reference levels should be used as the regulatory framework. The regulatory requirements for the project will be determined by the relevant regulatory authorities during the environmental design phase of the project.

These reference levels are to be used for a preliminary assessment of water quality only. More detailed assessment of the impact of any release from the mine site may be required in later design stages to assess the impact on receiving environments, such as aquatic systems, where different water quality requirements may be applicable.

Table 3.2: Reference Release Water Quality Standards

Parameter	Unit	ANZECC Livestock	IFC 2004	IFC 2007	Adopted Reference Level
pH	S.U.		6 to 9	6 to 9	6 to 9
TDS	mg/kg	2000			2000
Aluminum	mg/L	5			5
Antimony	mg/L				N/G
Arsenic	mg/L	0.5	0.1	0.1	0.1
Barium	mg/L				N/G
Boron	mg/L	5			5
Cadmium	mg/L	0.01	0.1	0.05	0.01
Calcium	mg/L	1000			1000
Chloride	mg/L				N/G
Chromium	mg/L	1			1
Chromium (Cr^{+6})	mg/L		0.1	0.1	0.1
Cobalt	mg/L	1			1
Copper	mg/L	0.4	0.5	0.3	0.3
Cyanide-Total	mg/L			1	1
Cyanide-Free	mg/L			0.1	0.1
Cyanide-WAD	mg/L		0.5	0.5	0.5
Fluoride	mg/L	2	20		2
Iron	mg/L		3.5	2	2
Lead	mg/L	0.1	0.1	0.2	0.1
Magnesium	mg/L	2000			2000
Manganese	mg/L				N/G
Mercury	mg/L	0.002	0.01	0.002	0.002
Molybdenum	mg/L	0.15			0.15
Nickel	mg/L	1	0.5	0.5	0.5
Phosphorus	mg/L				N/G
Selenium	mg/L	0.02	0.1		0.02
Silver	mg/L		0.5		0.5
Sodium	mg/L				N/G
Sulfate	mg/L	1000			1000
Tin	mg/L				N/G
Uranium	mg/L	0.2			0.2
Vanadium	mg/L				N/G
Zinc	mg/L	20	2	0.5	0.5

N/G – No guideline

3.2 GEOCHEMICAL CHARACTERISTICS

Laboratory test certificates for all the tailings analytical testing conducted by Genalysis are provided in Appendix B, with the results presented and discussed in the following sections. As part of the quality control and assurance program conducted by the laboratory, a duplicate run of all tests were conducted on the Frogs Legs tailings and supernatant samples. The results of the Frogs Legs tailings and supernatant samples presented in the following sections are the average values of the initial and duplicate tests.

3.2.1 Tailings Acid Base Accounting

The total sulfur content of the tailings was determined by Leco combustion. In addition, the samples were analysed for Na_2CO_3 soluble sulfate. The difference between these two

values was assumed to be equal to the sulfide content of the samples. The results of the analysis are given in Table 3.3.

Table 3.3: Tailings Sulfur Analysis Results

Sample	Total Sulfur (%)	Sulfate Sulfur (%)	Sulfide Sulfur (%)	Maximum Potential Acidity (kg H_2SO_4 /t)
Frogs Legs	1.85	0.21	1.64	50.4
White Foil	1.40	0.19	1.21	40.0

The results of the analysis indicate that the total sulfur content of the tailings samples ranged from 1.40 to 1.85% which is high. The sulfide content of the samples was calculated as between 1.21 and 1.64%, corresponding to a high content. The results of the speciated sulfur analysis indicate that the majority sulfur is present as sulfide. Accordingly, the maximum potential acidity calculated from the sulfide sulfur content ranged from 40.0 to 50.4 kg H_2SO_4 / tonne of tailings, which is also high.

The acid neutralising capacity (ANC) of the samples was determined along with the carbonate content. The two results can be used as a check against one another and to identify the contribution of ANC from carbonates and other non carbonate minerals. The results of the analysis are given in Table 3.4.

Table 3.4: Summarised Tailings Carbonate and Acid Neutralising Capacity Results

Sample	Carbonate Carbon (%)	CO_3-ANC [1] (kg H_2SO_4 /t)	ANC [2] (kg H_2SO_4 /t)
Frogs Legs	5.0	50.4	98.5
White Foil	4.0	40.0	58.0

[1]Calcuated ANC from carbonate content, [2]Measured Sobek ANC

The results of the carbonate analyses indicate that the tailings samples had a carbonate content of between 4.0 and 5.0%, which is high. The results also indicate that both samples have additional neutralising capacity available from non-carbonate minerals when subjected to strongly acidic conditions, especially the Frogs Legs sample. The measured acid neutralising capacity of the samples ranged from high (58.0%) to very high (98.5%).

The Net Acid Producing Potential (NAPP) of the samples was calculated from the MPA and the ANC and is given in Table 3.5 along with the ANC/MPA ratio. The net acid producing potential of both samples was negative with ANC/MPA ratios of 1.6 and 2.0, indicating that there is excess neutralising capacity in the samples, particularly the Frogs Legs sample.

Table 3.5: Tailings Net Acid Producing Potential Results

Sample	ANC (kg H_2SO_4 /t)	MPA (kg H_2SO_4 /t)	NAPP (kg H_2SO_4 /t)	ANC/MPA (unit less)
Frogs Legs	98.5	50.2	-48.3	2.0
White Foil	58.0	40.0	-21.0	1.6

3.2.2 Tailings Net Acid Generation

The net acid generation (NAG) test aids in interpretation of acid formation potential classifications. It also identifies if the sulfides and neutralising minerals contained in the samples are readily available to produce or consume acid.

The results of the net acid generation test are given in Table 3.6 and indicate that no measurable acid was produced by either sample when exposed to extreme oxidising conditions. The final NAG pH of the tailings after complete oxidation was between 8.95 and 9.4, indicating that weak alkaline pH conditions are likely to prevail within the tailings pore waters, should complete oxidation of the tailings solids occur.

Table 3.6: Tailings Net Acid Generation Results

Sample	NAG (7.0) (kg H_2SO_4/t)	NAG pH
Frogs Legs	0	8.95
White Foil	0	9.4

3.2.3 Tailings Acid Formation Potential

The acid formation potential is determined based on the acid base accounting results and the NAG test. Both samples recorded negative net acid producing potentials, with the NAG test resulting in a NAG pH of 8.9 and 9.4. The samples were therefore classified as Non Acid Forming. The classification of both samples is shown in Figure 3.1.

3.2.4 Tailings Solids Geochemical Enrichments

Multi-element analysis of the tailings solids was conducted to assess elemental enrichments within the solid portion of the tailings material. Multi-element analysis results were compared to the average crustal abundance to give the geochemical abundance indices. The Geochemical Abundance Index (GAI) quantifies an assay result for a particular element in terms of average crustal abundance.

The assay results, average crustal abundance (ACA) and corresponding geochemical abundance indices (GAI) are given in tables 3.7 and 3.8. The results of the analysis show that the White Foil tailings solids had a low number of elemental enrichments, with the Frogs Legs tailings having a moderate level of enrichment. Both samples were found to be enriched in a similar set of elements.

Arsenic, chloride and sulfur were classed as highly enriched in both samples, with carbon found to be significantly enriched in both samples. Cadmium, lead, antimony and selenium were also found to be significantly enriched in the Frogs Legs sample. Silver, boron, bismuth were found to be slightly enriched in both samples, with cadmium found to be slightly enriched in the White Foil sample and zinc found to be slightly enriched in the Frogs Legs sample.

The results of the analysis have also been compared to a set of soil intervention guidelines compiled from Australian National Environmental Protection Measures investigations levels for assessment of site contamination (Ref. 13) and Netherlands National Institute of Public Health and Environment intervention levels for soil (Ref. 14) and ecological threshold concentrations for antimony in water and soil published by the European Centre for Risk Assessment (Ref. 15). The results of the comparison are given in Table 3.9 and indicate that arsenic, barium, manganese and sulfur exceed the guideline values in both samples, with the Frogs Legs sample also exceeding the guideline values for cadmium, copper, nickel, vanadium and zinc. The results of this comparison indicate that a cover system would likely be required on closure to isolate the tailings from the environment

Table 3.7: Tailings Multi-Element Results & Geochemical Abundance Indices

Element	Unit	Multi-Element Analysis Result	
		Frogs Legs	White Foil
Ag	ppm	0.6	0.5
Al	ppm	71896	59803
As	ppm	667	83
B	ppm	69	53
Ba	ppm	352	500
Be	ppm	0.88	1.3
Bi	ppm	0.31	0.24
C	ppm	7550	5100
Ca	ppm	49458	32361
Cd	ppm	3.2	0.47
Cl	ppm	96600	91700
Co	ppm	35	22
Cr	ppm	110	18
Cu	ppm	107	19
F	ppm	305	407
Fe	ppm	60250	84500
Hg	ppm	0.02	0.01
K	ppm	18150	12717
Mg	ppm	20607	10111
Mn	ppm	1204	1223
Mo	ppm	1.2	1.6
Na	ppm	18706	30060
Ni	ppm	68.5	11
P	ppm	373	1083
Pb	ppm	164	28
S	ppm	18500	14000
Sb	ppm	3.5	0.84
Se	ppm	0.92	0.21
Sn	ppm	1.9	2.2
Sr	ppm	182	193
Th	ppm	2.4	10
U	ppm	0.65	2.5
V	ppm	155	27
Zn	ppm	411	130

Table 3.8: Tailings Multi-Element Results & Geochemical Abundance Indices

Element	Average Crustal Abundance	Geochemical Abundance Index	
		Frogs Legs	White Foil
Ag	0.07	2	2
Al	82000	0	0
As	1.5	6	5
B	10	2	2
Ba	500	0	0
Be	2.6	0	0
Bi	0.048	2	2
C	480	3	3
Ca	41000	0	0
Cd	0.11	4	2
Cl	130	6	6
Co	20	0	0
Cr	100	0	0
Cu	50	1	0
F	950	0	0
Fe	41000	0	0
Hg	0.05	0	0
K	21000	0	0
Mg	23000	0	0
Mn	950	0	0
Mo	1.5	0	0
Na	23000	0	0
Ni	80	0	0
P	1000	0	0
Pb	14	3	0
S	260	6	5
Sb	0.2	4	1
Se	0.05	4	1
Sn	2.2	0	0
Sr	370	0	0
Th	12	0	0
U	2.4	0	0
V	160	0	0
Zn	75	2	0

Slightly enriched
Significantly enriched
Highly enriched

Table 3.9: Tailings Solid Multi-Element Results & Site Contamination Guidelines

Element	Ecological Investigation - interim Urban[1] (ppm)	Health Investigation levels - Category A[2] (ppm)	Intervention Values for Soil [3] (ppm)	Most Conservative	Multi-Element Analysis Results (ppm)	
					Frogs Legs	White Foil
Antimony			15	15	3.5	0.8
Arsenic	20	100	55	20	**667**	**83**
Barium	300		625	300	**352**	**500**
Beryllium		20	30	20	0.88	1.3
Boron		3000		3000	69	53
Cadmium	3	20	12	3	**3.2**	0.47
Chromium (total)			380	380	110	18
Cobalt		100	240	100	35	22
Copper	100	1000	190	100	**107**	19
Lead	600	300	530	300	164	28
Manganese	500	1500		500	**1204**	**1223**
Mercury (inorganic)	1	15	10	1	0.02	0.01
Molybdenum			200	200	1.15	1.6
Nickel	60	600	210	60	**69**	11
Phosphorus	2000			2000	373	1083
Selenium			100	100	0.92	0.21
Silver			15	15	0.56	0.50
Sulfur	600			600	**18500**	**14000**
Sulfate	2000			2000	**2100**	1900
Tin			900	900	1.9	2.2
Vanadium	50		250	50	**155**	27
Zinc	200	7000	720	200	**411**	130

1 = National Environmental Protection Council - National Environmental Protection Measures – Soil Investigation levels for assessment of site contamination 2 = Netherlands National Institute of Public Health and Environment, 3 = European Centre for Risk Assessment.

3.2.5 Supernatant Water Quality

The supernatant water quality was assessed to examine the solubility of the various parameters which will occur when the ore is processed within the process plant. The results of the testing give an indication of the water quality which is likely within the supernatant pond during operation, but cannot be used to predict long term seepage quality from the facility. This would require leach and/or kinetic testing of the tailings solids which is beyond the scope of this initial geochemical assessment.

The results of the supernatant testing have been compared to the reference water quality standard for release of water from mining operations and livestock drinking water, as detailed in Table 3.2. The results of the supernatant testing are provided in Table 3.10.

The Frogs Legs and White Foil supernatant was found to be hypersaline, with a total dissolved solids (TDS) value of 163,599 and 171,448 mg/kg respectively. As a result, the samples had to be diluted by the laboratory to enable the analysis to be completed and, consequently, the detection limits of many elements were increased. Therefore, the limit of detection for numerous elements (namely chromium, copper, mercury, nickel and zinc) exceeded the assessment criteria. As such, even though several determinants were found to be below the laboratory limits of detection, it is not possible to ascertain whether they exceed the assessment criteria. Further, where an element is indicated to below the detection limit in the laboratory results, Knight Piésold conservatively assumes that the element is present at the detection limit concentration. This is also how the results are presented in Table 3.10, with elements highlighted in blue indicating that the laboratory limit of detection exceeds the reference water quality value and elements highlighted in red indicating that the element genuinely exceeds the criteria value.

The results indicate that the TDS, arsenic, magnesium, selenium and sulfate concentrations exceed the reference values in both samples, with the Frogs Legs sample also exceeding the reference vales for lead and the White Foil sample exceed the assessment criteria for boron, cyanide-total, cyanide-WAD and silver. The results also indicate that the highest exceedances were recorded for TDS and selenium (both samples) and silver (White Foil only). In addition, although there are no guideline values for chloride or sodium, the concentrations of these determinants were found to be extremely high, which is indicative of hypersaline water.

It is understood that the regional groundwater is very saline, and that this groundwater was used as process water to produce the tailings samples. Therefore, it is probable that this has resulted in the supernatant also becoming hypersaline. Nevertheless, it is recommended that the facility is equipped with a basal liner with an underdrainage system also constructed (above the liner) to minimise seepage from the facility and potential contamination of surface water or near surface groundwater. The facility will also need to be fenced to prevent access by stock or terrestrial wildlife which may be adversely affected by drinking the supernatant/seepage water. A cover system should also be constructed on closure to minimise any water ingress and resulting seepage.

Table 3.10: Supernatant Comparison to Release and Livestock Guidelines

Parameter	Reference Value (mg/L)	Assay Results (mg/L)	
		Frogs Legs	White Foil
pH	6 to 9 (S.U.)	7.40	7.10
TDS	2000 (mg/Kg)	**163,599**	**171,448**
Aluminum	5	**1.0**	**1.0**
Antimony	N/G	0.044	0.008
Arsenic	0.1	**0.24**	**0.21**
Barium	N/G	0.11	0.17
Boron	5	**1.0**	1.0
Cadmium	0.01	**0.002**	**0.002**
Calcium	1000	845	892
Chloride	N/G	93,881	93,354
Chromium (total)	1	**1.0**	**1.0**
Cobalt	1	0.08	0.03
Copper	0.3	**1.0**	**1.0**
Cyanide-Total	1	0.75	**1.6**
Cyanide-Free	0.1	N/D	N/D
Cyanide-WAD	0.5	**0.5**	**1.0**
Fluoride	2	0.1	0.1
Iron	2	1.0	1.0
Lead	0.1	**0.05**	**0.05**
Magnesium	2000	**7,684**	**7,770**
Manganese	N/G	30	4.0
Mercury	0.002	**0.01**	**0.01**
Molybdenum	0.15	0.043	0.032
Nickel	0.5	**1.0**	**1.0**
Phosphorus	N/G	10	10
Selenium	0.02	**0.78**	**0.76**
Silver	0.5	**0.001**	0.004
Sodium	N/G	49,275	49,955
Sulfate	1000	**16,179**	**15,722**
Tin	N/G	0.01	0.01
Uranium	0.2	0.002	0.005
Vanadium	N/G	1.0	1.0
Zinc	0.5	**1.0**	**1.0**

Note: Elements highlighted in **blue** indicate that the laboratory limit of detection exceeds the reference water quality value and elements highlighted in **red** indicate that an element genuinely exceeds the criteria value. Elements in **green** indicate detection limits were reached but criteria values were still not exceeded.

3.3 IMPLICATIONS FOR DESIGN

Results of the geochemical testing on two samples of tailings from the proposed Mungari project indicate the following:

- The acid formation potential of each tailings sample was determined based on the acid base accounting results and the net acid generation test. Both samples were classified as Non Acid Forming.

- Multi-element analysis results of the solids were compared to the average crustal abundance to calculate geochemical abundance indices. The results of the analysis show that the White Foil tailings solids had a low number of elemental enrichments, with the Frogs Legs tailings having a moderate level of enrichment. Arsenic, chloride and sulfur were classed as highly enriched in both samples, with carbon found to be significantly enriched in both samples. Cadmium, lead, antimony and selenium were also found to be significantly enriched in the Frogs Legs sample.

- The multi-element analyses of the solids were also compared to a set of soil intervention values. The results of this comparison indicate several metals to be present at elevated concentrations (namely arsenic, barium, manganese and sulfur in both samples, and cadmium, copper, nickel, vanadium and zinc in the Frogs Legs sample) and, as such, a cover system would likely be required on closure to isolate the tailings from the environment.

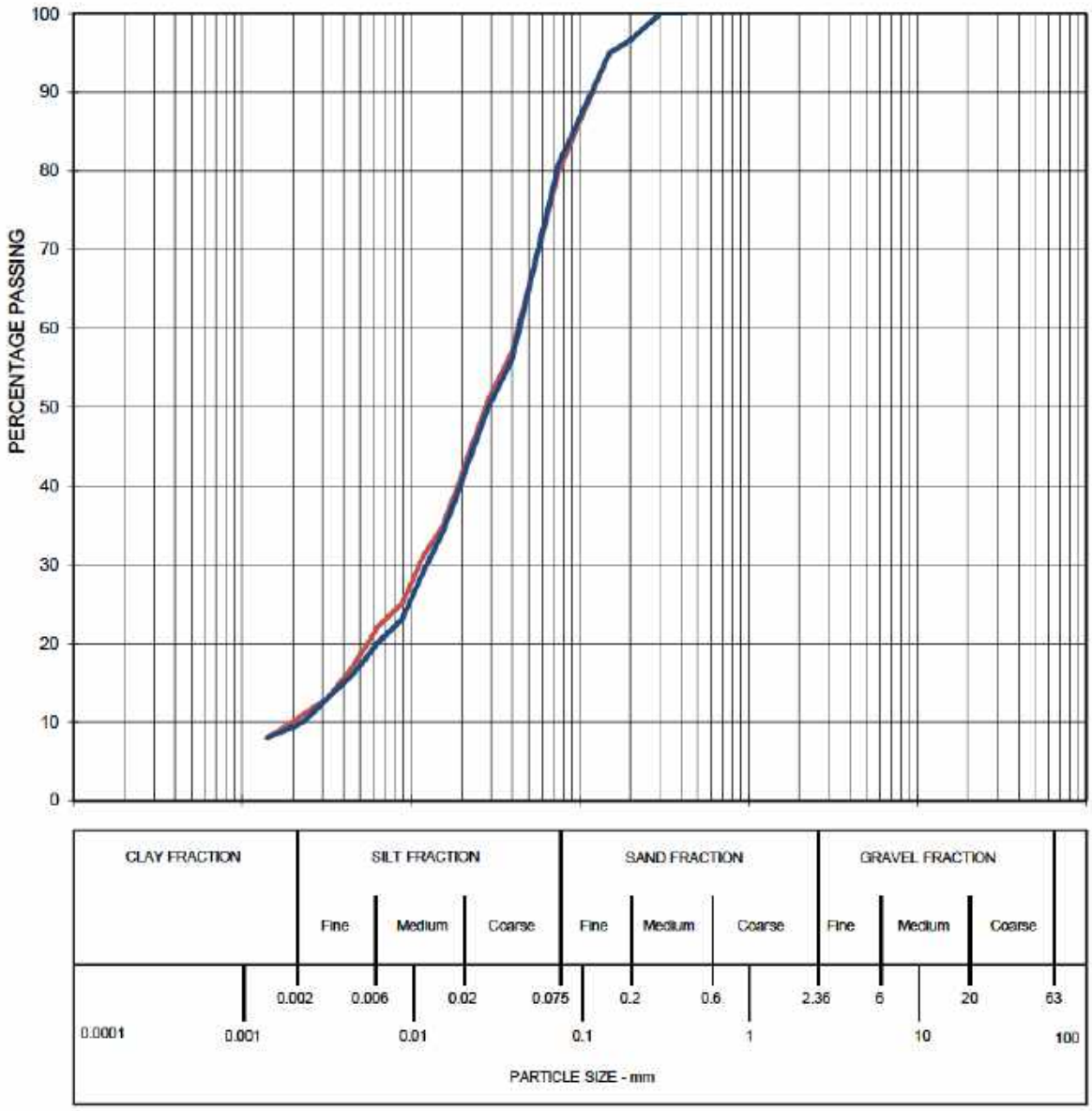
- The supernatant water quality has been compared with reference water quality standards for release from mining operations and livestock and wildlife drinking water. The Frogs Legs and White Foil supernatant was found to be hypersaline, with a total dissolved solids (TDS) value of 163,599 and 171,448 mg/kg respectively. Further, the results indicate that the arsenic, magnesium, selenium and sulfate concentrations exceed the reference values in both samples, with the Frogs Legs sample also exceeding the reference vales for lead and the White Foil sample exceed the assessment criteria for boron, cyanide-total, cyanide-WAD and silver.

- In view of the supernatant results, it is recommended that the facility is equipped with a basal liner and underdrainage system to minimise seepage from the facility and potential contamination of surface water or near surface groundwater. The facility will also need to be fenced to prevent access by stock or terrestrial wildlife which may be adversely affected by drinking the supernatant/seepage water. A cover system should also be constructed on closure to minimise any water ingress and resulting seepage.

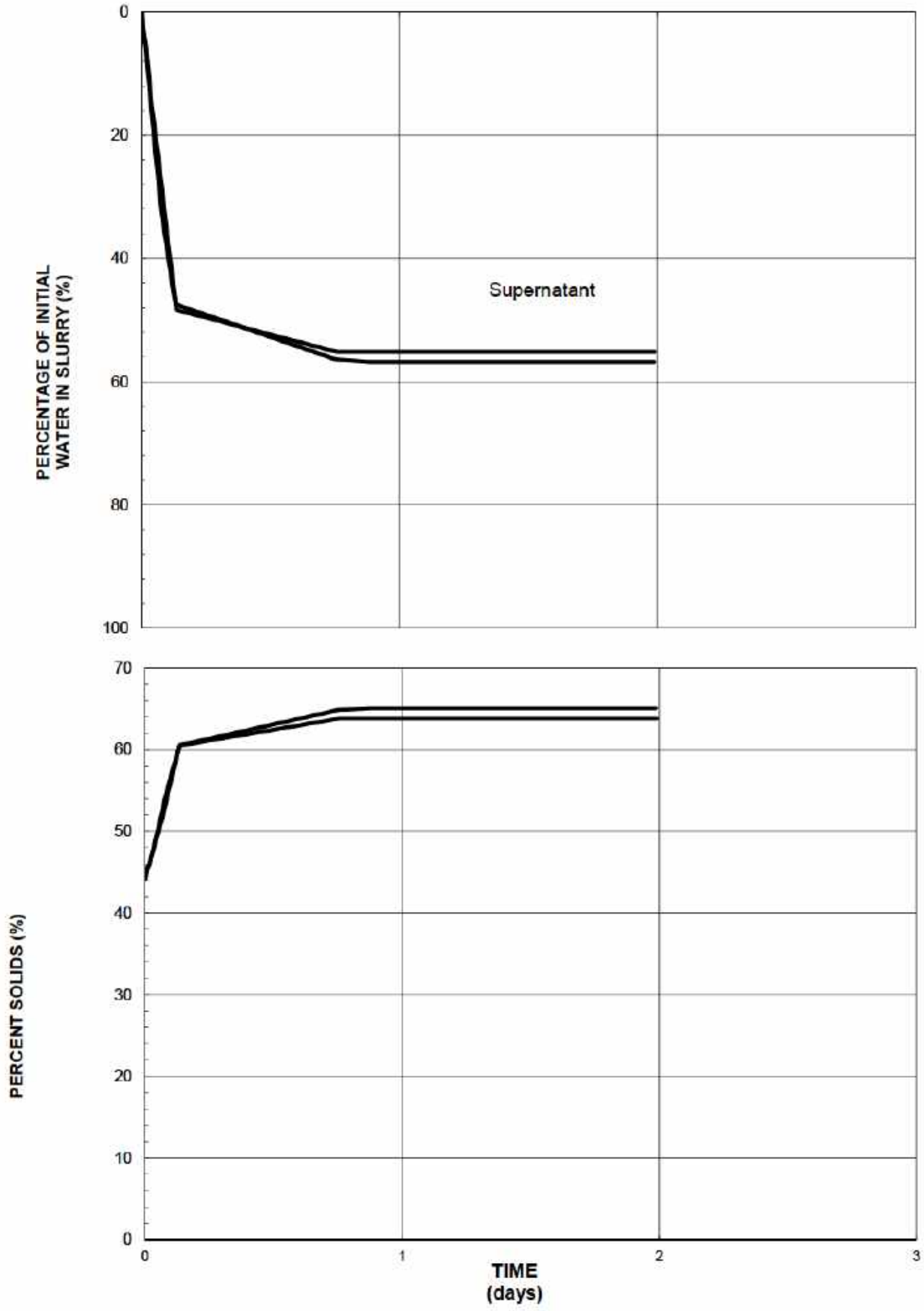
- It is understood that the regional groundwater is very saline, and that this groundwater was used as process water to produce the tailings samples. Therefore, it is probable that this has resulted in the supernatant also becoming hypersaline. As such, it is recommended that the results of the supernatant analyses are compared to regional groundwater quality data to allow the actual impact of the mineral processing to be assessed.

FIGURES

PARTICLE SIZE DISTRIBUTION



SYMBOL	SOIL DESCRIPTION	LIQUID LIMIT	PLASTICITY INDEX	SPECIFIC GRAVITY
	FROGS LEG COMP	NP	NP	2.82
	WHITE FOIL COMP	NP	NP	2.84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40
60
80
100
Supernatant
PERCENT SOLIDS (%)
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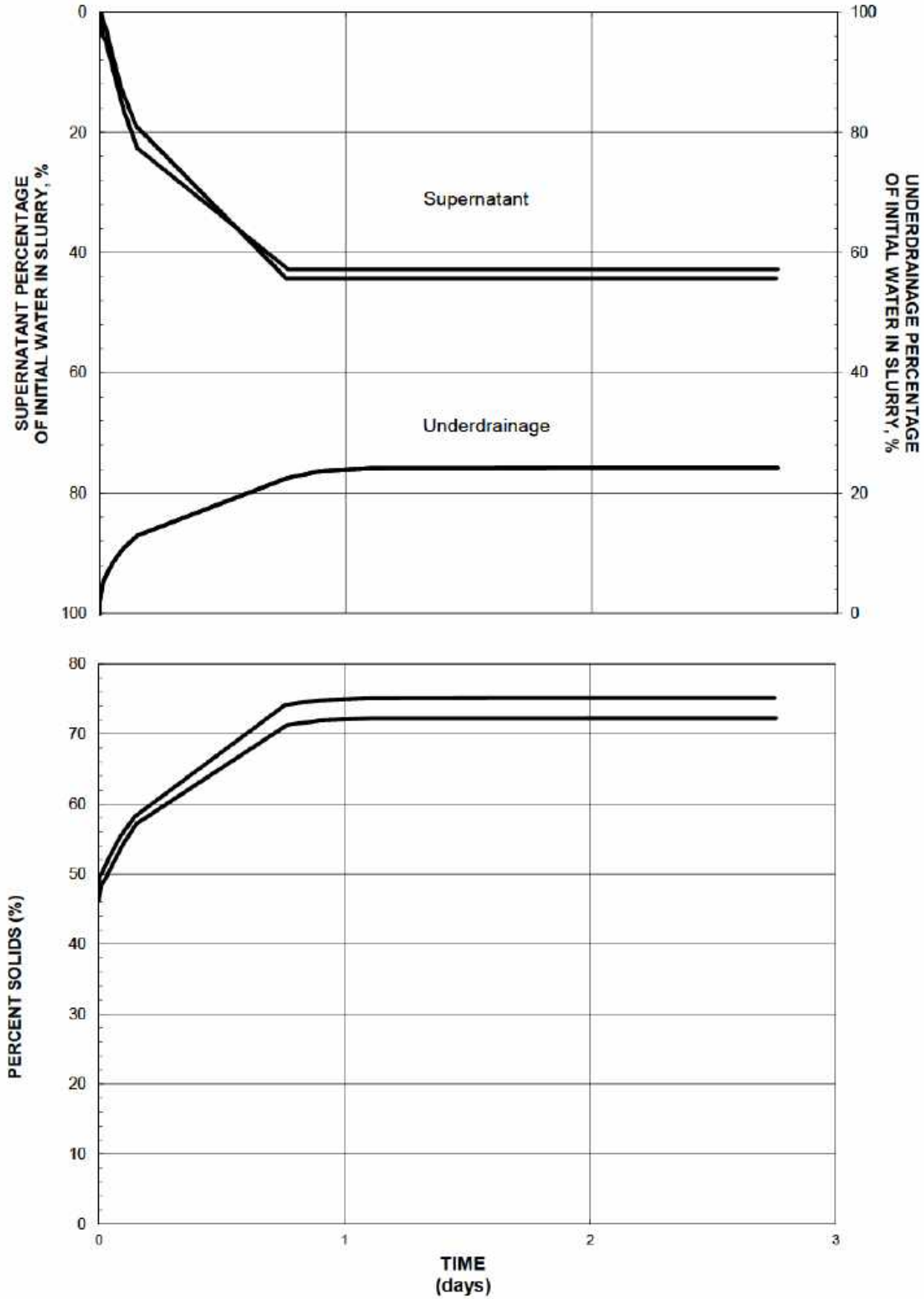
50
40
30
20
10
0
0
1
2
3
TIME (days)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UNDERDRAINAGE PERCENTAGE OF INITIAL WATER IN SLURRY, %
Supernatant
Underdrainage
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40
60
80
100
PERCENT SOLIDS (%)
TIME (days)
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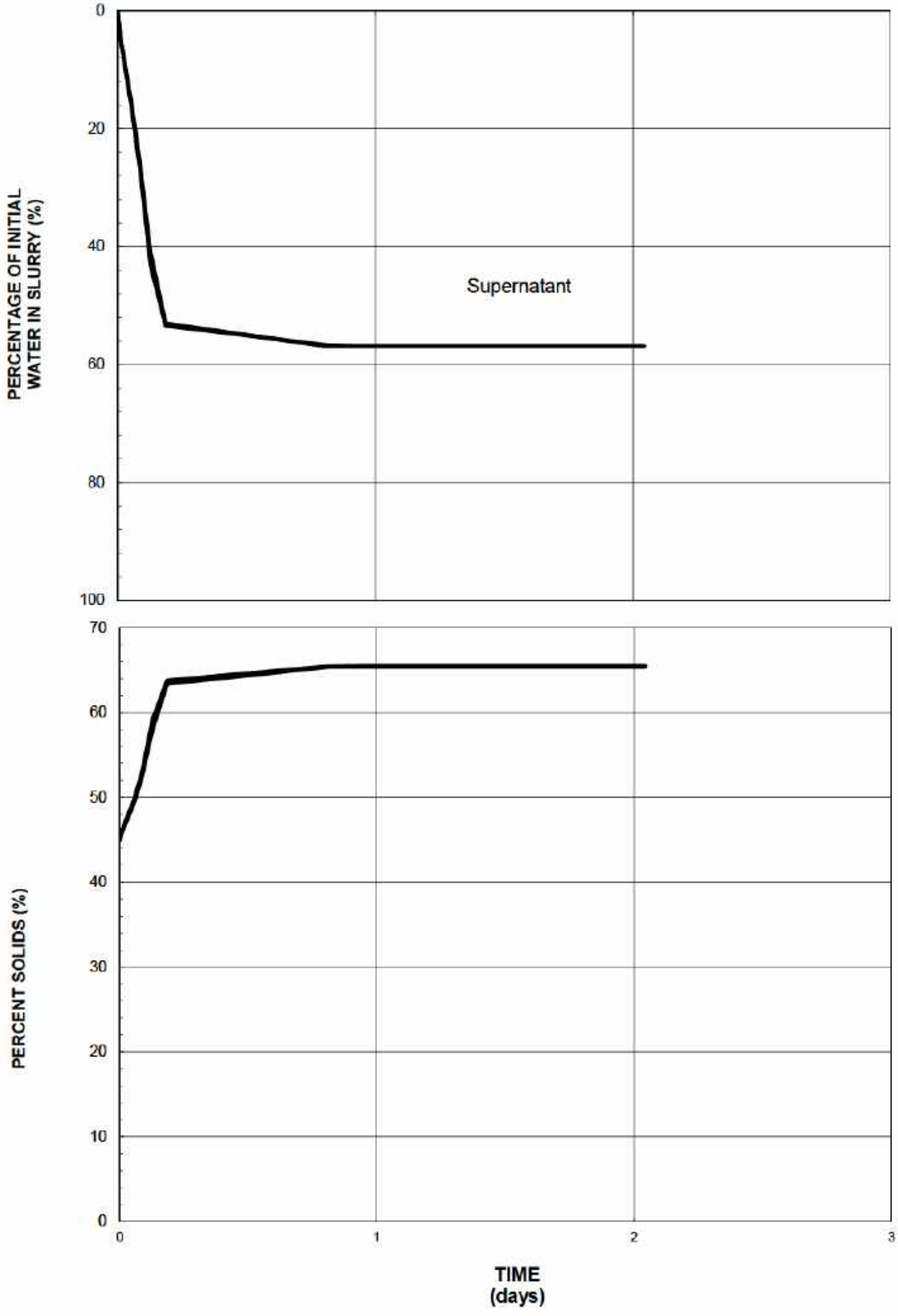
3
10
30
50
70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40
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Supernatant
PERCENT SOLIDS (%)
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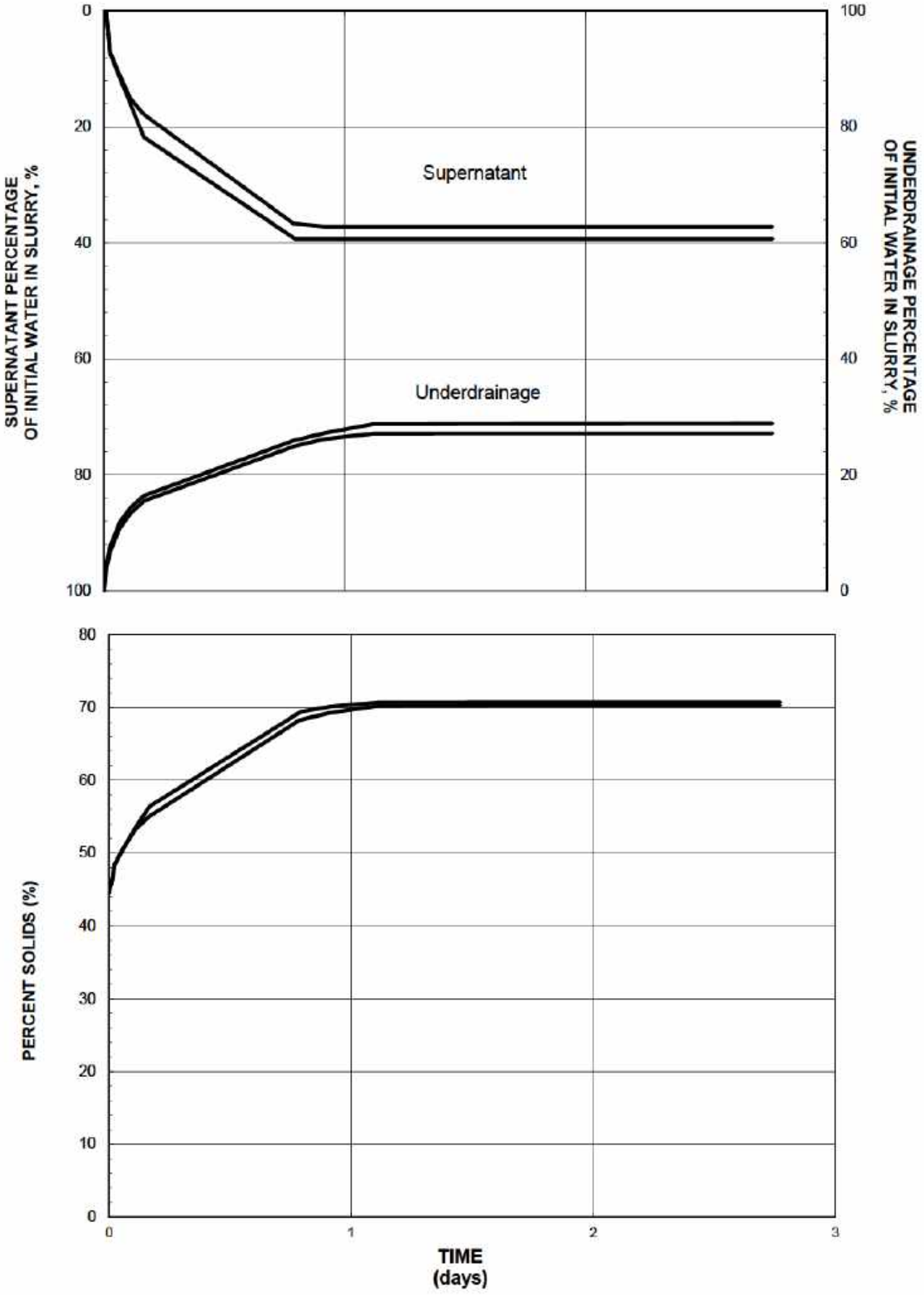
0
0
1
2
3
TIME
(days)


SUPERNATANT PERCENTAGE OF INITIAL WATER IN SLURRY, %
UNDERDRAINAGE PERCENTAGE OF INITIAL WATER IN SLURRY, %
Supernatant
Underdrainage
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20
40
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80
100
PERCENT SOLIDS (%)
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30
40
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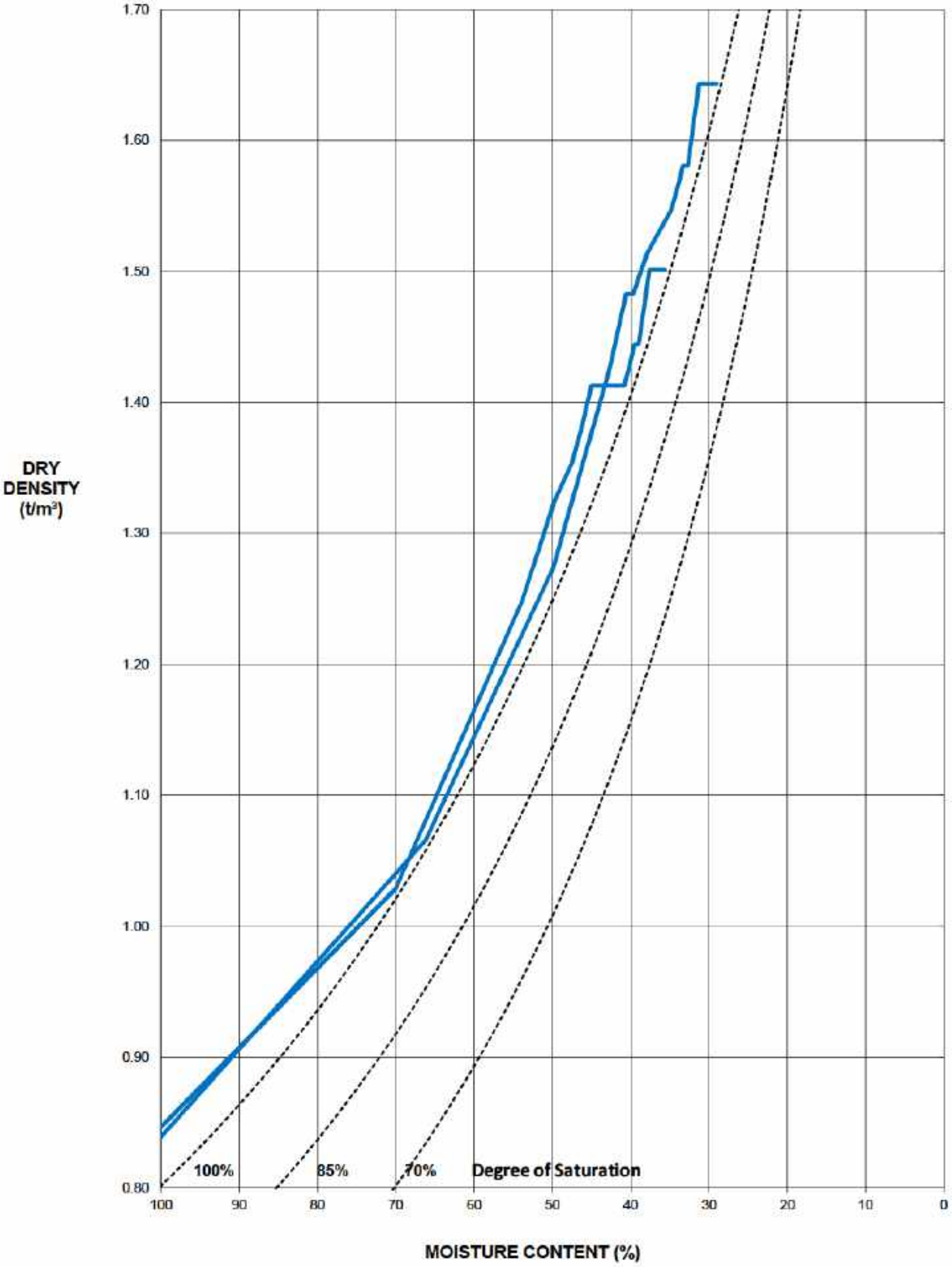
60
70
80
1
2
3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0.80
100%
85%
70%
Degree of Saturation
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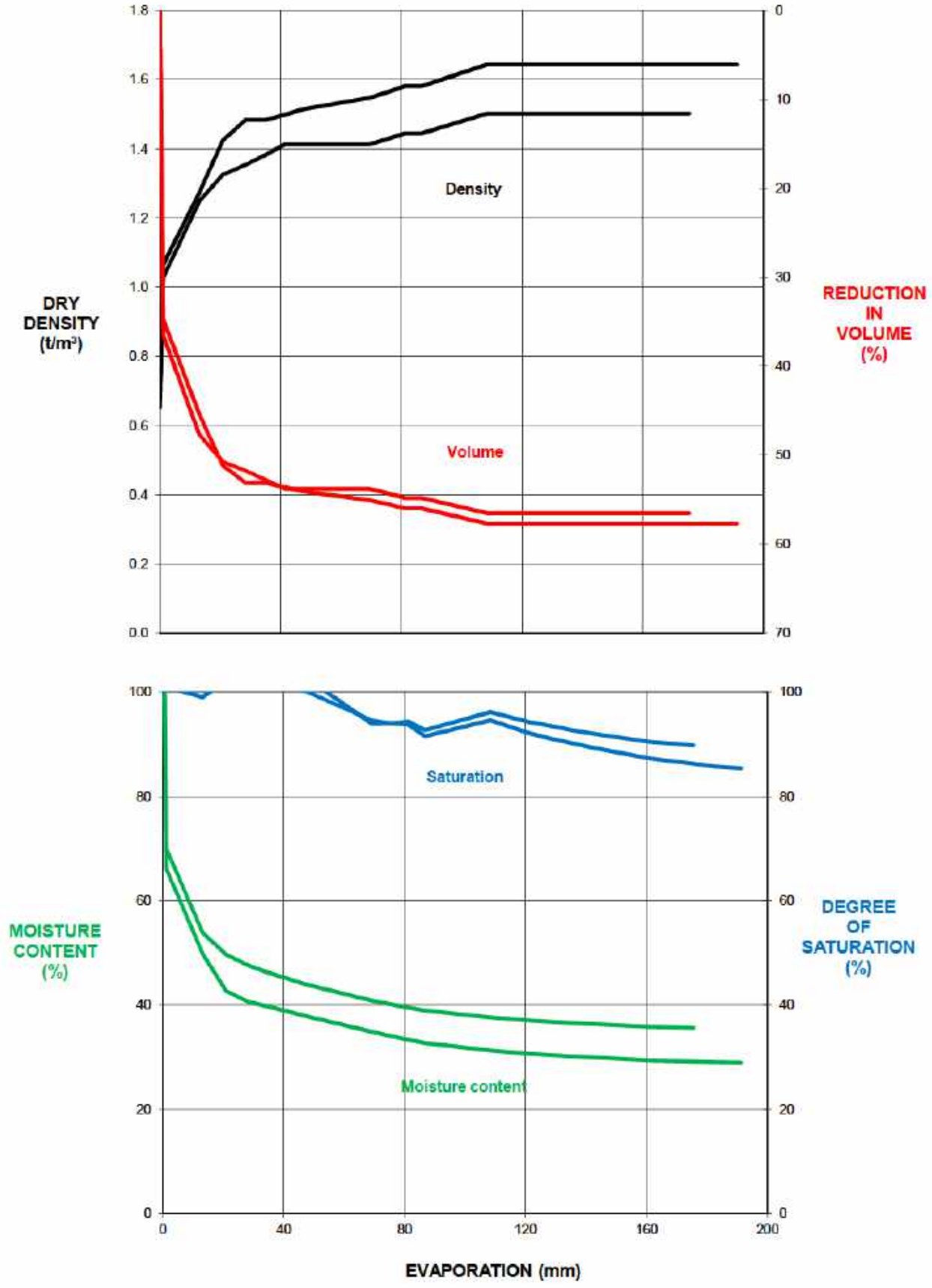
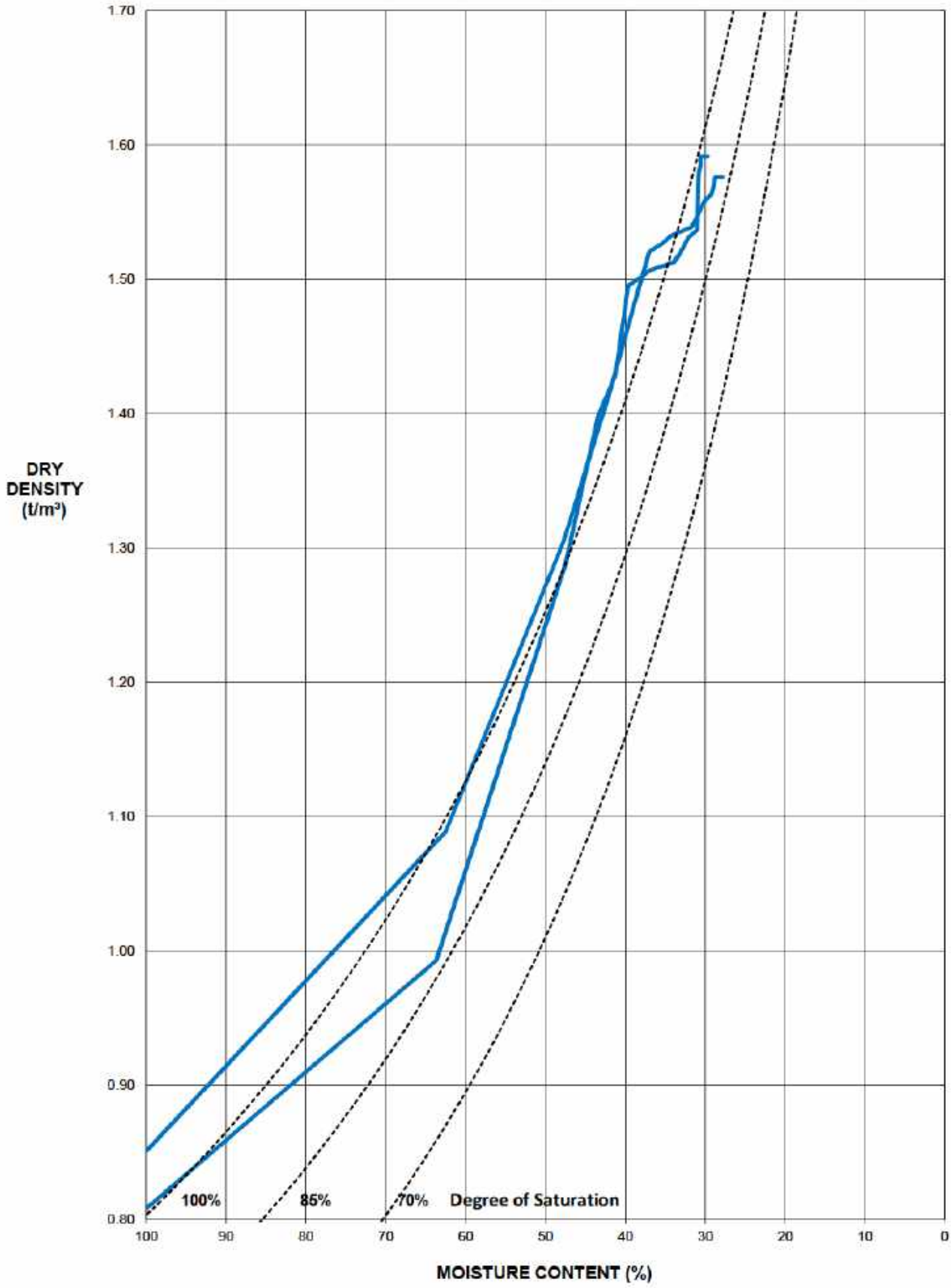
90
80
70
60
50
40
30
20
10
0
MOISTURE CONTENT (%)


DRY DENSITY (t/m³)
REDUCTION IN VOLUME (%)
Density
Volume
MOISTURE CONTENT (%)
DEGREE OF SATURATION (%)
Saturation
Moisture content
EVAPORATION (mm)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100%
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Degree of Saturation
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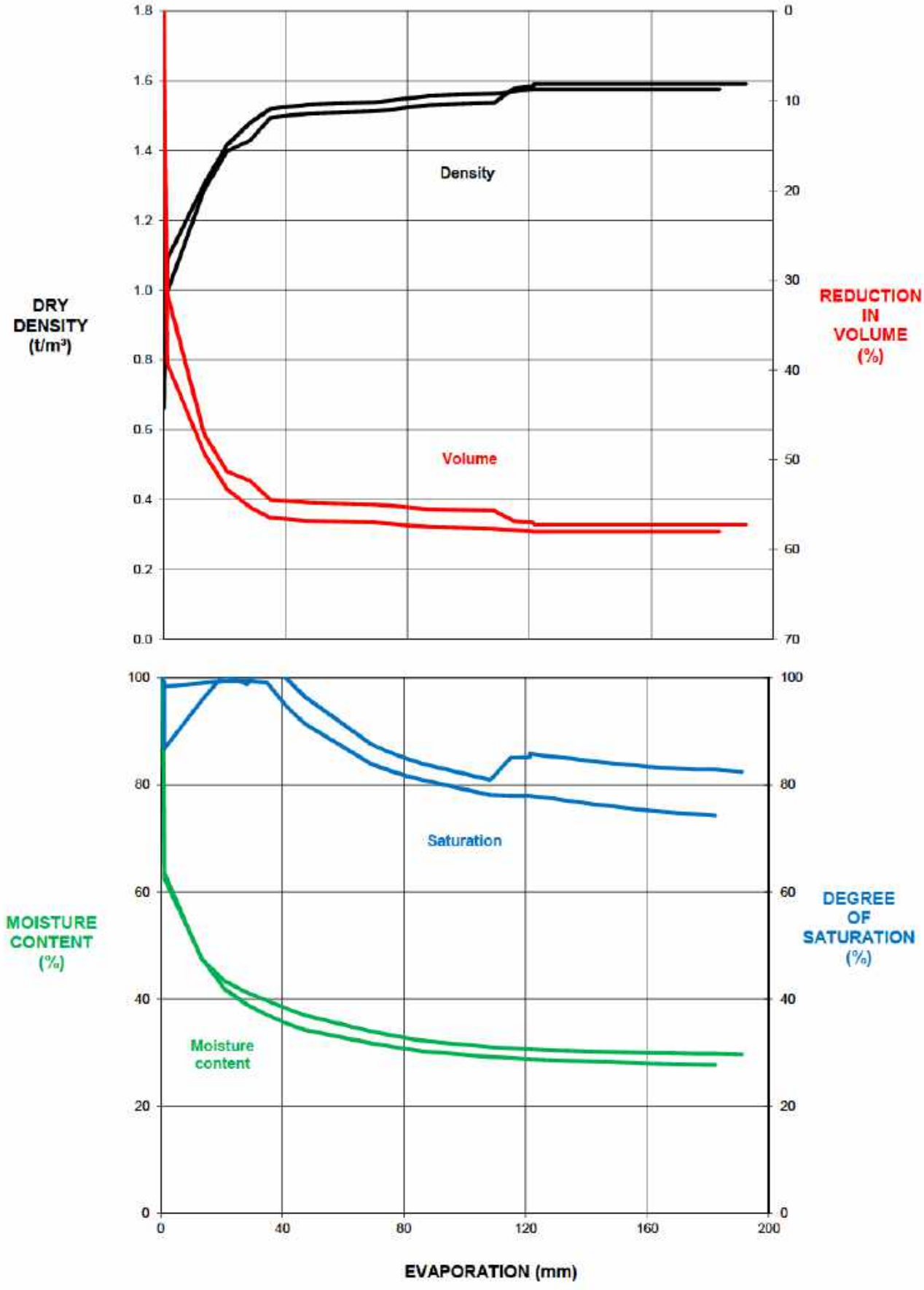
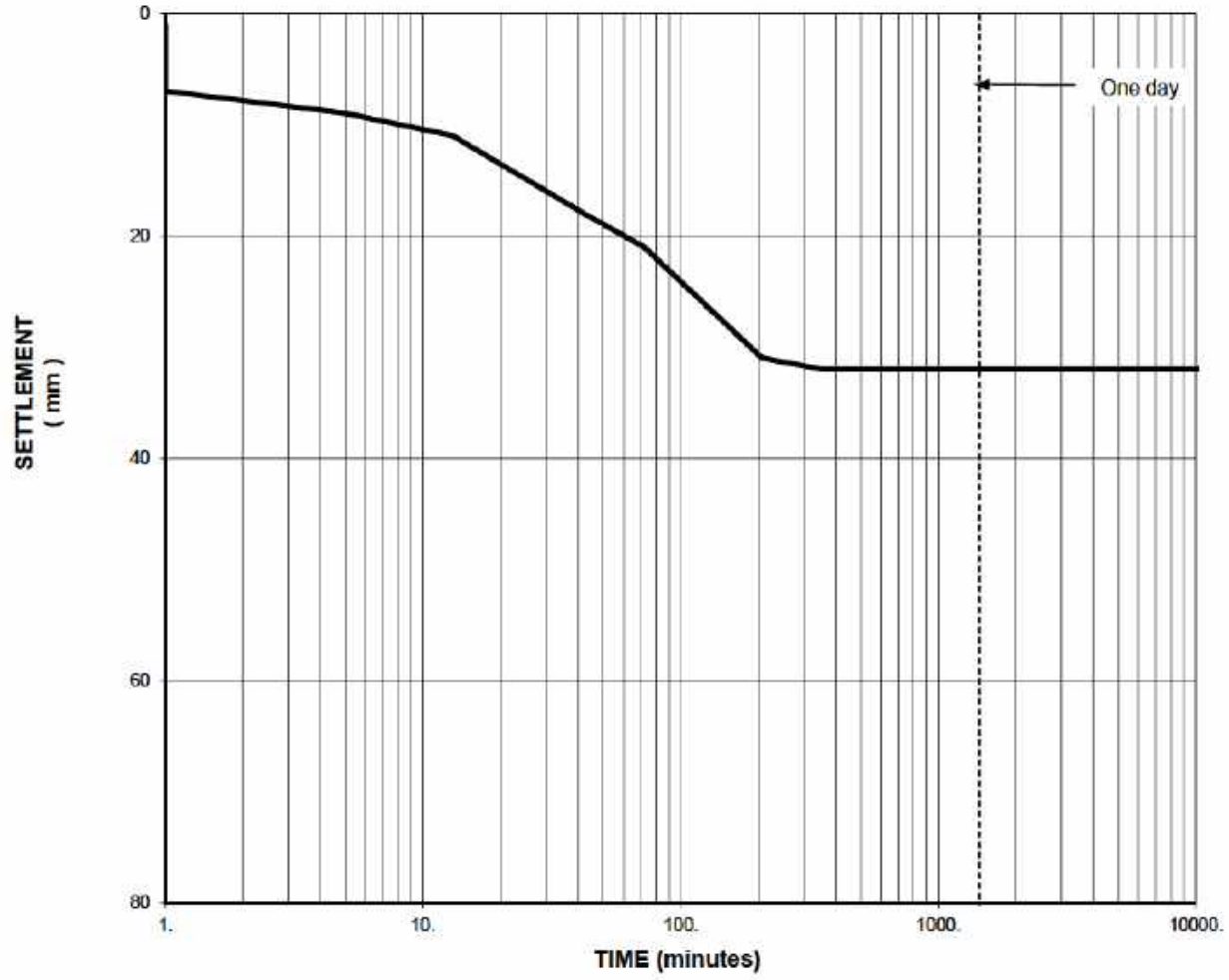
0
MOISTURE CONTENT (%)


DRY DENSITY (t/m³)
REDUCTION IN VOLUME (%)
Density
Volume
MOISTURE CONTENT (%)
DEGREE OF SATURATION (%)
Saturation
Moisture content
EVAPORATION (mm)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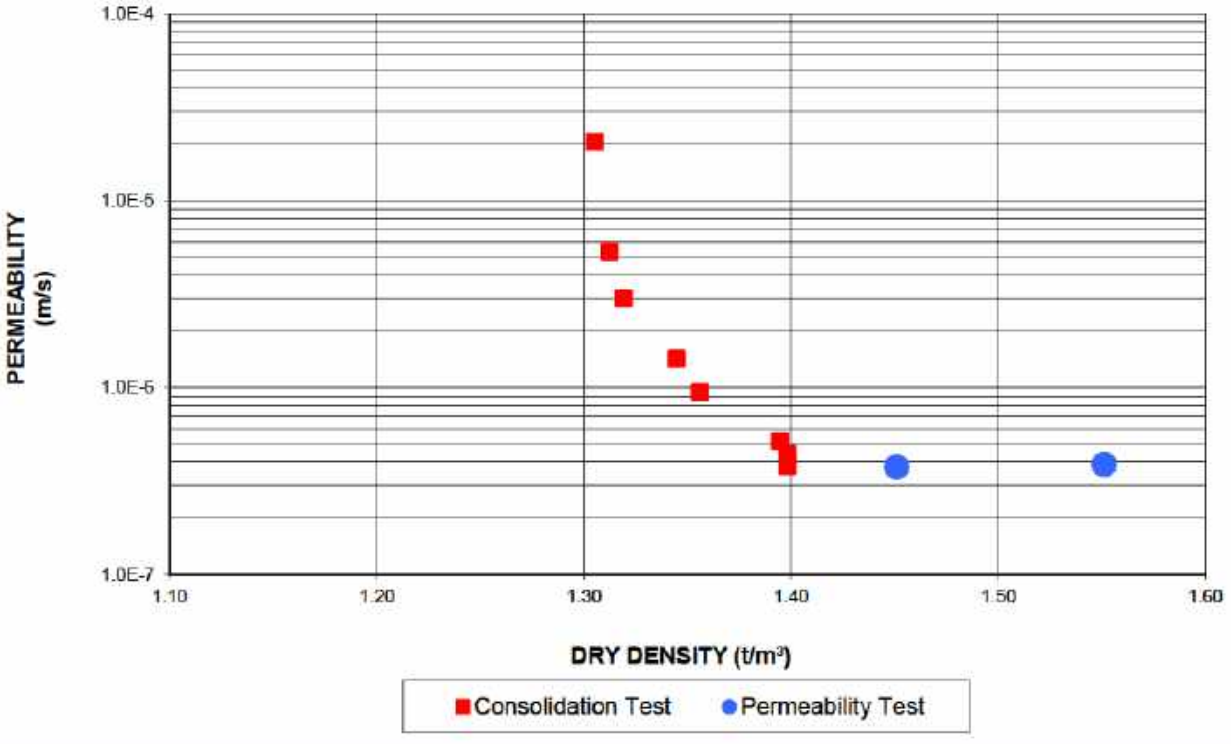
40
60
80
One day
1.
10.
100.
1000.
10000.
TIME (minutes)


PERMEABILITY (m/s)
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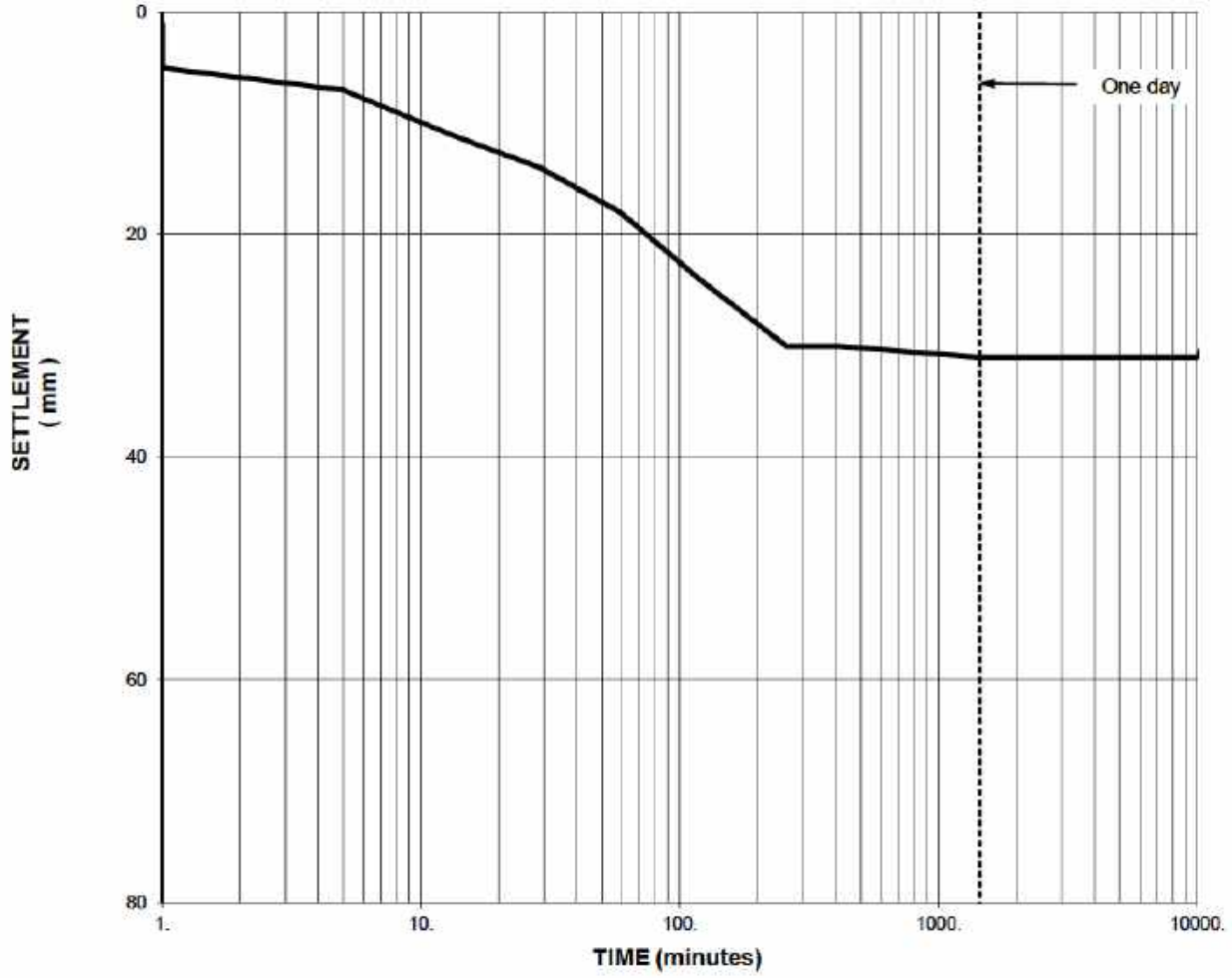
1.0E-5
1.0E-5
1.0E-7
1.10
1.20
1.30
1.40
1.50
1.60
DRY DENSITY (t/m³)
Consolidation Test
Permeability Test


0
20
40
60
80
SETTLEMENT (mm)
One day
1.
10.
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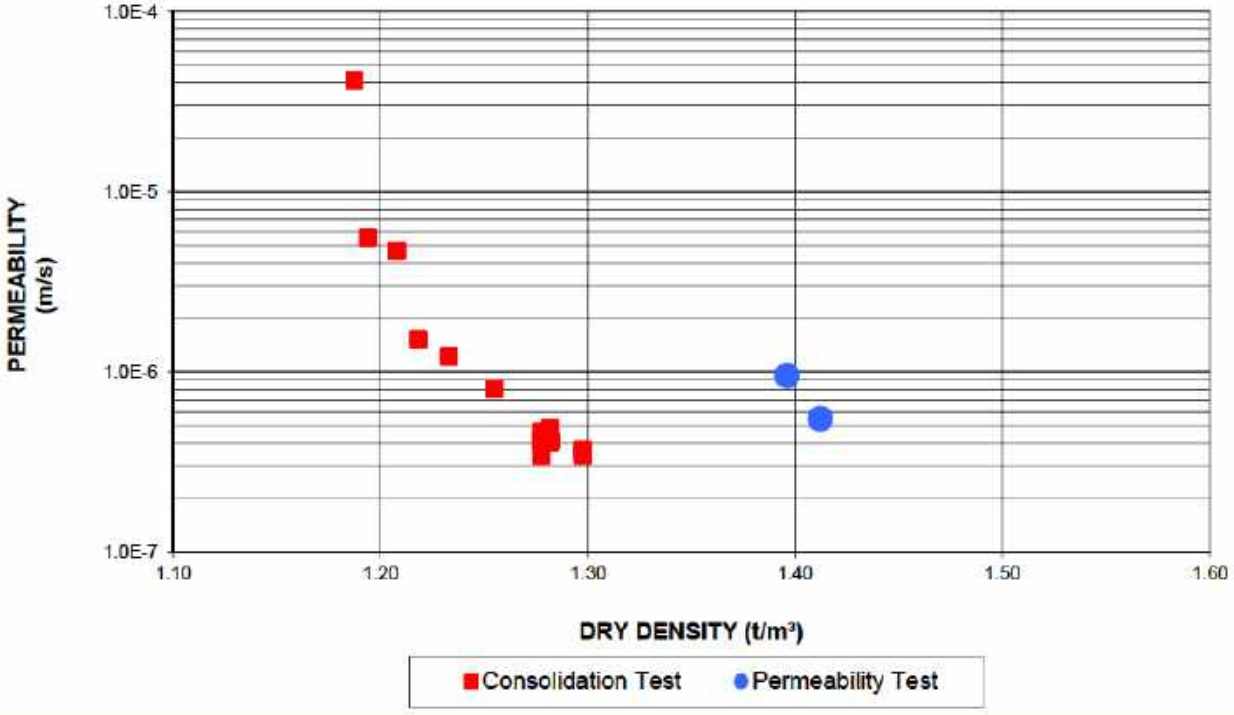
1000.
10000.
TIME (minutes)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1.0E-6
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PERMEABILITY (m/s)
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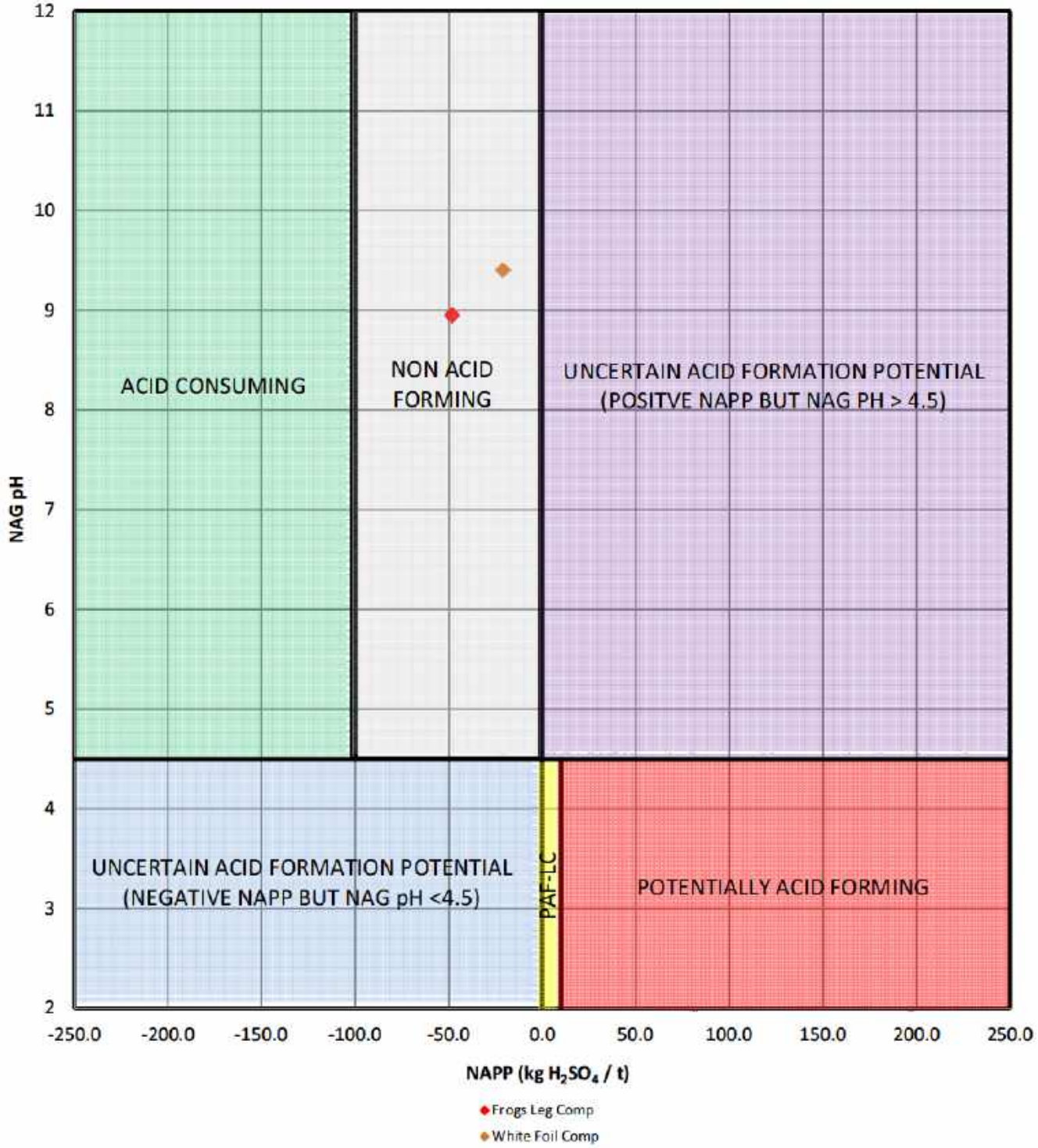
1.20
1.30
1.40
1.50
1.60
DRY DENSITY (t/m³)
Consolidation Test
Permeability Test

Acid Formation Potential



Acid Formation Potential	NAPP (kg H_2SO_4 / t)	NAG pH
Potential Acid Forming (PAF)	>10	<4.5
Potential Acid Forming - Low Capacity (PAF - LC)	0 to 10	<4.5
Non Acid Forming (NAF)	Negative	≥4.5
Acid Consuming (AC)	Less than - 100	≥4.5
Uncertain	Positve	≥4.5
	Negative	<4.5

APPENDIX A

SGS Laboratory Testing

ABN: 44 000 964 278
ph: 1300 781 744
fx: (08) 9458 3700

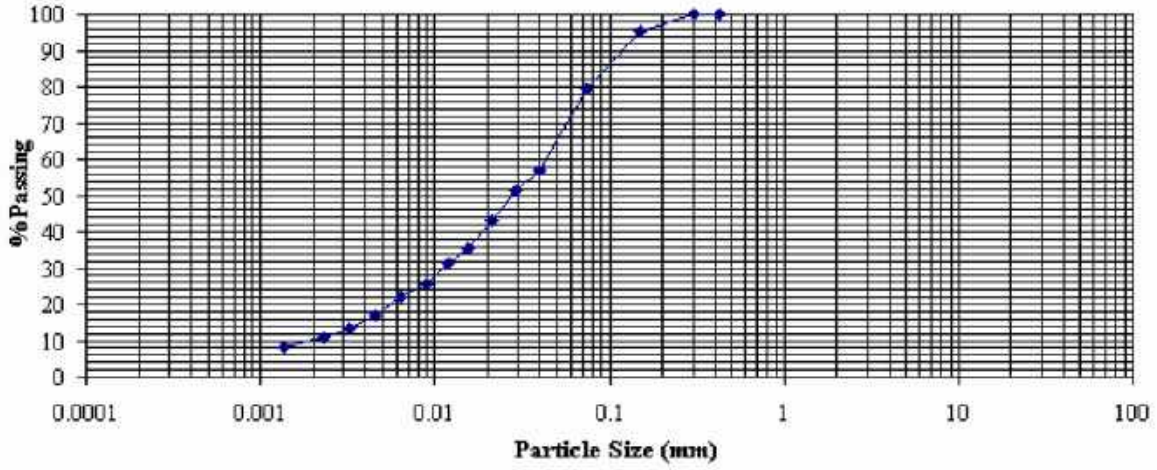
TEST CERTIFICATE

SGS Australia Pty Ltd
PO Box 219 Bentley WA 6982
36 Railway Parade
Welshpool WA 6106

Client:	Knight Piesold Pty Ltd	Client Job No:	PE801-00137
Order No:	PO9307	Project:	Mungari Poject
Tested Date:	13/12/2011	Location:	
SGS Job Number:	11-01-2096	Sample No:	11-MT-12625
Lab:	Welshpool	Sample ID:	Frogs Leg Comp

PARTICLE SIZE DISTRIBUTION - SIEVING AND HYDROMETER ANALYSIS

AS1289.3.6.1 & AS1289.3.6.3



SIEVING	(AS1289.3.6.1)	HYDROMETER	(AS1289.3.6.3)
Sieve Size	Passing	Particle Diameter	Finer
(mm)	%	(mm)	%
53.0		0.0396	57
37.5		0.0288	51
19.0		0.0212	43
9.5		0.0155	35
4.75		0.0118	31
2.36	100	0.0088	25
1.18		0.0063	22
0.600		0.0045	17
0.425	100	0.0032	13
0.300	100	0.0023	11
0.150	95	0.0014	8
0.075	80		

Method of Dispersion : Mechanical ; Hydrometer Used : Glass, -5 to 60g/l soil Colloids
Loss after Pretreatment: No Pretreatment

Note: Sample supplied by client.

[redacted]

Date: 23/12/2011

ABN: 44 000 964 278
ph: 1300 781 744
fx: (08) 9458 3700

TEST CERTIFICATE

SGS Australia Pty Ltd
PO Box 219 Bentley WA 6982
36 Railway Parade
Welshpool WA 6106

Client:	Knight Piesold Pty Ltd	Client Job No:	PE801-00137
Order No:	PO9307	Project:	Mungari Poject
Tested Date:	22/12/2011	Location:	
SGS Job Number:	11-01-2096	Sample No:	11-MT-12625
Lab:	Welshpool	Sample ID:	Frogs Leg Comp

PLASTICITY INDEX

AS 1289.3.9.2(Single Point Cone Method), 3.2.1(Plastic Limit), 3.3.2(Plasticity Index), 3.4.1(Linear Shrinkage)

AS 1289.3.9.2

AS 1289.3.2.1

Plastic Limit (%) **NP**

AS 1289.3.3.2

Plasticity Index (%) **NP**

AS 1289.3.4.1

History of Sample Oven Dried at <50ºC

Method of preparation Dry Sieved

Note: Sample supplied by client.

[redacted]

Date: 22/12/2011

Accredited for compliance with ISO/IEC 17025

ABN: 44 000 964 278
ph: 1300 781 744
fx: (08) 9458 3700

TEST CERTIFICATE

SGS Australia Pty Ltd
PO Box 219 Bentley WA 6982
36 Railway Parade
Welshpool WA 6106

Client:	Knight Piesold Pty Ltd	Client Job No:	PE801-00137
Order No:	PO9307	Project:	Mungari Poject
Tested Date:	20/12/2011	Location:	
SGS Job Number:	11-01-2096	Sample No:	11-MT-12625
Lab:	Welshpool	Sample ID:	Frogs Leg Comp

FINE PARTICLE DENSITY

AS1289.3.5.1

FINE FRACTION

SOIL APPARENT	
PARTICLE DENSITY (g/cc)	**2.82**
at temperature	25 ° C

Note: Sample supplied by client.

[redacted]

Date: 23/12/2011

Accredited for compliance with ISO/IEC 17025

ABN: 44 000 964 278
ph: 1300 781 744
fx: (08) 9458 3700

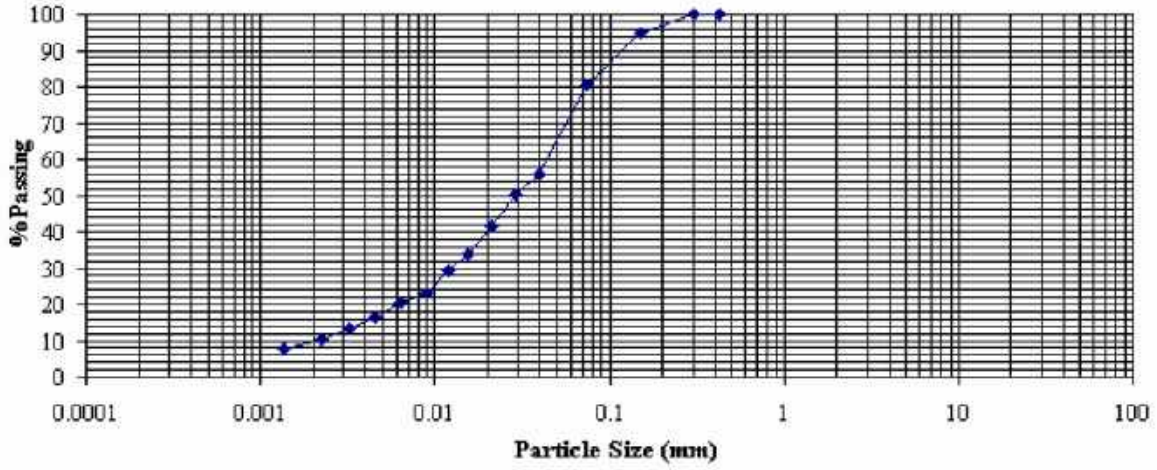
TEST CERTIFICATE

SGS Australia Pty Ltd
PO Box 219 Bentley WA 6982
36 Railway Parade
Welshpool WA 6106

Client:	Knight Piesold Pty Ltd	Client Job No:	PE801-00137
Order No:	PO9307	Project:	Mungari Poject
Tested Date:	13/12/2011	Location:	
SGS Job Number:	11-01-2096	Sample No:	11-MT-12626
Lab:	Welshpool	Sample ID:	White Foil Comp

PARTICLE SIZE DISTRIBUTION - SIEVING AND HYDROMETER ANALYSIS

AS1289.3.6.1 & AS1289.3.6.3



SIEVING	(AS1289.3.6.1)	HYDROMETER	(AS1289.3.6.3)
Sieve Size	Passing	Particle Diameter	Finer
(mm)	%	(mm)	%
53.0		0.0394	56
37.5		0.0287	50
19.0		0.0211	42
9.5		0.0154	34
4.75		0.0118	29
2.36	100	0.0088	23
1.18		0.0063	20
0.600		0.0045	16
0.425	100	0.0032	13
0.300	100	0.0023	10
0.150	95	0.0014	8
0.075	81		

Method of Dispersion : Mechanical ; Hydrometer Used : Glass, -5 to 60g/l soil Colloids

Loss after Pretreatment: No Pretreatment

Note: Sample supplied by client.

[redacted]

Date: 23/12/2011

Accredited for compliance with ISO/IEC 17025

ABN: 44 000 964 278
ph: 1300 781 744
fx: (08) 9458 3700

TEST CERTIFICATE

SGS Australia Pty Ltd
PO Box 219 Bentley WA 6982
36 Railway Parade
Welshpool WA 6106

Client:	Knight Piesold Pty Ltd	Client Job No:	PE801-00137
Order No:	PO9307	Project:	Mungari Poject
Tested Date:	22/12/2011	Location:	
SGS Job Number:	11-01-2096	Sample No:	11-MT-12626
Lab:	Welshpool	Sample ID:	White Foil Comp

PLASTICITY INDEX

AS 1289.3.9.2(Single Point Cone Method), 3.2.1(Plastic Limit), 3.3.2(Plasticity Index), 3.4.1(Linear Shrinkage)

AS 1289.3.9.2

AS 1289.3.2.1

Plastic Limit (%)	**NP**

AS 1289.3.3.2

Plasticity Index (%)	**NP**

AS 1289.3.4.1

History of Sample	Oven Dried at <50°C
Method of preparation	Dry Sieved

Note: Sample supplied by client.

[redacted]

Date: 22/12/2011

Accredited for compliance with ISO/IEC 17025

ABN: 44 000 964 278
ph: 1300 781 744
fx: (08) 9458 3700

TEST CERTIFICATE

SGS Australia Pty Ltd
PO Box 219 Bentley WA 6982
36 Railway Parade
Welshpool WA 6106

Client:	Knight Piesold Pty Ltd	Client Job No:	PE801-00137
Order No:	PO9307	Project:	Mungari Poject
Tested Date:	20/12/2011	Location:	
SGS Job Number:	11-01-2096	Sample No:	11-MT-12626
Lab:	Welshpool	Sample ID:	White Foil Comp

FINE PARTICLE DENSITY

AS1289.3.5.1

FINE FRACTION

SOIL APPARENT

PARTICLE DENSITY (g/cc) **2.84**

at temperature 25 º C

Note: Sample supplied by client.

[redacted]

Date: 23/12/2011

Accredited for compliance with ISO/IEC 17025

APPENDIX B

Genalysis Laboratory Testing

ANALYTICAL REPORT

D SAWYER
KNIGHT PIESOLD PTY LIMITED
PO Box 6837
EAST PERTH, W.A. 6892
AUSTRALIA

JOB INFORMATION

JOB CODE	:	752.0/1117465
No. of SAMPLES	:	2
No. of ELEMENTS	:	44
CLIENT O/N	:	P09351 :1/2 (Job 1 of 2)
SAMPLE SUBMISSION No.	:	PE801-00137
PROJECT	:	Mungari Project
STATE	:	Slurry
DATE RECEIVED	:	10/11/2011
DATE COMPLETED	:	29/12/2011
DATE PRINTED	:	29/12/2011
PRIMARY LABORATORY	:	Genalysis Main Laboratory

LEGEND

X	= Less than Detection Limit
N/R	= Sample Not Received
*	= Result Checked
( )	= Result still to come
I/S	= Insufficient Sample for Analysis
E6	= Result X 1,000,000
UA	= Unable to Assay
>	= Value beyond Limit of Method
OV	= Value over-range for Package

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Email: genalysis@intertek.com
Web Page: www.genalysis.com.au

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TOWNSVILLE LABORATORY
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SAMPLE DETAILS

DISCLAIMER

Genalysis Laboratory Services Pty Ltd wishes to make the following disclaimer pertaining to the accompanying analytical results.

Genalysis Laboratory Services Pty Ltd disclaims any liability, legal or otherwise, for any inferences implied from this report relating to either the origin of, or the sampling technique employed in the collection of, the submitted samples.

SIGNIFICANT FIGURES

It is common practice to report data derived from analytical instrumentation to a maximum of two or three significant figures. Some data reported herein may show more figures than this. The reporting of more than two or three figures in no way implies that the third, fourth and subsequent figures may be real or significant.

Genalysis Laboratory Services Pty Ltd accepts no responsibility whatsoever for any interpretation by any party of any data where more than two or three significant figures have been reported.

SAMPLE STORAGE DETAILS

GENERAL CONDITIONS

SAMPLE STORAGE OF SOLIDS

Bulk Residues and Pulps will be stored for 60 DAYS without charge. After this time all Bulk Residues and Pulps will be stored at a rate of $3.30 per cubic metre per day until your written advice regarding collection or disposal is received. Expenses related to the return or disposal of samples will be charged to you at cost. Current disposal cost is charged at $100.00 per cubic metre.

SAMPLE STORAGE OF SOLUTIONS

Samples received as liquids, waters or solutions will be held for 60 DAYS free of charge then disposed of, unless written advice for return or collection is received.

ANALYSIS

ELEMENTS	Ag	Al	ANC	As	B	Ba
UNITS	ppm	ppm	kgH2SO4/t	ppm	ppm	ppm
DETECTION LIMIT	0.01	50	1	0.5	5	0.1
DIGEST	4AB/	4AB/	ANCx/	4AB/	4AB/	4AB/
ANALYTICAL FINISH	MS	OE	VOL	MS	OE	MS
SAMPLE NUMBERS						
0001 Frogs Leg Comp	0.55	7.10%	97	669.6	69	351.5
0002 White Foil Comp	0.50	5.98%	58	82.5	53	500.1
CHECKS						
0001 Frogs Leg Comp	0.57	7.28%	100	665.3	69	353.3
STANDARDS						
0001 0.5%NaCl						
0002 HgSTD-4						
0003 MA-1b						
0004 OREAS 97.01						
0005 PD-1						
0006 STSD-2						
0007 SY-4	0.07	9.99%		1.1	55	321.1
BLANKS						
0001 Control Blank	X	X	-1	X	9	X
0002 Control Blank						
0003 Control Blank						
0004 Control Blank						
0005 Acid Blank	0.03	X		X	X	X
0006 Control Blank						

ANALYSIS

ELEMENTS	Be	Bi	C	Ca	Cd	Cl
UNITS	ppm	ppm	%	ppm	ppm	%
DETECTION LIMIT	0.05	0.01	0.01	50	0.02	0.02
DIGEST	4AB/	4AB/		4AB/	4AB/	CL1/
ANALYTICAL FINISH	MS	MS	/CSA	OE	MS	COL
SAMPLE NUMBERS						
0001 Frogs Leg Comp	0.81	0.31	0.74	4.89%	3.11	9.58
0002 White Foil Comp	1.30	0.24	0.51	3.24%	0.47	9.17
CHECKS						
0001 Frogs Leg Comp	0.95	0.31	0.77	5.00%	3.25	9.74
STANDARDS						
0001 0.5%NaCl						0.32
0002 HgSTD-4						
0003 MA-1b			2.44			
0004 OREAS 97.01						
0005 PD-1						
0006 STSD-2						
0007 SY-4	3.13	0.02		5.64%	0.08	
BLANKS						
0001 Control Blank	X	0.01	X	X	X	X
0002 Control Blank						
0003 Control Blank						
0004 Control Blank						
0005 Acid Blank	X	X		X	X	
0006 Control Blank						

ANALYSIS

ELEMENTS	Co	ColourChange	Cr	Cu	F	Fe
UNITS	ppm	NONE	ppm	ppm	ppm	%
DETECTION LIMIT	0.1	0	5	1	50	0.01
DIGEST	4AB/	ANCx/	4AB/	4AB/	FC7/	4AB/
ANALYTICAL FINISH	MS	QUAL	OE	OE	SIE	OE
SAMPLE NUMBERS						
0001 Frogs Leg Comp	34.6	No	114	106	322	5.95
0002 White Foil Comp	21.7	No	18	19	407	8.45
CHECKS						
0001 Frogs Leg Comp	34.6	No	106	107	287	6.10
STANDARDS						
0001 0.5%NaCl						
0002 HgSTD-4						
0003 MA-1b						
0004 OREAS 97.01						
0005 PD-1						
0006 STSD-2					1071	
0007 SY-4	2.5		X	5		4.41
BLANKS						
0001 Control Blank	0.1	No	X	X	69	X
0002 Control Blank						
0003 Control Blank						
0004 Control Blank						
0005 Acid Blank	X		X	X		X
0006 Control Blank						

ANALYSIS

ELEMENTS	Final-pH	Fizz-Rate	Hg	K	Mg	Mn
UNITS	NONE	NONE	ppm	ppm	ppm	ppm
DETECTION LIMIT	0.1	0	0.01	20	20	1
DIGEST	ANCx/	ANCx/	HG1/	4AB/	4AB/	4AB/
ANALYTICAL FINISH	MTR	QUAL	CV	OE	OE	OE
SAMPLE NUMBERS						
0001 Frogs Leg Comp	1.5	2	0.02	1.77%	2.02%	1181
0002 White Foil Comp	1.4	2	X	1.27%	1.01%	1223
CHECKS						
0001 Frogs Leg Comp	1.5	2	0.02	1.86%	2.10%	1227
STANDARDS						
0001 0.5%NaCl						
0002 HgSTD-4			0.29			
0003 MA-1b						
0004 OREAS 97.01						
0005 PD-1						
0006 STSD-2						
0007 SY-4				1.45%	2850	804
BLANKS						
0001 Control Blank	1.2	0	X	X	X	X
0002 Control Blank			X			
0003 Control Blank						
0004 Control Blank						
0005 Acid Blank				X	X	X
0006 Control Blank						

ANALYSIS

ELEMENTS	Mo	Na	NAG	NAGpH	NAG(4.5)	Ni
UNITS	ppm	ppm	kgH2SO4/t	NONE	kgH2SO4/t	ppm
DETECTION LIMIT	0.1	20	1	0.1	1	1
DIGEST	4AB/	4AB/	NAGx/	NAGx/	NAGx/	4AB/
ANALYTICAL FINISH	MS	OE	VOL	MTR	VOL	OE
SAMPLE NUMBERS						
0001 Frogs Leg Comp	1.1	1.86%	0	8.9	0	68
0002 White Foil Comp	1.6	3.01%	0	9.4	0	11
CHECKS						
0001 Frogs Leg Comp	1.2	1.88%	0	9.0	0	69
STANDARDS						
0001 0.5%NaCl						
0002 HgSTD-4						
0003 MA-1b						
0004 OREAS 97.01						
0005 PD-1						
0006 STSD-2						
0007 SY-4	0.3	5.03%				7
BLANKS						
0001 Control Blank	X	26	0	4.6	0	X
0002 Control Blank						
0003 Control Blank						
0004 Control Blank						
0005 Acid Blank	X	29				X
0006 Control Blank						

ANALYSIS

ELEMENTS	P	Pb	pH Drop	S	S-SO4	Sb
UNITS	ppm	ppm	NONE	%	%	ppm
DETECTION LIMIT	50	0.5	0.1	0.005	0.01	0.05
DIGEST	4AB/	4AB/	ANCx/		S71/	4AB/
ANALYTICAL FINISH	OE	MS	MTR	/CSA	OE	MS
SAMPLE NUMBERS						
0001 Frogs Leg Comp	366	163.4	X	1.800	0.21	3.33
0002 White Foil Comp	1083	28.1	2.9	1.400	0.19	0.84
CHECKS						
0001 Frogs Leg Comp	380	165.2	X	1.900	0.21	3.68
STANDARDS						
0001 0.5%NaCl						
0002 HgSTD-4						
0003 MA-1b				1.130		
0004 OREAS 97.01						
0005 PD-1					4.56	
0006 STSD-2						
0007 SY-4	506	10.9				X
BLANKS						
0001 Control Blank	X	X	X	0.010	X	X
0002 Control Blank						
0003 Control Blank					X	
0004 Control Blank						
0005 Acid Blank	X	X				X
0006 Control Blank					X	

ANALYSIS

ELEMENTS	Se	Sn	Sr	Th	TIC	U
UNITS	ppm	ppm	ppm	ppm	%	ppm
DETECTION LIMIT	0.01	0.1	0.05	0.01	0.01	0.01
DIGEST	SE1/	4AB/	4AB/	4AB/	C72/	4AB/
ANALYTICAL FINISH	MS	MS	MS	MS	CSA	MS
SAMPLE NUMBERS						
0001 Frogs Leg Comp	0.97	1.8	178.90	2.36	0.55	0.65
0002 White Foil Comp	0.21	2.2	192.55	10.07	0.48	2.53
CHECKS						
0001 Frogs Leg Comp	0.86	1.9	184.74	2.36	0.66	0.65
STANDARDS						
0001 0.5%NaCl						
0002 HgSTD-4						
0003 MA-1b						
0004 OREAS 97.01	0.63					
0005 PD-1						
0006 STSD-2						
0007 SY-4		7.5	1206.28	1.28		0.49
BLANKS						
0001 Control Blank	0.01	X	X	X		X
0002 Control Blank						
0003 Control Blank						
0004 Control Blank	X					
0005 Acid Blank		X	0.09	X		X
0006 Control Blank						

ANALYSIS

ELEMENTS	V	Zn
UNITS	ppm	ppm
DETECTION LIMIT	2	1
DIGEST	4AB/	4AB/
ANALYTICAL FINISH	OE	OE
SAMPLE NUMBERS		
0001 Frogs Leg Comp	154	409
0002 White Foil Comp	27	130

CHECKS		
0001 Frogs Leg Comp	155	412

STANDARDS		
0001 0.5%NaCl		
0002 HgSTD-4		
0003 MA-1b		
0004 OREAS 97.01		
0005 PD-1		
0006 STSD-2		
0007 SY-4	6	84

BLANKS		
0001 Control Blank	X	2
0002 Control Blank		
0003 Control Blank		
0004 Control Blank		
0005 Acid Blank	X	2
0006 Control Blank		

METHOD CODE DESCRIPTION

/CSA Genalysis Main Laboratory

Induction Furnace Analysed by Infrared Spectrometry

4AB/MS Genalysis Main Laboratory

Multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids in Teflon Beakers. Analysed by Inductively Coupled Plasma Mass Spectrometry.

4AB/OE Genalysis Main Laboratory

Multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids in Teflon Beakers. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.

ANCx/MTR Genalysis Main Laboratory

Acid Neutralizing Capacity Digestion Procedure. Analysed with Electronic Meter Measurement

ANCx/QUAL Genalysis Main Laboratory

Acid Neutralizing Capacity Digestion Procedure. Analysed by Qualitative Inspection

ANCx/VOL Genalysis Main Laboratory

Acid Neutralizing Capacity Digestion Procedure. Analysed by Volumetric Technique.

C72/CSA Genalysis Main Laboratory

Digestion by hot acid(s) Analysed by Infrared Spectrometry

CL1/COL Genalysis Main Laboratory

Carbonate leach specific for Chlorine. Analysed by UV-Visible Spectrometry.

FC7/SIE Genalysis Main Laboratory

Alkaline fusion (Nickel crucible) specific for Fluorine. Analysed by Specific Ion Electrode.

HG1/CV Genalysis Main Laboratory

Low temperature Perchloric acid digest specific for Mercury. Analysed by Cold Vapour Generation Atomic Absorption Spectrometry.

NAGx/MTR Genalysis Main Laboratory

Net Acid Generation Extraction of samples with H2O2 Analysed with Electronic Meter Measurement

NAGx/VOL Genalysis Main Laboratory

Net Acid Generation Extraction of samples with H2O2 Analysed by Volumetric Technique.

S71/OE Genalysis Main Laboratory

Digestion to eliminate sulphides. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.

SE1/MS Genalysis Main Laboratory

Aqua-Regia digest followed by Precipitation and Concentration. Specific for Selenium. Analysed by Inductively Coupled Pl

ANALYTICAL REPORT

Tim ROWLES
KNIGHT PIESOLD PTY LIMITED
PO Box 6837
EAST PERTH, W.A. 6892
AUSTRALIA

JOB INFORMATION

JOB CODE	:	752.0/1117466
No. of SAMPLES	:	2
No. of ELEMENTS	:	38
CLIENT O/N	:	P09351 :2/2 (Job 2 of 2)
SAMPLE SUBMISSION No.	:	PE801-00137
PROJECT	:	Mungari Project
STATE	:	Solutions
DATE RECEIVED	:	10/11/2011
DATE COMPLETED	:	29/12/2011
DATE PRINTED	:	29/12/2011
PRIMARY LABORATORY	:	Genalysis Main Laboratory

LEGEND

X	= Less than Detection Limit
N/R	= Sample Not Received
*	= Result Checked
( )	= Result still to come
I/S	= Insufficient Sample for Analysis
E6	= Result X 1,000,000
UA	= Unable to Assay
>	= Value beyond Limit of Method
OV	= Value over-range for Package

MAIN OFFICE AND LABORATORY
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SAMPLE DETAILS

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SIGNIFICANT FIGURES

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SAMPLE STORAGE DETAILS

GENERAL CONDITIONS

SAMPLE STORAGE OF SOLIDS

Bulk Residues and Pulps will be stored for 60 DAYS without charge. After this time all Bulk Residues and Pulps will be stored at a rate of $3.30 per cubic metre per day until your written advice regarding collection or disposal is received. Expenses related to the return or disposal of samples will be charged to you at cost. Current disposal cost is charged at $100.00 per cubic metre.

SAMPLE STORAGE OF SOLUTIONS

Samples received as liquids, waters or solutions will be held for 60 DAYS free of charge then disposed of, unless written advice for return or collection is received.

NOTES

1. Please note the samples have an EC reading greater than 200 mS/cm and a correct reading can'be given

ANALYSIS

ELEMENTS	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Cl
UNITS	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
DETECTION LIMIT	0.001	1	0.01	1	0.005	0.01	0.001	1	0.002	5
DIGEST										
ANALYTICAL FINISH	/MS	/OE	/MS	/OE	/MS	/MS	/MS	/OE	/MS	/VOL
SAMPLE NUMBERS										
0001 Frogs Leg Comp	X	X	0.24	X	0.110	X	X	838	X	93705
0002 White Foil Comp	0.004	X	0.21	1	0.168	X	X	892	X	93354
CHECKS										
0001 Frogs Leg Comp	0.001	X	0.23	X	0.105	X	X	852	X	94056
STANDARDS										
0001 Alcoa-High4-MS	0.019		0.10		0.020	0.02	0.019		0.020	
0002 SOLN-001										
BLANKS										
0001 Control Blank	X	2	X	X	X	X	X	X	X	

ANALYSIS

ELEMENTS	CN-Tot	CN-WAD	Co	Cr	Cu	F	Fe-Sol	Hg	K	Mg
UNITS	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
DETECTION LIMIT	0.01	0.01	0.01	1	1	0.1	1	0.01	10	1
DIGEST										
ANALYTICAL FINISH	/COL	/COL	/MS	/OE	/OE	/SIE	/OE	/MS	/OE	/OE
SAMPLE NUMBERS										
0001 Frogs Leg Comp	1.50	1.00	0.08	X	X	X	X	X	317	7612
0002 White Foil Comp	1.60	1.00	0.03	X	X	0.1	X	X	459	7770
CHECKS										
0001 Frogs Leg Comp			0.08	X	X	X	X	X	291	7755
STANDARDS										
0001 Alcoa-High4-MS			1.03					0.02		
0002 SOLN-001						0.9				
BLANKS										
0001 Control Blank			X	X	X	X	X	X	X	1

ANALYSIS

ELEMENTS	Mn	Mo	Na	Ni	P	Pb	pH	S	SO4	Sb
UNITS	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	NONE	mg/l	mg/l	mg/l
DETECTION LIMIT	1	0.005	10	1	10	0.05	0.1	10	30	0.001
DIGEST										
ANALYTICAL FINISH	/OE	/MS	/OE	/OE	/OE	/MS	/MTR	/OE	/CALC	/MS
SAMPLE NUMBERS										
0001 Frogs Leg Comp	3	0.044	48457	X	X	X	7.4	5263	15766	0.044
0002 White Foil Comp	4	0.032	49955	X	X	X	7.1	5248	15722	0.008
CHECKS										
0001 Frogs Leg Comp	3	0.042	50093	X	X	0.06	7.4	5539	16592	0.043
STANDARDS										
0001 Alcoa-High4-MS		0.020				X				0.021
0002 SOLN-001										
BLANKS										
0001 Control Blank	X	X	X	X	X	X		12	37	X

ANALYSIS

ELEMENTS	Se	Sn	Sr	TDSEva	Th	U	V	Zn
UNITS	mg/l	mg/l	mg/l	mg/Kg	mg/l	mg/l	mg/l	mg/l
DETECTION LIMIT	0.05	0.01	0.002	20	0.001	0.001	1	1
DIGEST								
ANALYTICAL FINISH	/MS	/MS	/MS	/GR	/MS	/MS	/OE	/OE
SAMPLE NUMBERS								
0001 Frogs Leg Comp	0.81	X	13.900	164784	X	0.002	X	X
0002 White Foil Comp	0.76	X	13.195	171448	X	0.005	X	X
CHECKS								
0001 Frogs Leg Comp	0.75	X	13.619	162413	X	0.002	X	X
STANDARDS								
0001 Alcoa-High4-MS	0.10	0.02	1.021		0.020	0.020		
0002 SOLN-001								
BLANKS								
0001 Control Blank	X	X	0.004	X	X	X	X	X

METHOD CODE DESCRIPTION

/CALC Genalysis Main Laboratory

No digestion or other pre-treatment undertaken. Results Determined by calculation from other reported data.

/COL Genalysis Main Laboratory

No digestion or other pre-treatment undertaken. Analysed by UV-Visible Spectrometry.

/GR Genalysis Main Laboratory

Analysed by Gravimetric Technique.

/MS Genalysis Main Laboratory

No digestion or other pre-treatment undertaken. Analysed by Inductively Coupled Plasma Mass Spectrometry.

/MTR Genalysis Main Laboratory

No digestion or other pre-treatment undertaken. Analysed with Electronic Meter Measurement

/OE Genalysis Main Laboratory

Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.

/SIE Genalysis Main Laboratory

No digestion or other pre-treatment undertaken. Analysed by Specific Ion Electrode.

/VOL Genalysis Main Laboratory

No digestion or other pre-treatment undertaken. Analysed by Volumetric Technique.

Knight Piésold
CONSULTING

MEMORANDUM

To:	**La Mancha Resources Australia Pty Ltd**	**Date:**	1st September 2015
[redacted]		**Our Ref:**	PE15-00887
		KP File Ref.:	**PE801-00137/10-A dss M15009**
cc:		**From:**	[redacted]

RE: MUNGARI PROJECT – MAY 2015 OPERATING SAMPLE TAILINGS PHYSICAL TESTING

La Mancha Resources has been operating the Mungari Gold Project located 20 km west of Kalgoorlie, Western Australia since 2014. Pilot plant samples of tailings (White Foil and Frog's Leg orebodies) were tested for physical properties as part of the original TSF design in 2011. As part of the annual audit of the TSF, an operating sample was requested to validate some of the design assumptions.

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, consolidation and strength tests were performed. This memo discusses the physical test work of the May 2015 Operating sample as well as a high level comparison with the previous results. Geochemical testing was also conducted but is reported in a separate memorandum.

1. SAMPLE DESCRIPTIONS AND TESTWORK

An operating plant sample (May 2015) was provided (in two 10 L buckets) by La Mancha Resources to the Knight Piésold (KP) laboratory in May 2015. The sample will be referred to as the "Operating Sample" for this memo. The sample arrived at approximately 40% solids (w/w). It was sampled direct from the tailings delivery pipeline at the plant.

The following tests were carried out on the sample received:

i. Classification tests to determine:
   - Particle size distribution of the tailings;
   - Supernatant liquor density;
   - Liquid and plastic limits of the tailings solids; and
   - Tailings solids particle density.

ii. Undrained and drained sedimentation tests;
iii. Air drying tests;
iv. Permeability tests;
v. High strain consolidation tests;
vi. Strength test.

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.

2. PHYSICAL TESTING

The following section discusses the physical testing results for the tailings samples. Predicted tailings behaviour is discussed in Section 3; however, it should be noted that field results are also dependent on the processing plant operation, layout and operation of the actual storage facilities and blending of the different ore types.

2.1 CLASSIFICATION TESTING

Classification testing was completed by Trilab in Perth. Where appropriate, classification tests were conducted in accordance with relevant Australian Standards. The results of the classification tests together with the results from the 2011 Frogs Leg and White Foil samples, and relevant Australian Standards are summarised in Table 2.1. The Trilab laboratory test reports for the Operating Sample are presented in Appendix A.

Table 2.1: Classification testing – results and relevant standards

Test	Operating Sample	Frogs Leg	White Foil	AS1289
Particle Density	2.89	2.82	2.84	3.5.1 (1995)
Supernatant Density	1.12	1.12	1.12	(hydrometer)
Supernatant pH	7.81	7.7	7.8	(pH meter)
Liquid Limit (%)	19	-	-	3.1.2 (1995)
Plastic Limit (%)	15	NP	NP	3.2.1 (1995)
Plasticity Index (%)	4	NP	NP	3.3.1 (1995)

* NP – Non Plastic

The classification tests of three samples are similar with the only difference the low plasticity of operating sample compared to the other two samples which are non plastic. The particle size analysis was completed in accordance with AS1289 3.6.3 - 2003. The measured particle size distribution is presented in Table 2.2 and the grading curve for the Operating Sample compared to the two previous results are shown on Figure 2.1.

Table 2.2: Particle size distribution

Fraction	Particle Size (µm)	Percent Passing (%)		
		Operating Sample	Frogs Leg	White Foil
Sand	600	100	100	100
	200	92	97	97
Silt	75	75	80	81
	20	46	41	40
	6	23	21	19
Clay	2	18	10	9
P_{80}		96	75	75

Using the Unified Soil Classification System (Geotechnical Site Investigations, AS1726-1993), the operating sample would be classified as a SILT with clay/sand (ML). The other two samples would be classified as SILT with sand and a trace of clay (ML). Both the Frog Legs and White Foil P_{80} size are around 75µm, whereas the Operating Sample P_{80} is around 96µm. Otherwise, all three samples are considered relatively similar but with the operating sample having slightly higher clay content.

2.2 SEDIMENTATION TESTS

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 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 2.2 and 2.3. Table 2.3 presents a summary of the measured sedimentation data.

Table 2.3: 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
Operating Sample	Undrained	42	54	-	1	1.09	1.65	2.2
	Drained	42	38	27	1	1.31	1.20	2.3
Frogs Leg	Undrained	44	56	-	1	1.18	1.39	-
	Drained	47	43	24	1	1.45	0.88	
White Foil	Undrained	45	57	-	1	1.21	1.33	-
	Drained	45	38	28	1	1.40	1.02	

The test indicate the Operating Sample settles rapidly, similar to the original testwork, although to a slightly lower final dry density. The sample released approximately 54% of the water in slurry to supernatant for the undrained case, reducing to 38% supernatant release for the drained case. There is an approximately 20% increase in the settled density with the inclusion of underdrainage. The settled densities achieved are moderate, with a resulting void ratio of approximately 1.2 to 1.6.

2.3 AIR DRYING TESTS

Air drying tests were carried out on slurry samples to determine the effect of air drying on 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.

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 tests are presented in figures 2.4 and 2.5 and are summarised in Table 2.4.

Table 2.4: Results of air drying tests

Sample	Moisture Content at Breakaway Point (%MC)	Dry Density at Breakaway Point (t/m^3)	Limiting Saturation Value (%Sat)	Final Dry Density (t/m^3)
Operating Sample	55	1.23	95	1.25
Frogs Leg	40	1.45	90	1.55
White Foil	40	1.50	80	1.55

The Operating Sample achieved a low final dry density, relative to the previous tailings samples, of around 1.25 t/m^3. This occurred over a short drying time of approximately 5 days at an evaporation rate of 5 mm/day. When the results of the Operating Sample are compared against those of the earlier testwork (Figures 2.4), it can be seen that the initial drying characteristics were similar. However shrinkage and loss of moisture stopped much earlier in the Operating Sample due to the formation of a significant salt layer which slowed down the rate of evaporation from the sample. It took a number of weeks to reduce the moisture content down to 45%. The air drying tests increased the final dry density by 14% when compared to the drained sedimentation test, however the test also resulted in a lower density than the drained test which is not typical tailings behaviour.

In situ measurements from the TSF have been reviewed. An assessment of density determined that the in situ dry density is of the order 1.5 t/m^3 (ref. KP Memo PE15-00353). A comparison of moisture contents obtained from the operating beach by LMR indicated lower moisture contents within the tailings mass than those measured in the laboratory. Moisture contents of around 32% were obtained from samples taken directly from the TSF beach.

Considering the available data in its entirety, it is assessed that the final dry density of tailings at the Mungari TSF will be of the order 1.5 t/m^3. Evaporation from the recently-tested Operating Sample was inhibited by the formation of a thick salt crust which prevented sufficient moisture loss in the laboratory when compared to field conditions. On site, there is progressive removal of the salt layer on the surface of the tailings by wind, rain and/or cyclic deposition which allows additional evaporation when compared to laboratory testing.

In future tailings testwork, it would be beneficial to run a drained air drying test (where water in slurry is allowed to drain from the base of the sample) which may reflect site conditions more closely by removing the saline water from the sample.

2.4 CONSOLIDATION TESTS

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. 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 2.6 and the results of the consolidation tests are summarised in Table 2.5.

Table 2.5: Consolidation test results

Sample	Dry Density (t/m^3)	Stress Range (kPa)	Coeff. of Consolidation C_V (m^2/y)	Coeff.of Volume Decrease M_V (m^2/kN)	Comp. Index C_C
Operating Sample	1.10 - 1.24	1.39 - 4.74	55	0.03	0.56
Frogs Leg	1.28 – 1.40	1.55 – 4.95	110	0.02	0.37
White Foil	1.17 – 1.30	1.33 – 4.55	56	0.03	0.44

Results indicate that the sample has reasonably high compressibility and will consolidate moderately quickly. The results are similar to the previous test work.

2.5 PERMEABILITY TESTS

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. Results are summarised in Table 2.6 and also presented in Figure 2.6.

Table 2.6: Permeability test results

Sample	Test Type	Dry Density (t/m^3)	Permeability (m/s)
Operating Sample May 2015	Falling Head	1.31	3.6×10^{-7}
	Consolidation Test	1.12	1.3×10^{-7}
		1.18	1.1×10^{-7}
		1.24	4.0×10^{-7}
Frogs Leg	Falling Head	1.5	4.0×10^{-7}
	Consolidation Test	1.31	5.3×10^{-6}
		1.36	1.0×10^{-6}
		1.4	4.0×10^{-7}
White Foil	Falling Head	1.41	7.5×10^{-7}
	Consolidation Test	1.19	5.5×10^{-5}
		1.25	7.9×10^{-7}
		1.3	3.7×10^{-7}

These results represent the permeability of saturated tailings prior to additional consolidation due to additional deposition loading or air-drying. In the range of expected settled densities, the permeability of the Operating tailings is similar to those of the 2 previous tailings samples at approximately 4×10^{-7} m/s.

2.6 STRENGTH TESTS

Preliminary undrained shear strength testing was undertaken on the Operating Sample to determine the relationship between undrained shear strength, saturation, and moisture

content of the tailings. The test is designed to determine the effect of air drying on the undrained shear strength of the tailings solids, after initial settling.

The sample of the tailings slurry was allowed to settle with supernatant water removed then air dried on the bench before the test commenced. The unconfined compressive strength of the tailings was measured over the following several days as the tailings dried further and began to gain strength. A dial pocket penetrometer with varying size footings was utilised to determine the undrained shear strength of the tailings during desiccation.

The results of the undrained strength testing from various containers (same sample) is presented in Figure 2.7 and summarised in Table 2.7.

Table 2.7: Observed increase in strength

Moisture Content (%)	Nominal strength (kPa)
47	1
45	5
43	30
41	70
38	100
35	200+

Although the testwork is not suitable to determine strength parameters for stability modelling, it indicates that the tailings surface may be trafficable by foot by the time the moisture content drops below 43%. This correlates with site experience where the beach moisture content is around 33% and is trafficable by light equipment. In situ testing should be conducted during the design phase (to determine detailed strength, liquefaction and pore pressure parameters) for any upstream construction proposed.

3. SUMMARY

An Operating Tailings Sample from Mungari Gold Mine has undergone laboratory testwork to determine physical characteristics. The results overall indicate that the Operating Sample is similar to the previously tested White Foil and Frog's Leg orebody samples and no significant variations to the design parameters were identified.

A lower than expected air drying density (compared to previous testwork and measurements on site) was attributed to the build-up of a salt crust which inhibited drying. Drained air drying tests are recommended for future testing to overcome issues with the salt build-up.

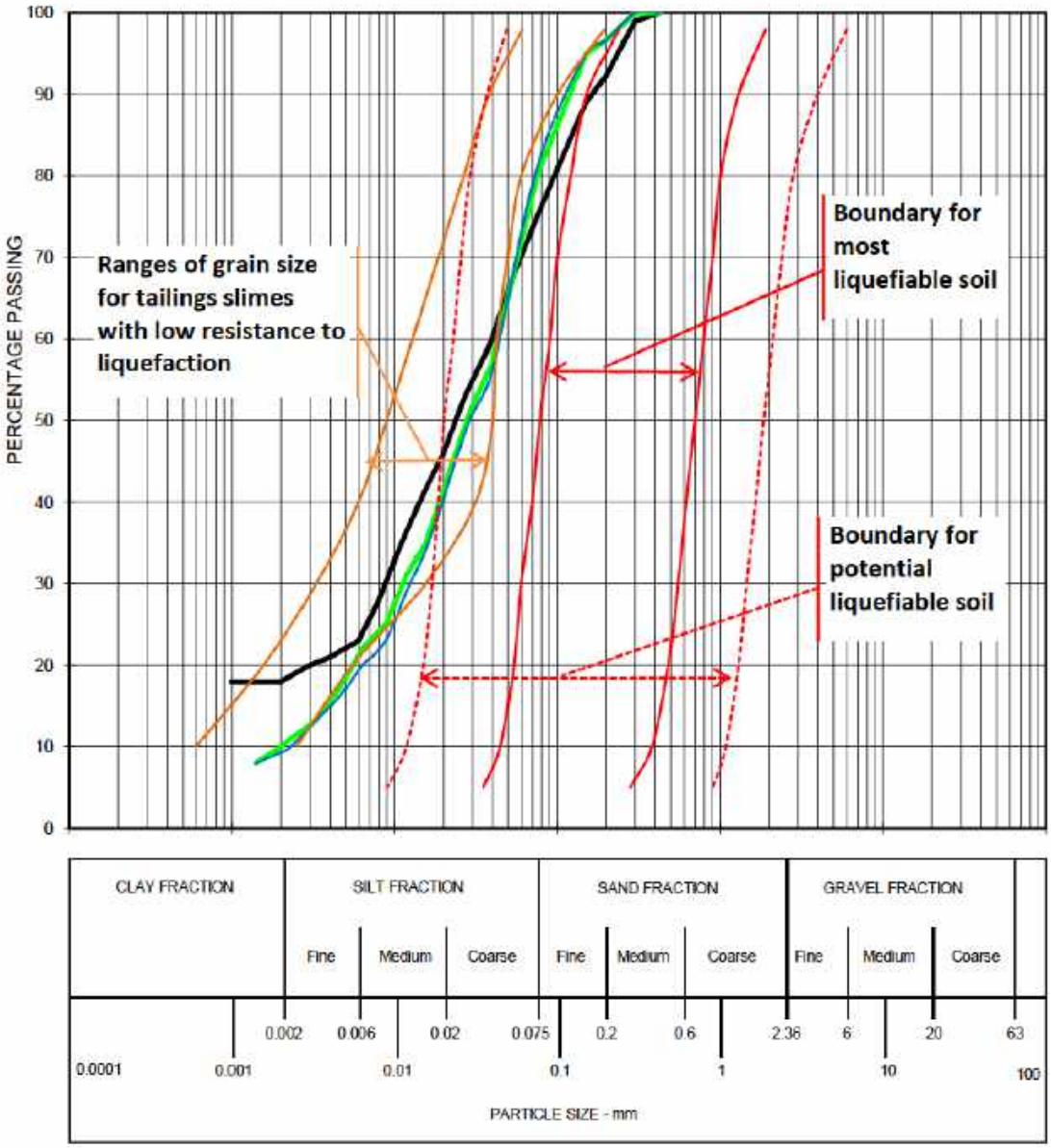
The anticipated physical properties of the tailings remain largely unchanged from earlier assessments and are provided here for reference:

Table 3.1: Tailings design parameters

Parameter	Value
Maximum Air Dried Density	1.50 t/m^3
P_{80}	95 µm
Solids Content	42-45%
Supernatant Release	30-35%
Underdrainage Release	5-10%
Vertical Permeability	5x10^{-7} m/s
Horizontal Permeability	5x10^{-6} m/s
Coeff. Of Consolidation (c_v)	80 m^2/yr
Coeff. Of Volume Decrease (m_v)	0.025 m^2/kN
Compression Index (c_c)	0.5

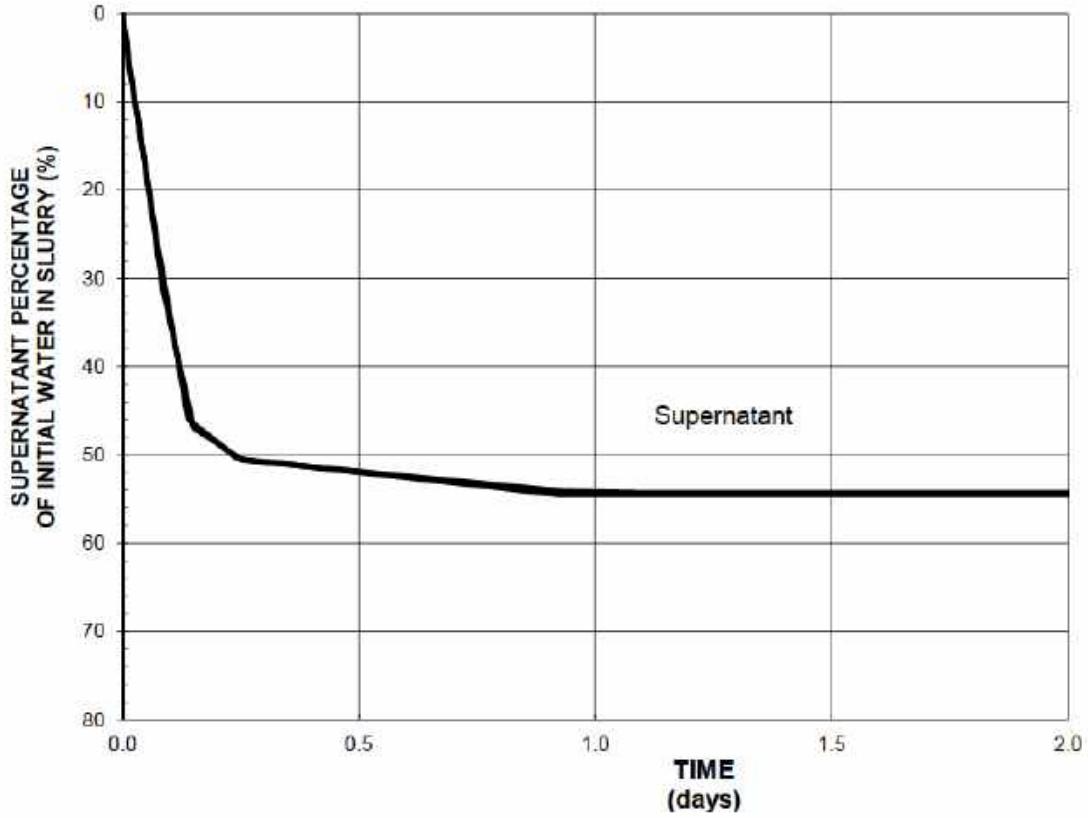
FIGURES

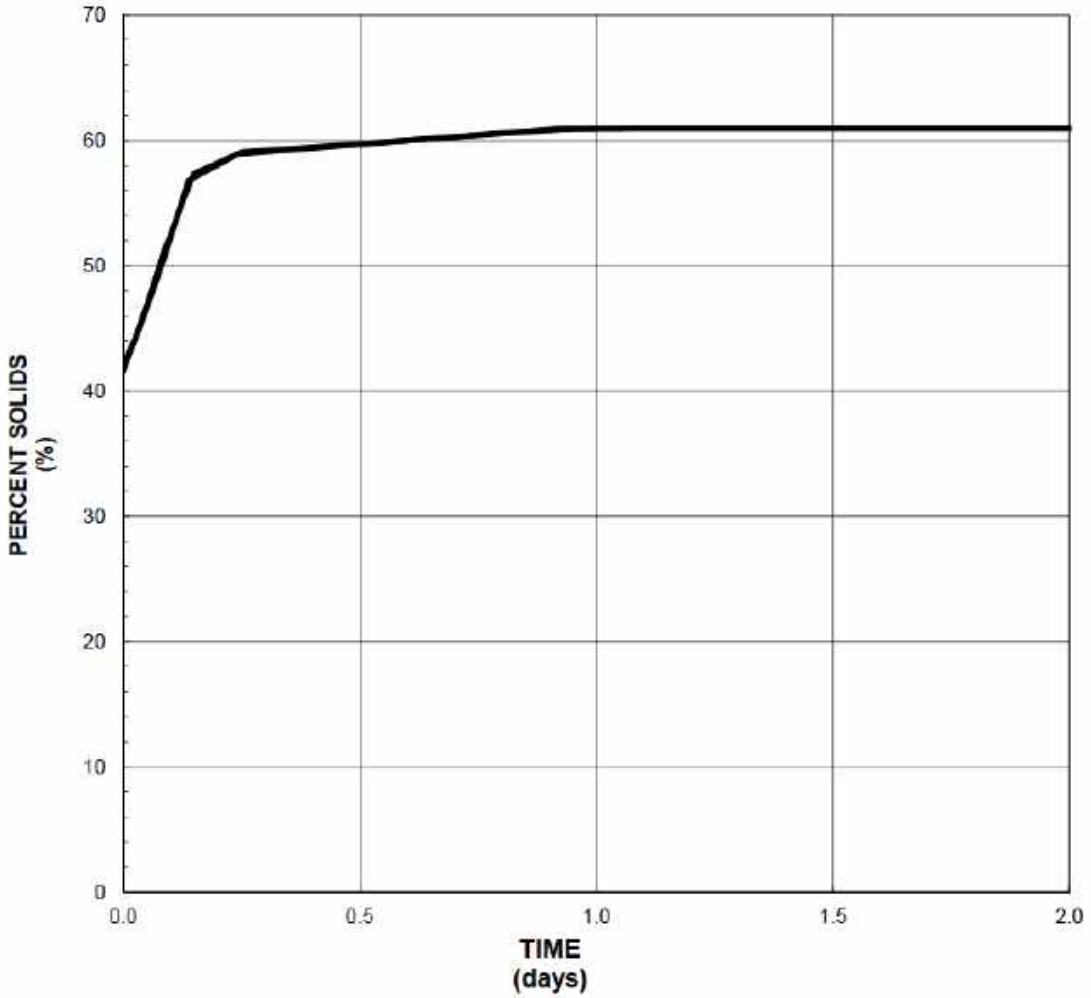
PARTICLE SIZE DISTRIBUTION

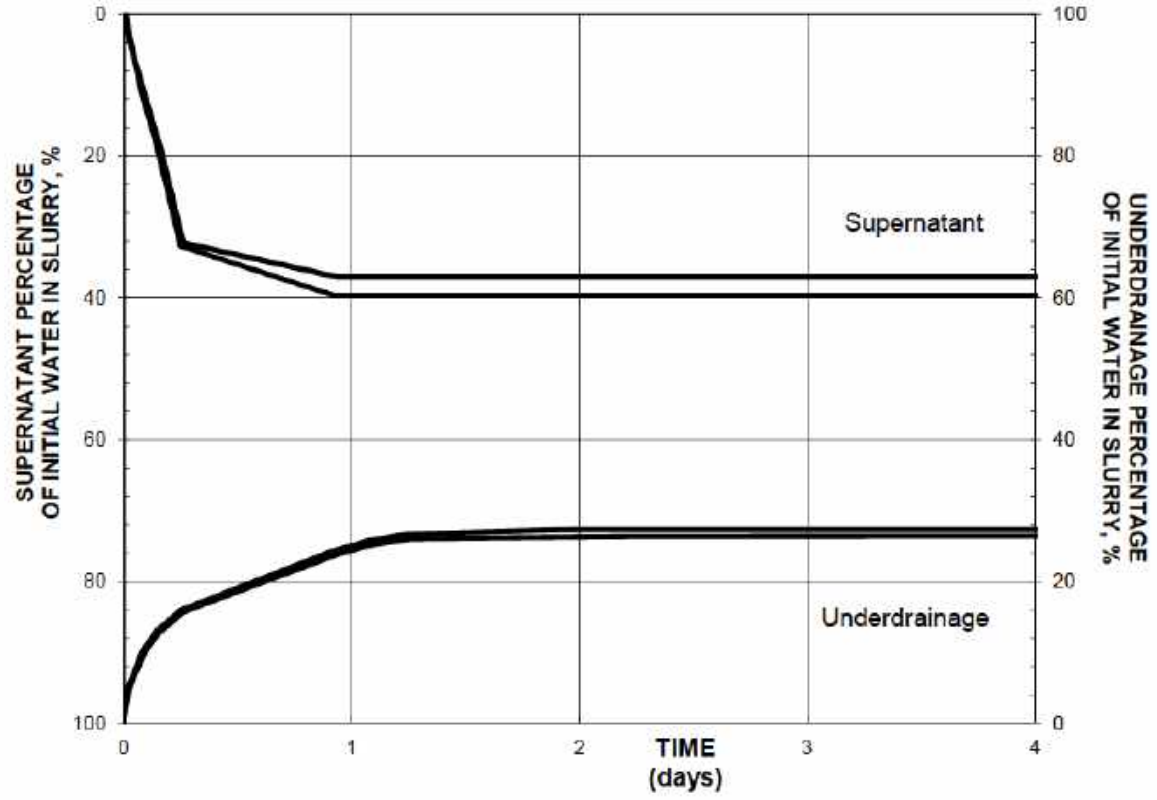


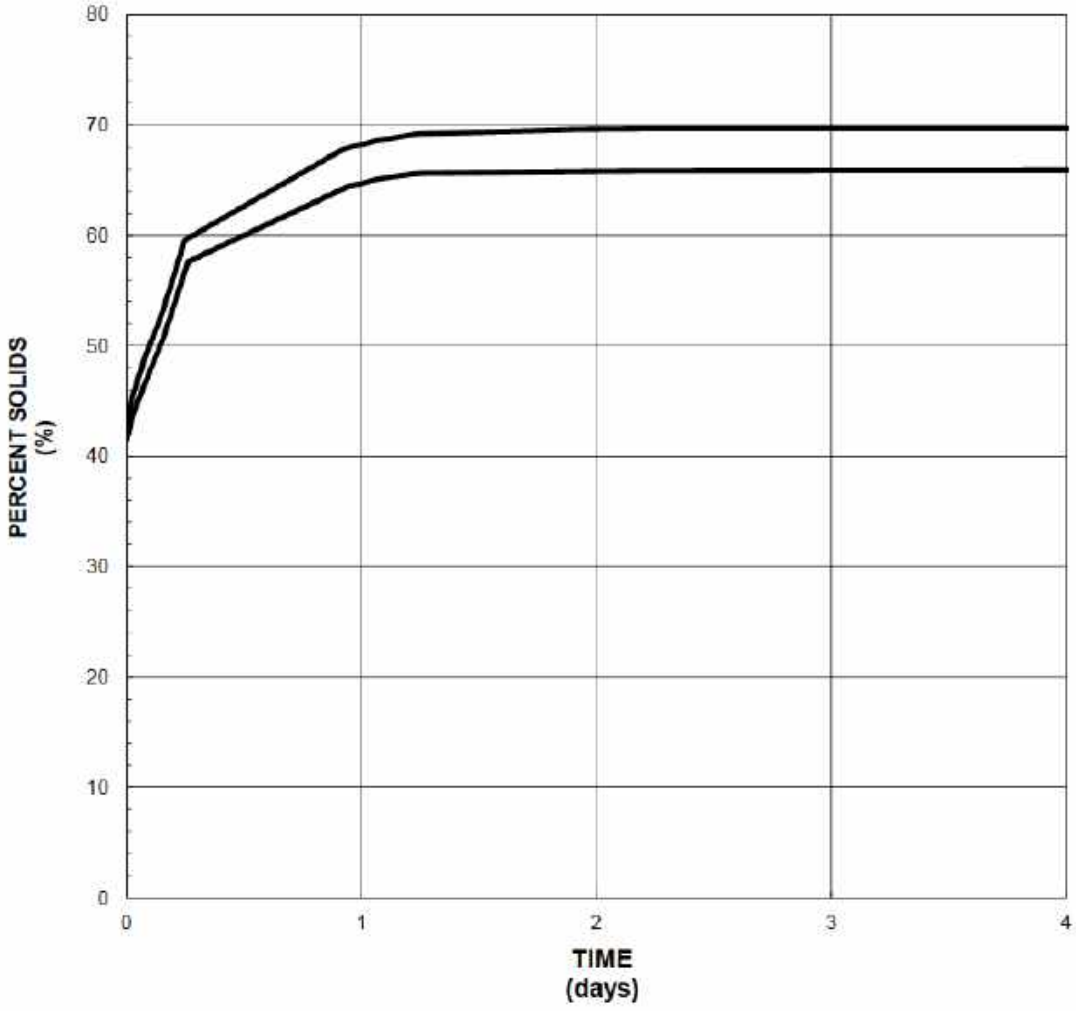
SYMBOL	SOIL DESCRIPTION	LIQUID LIMIT	PLASTICITY INDEX	SPECIFIC GRAVITY
	Operating Sample May 2015	19	4	2.89
	Frogs Legs	NP	NP	2.82
	White Foil	NP	NP	2.84

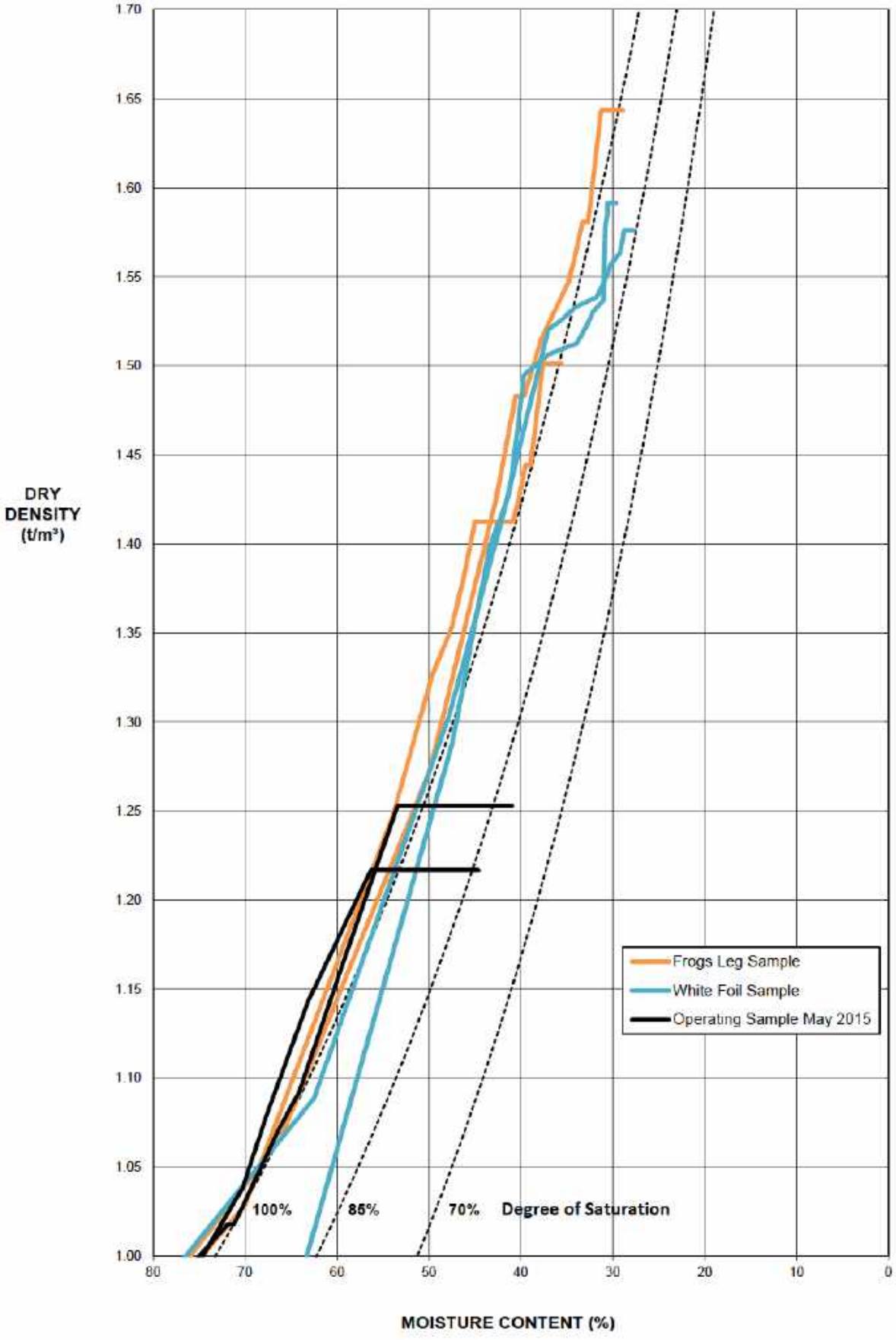
Note:
Liquefiable and potentially liquefiable soil limits suggested by USNRC 1985.
Data obtained from Figure 12.15 and 12.16 of Geotechnical Engineering of Dams, Fell 2005

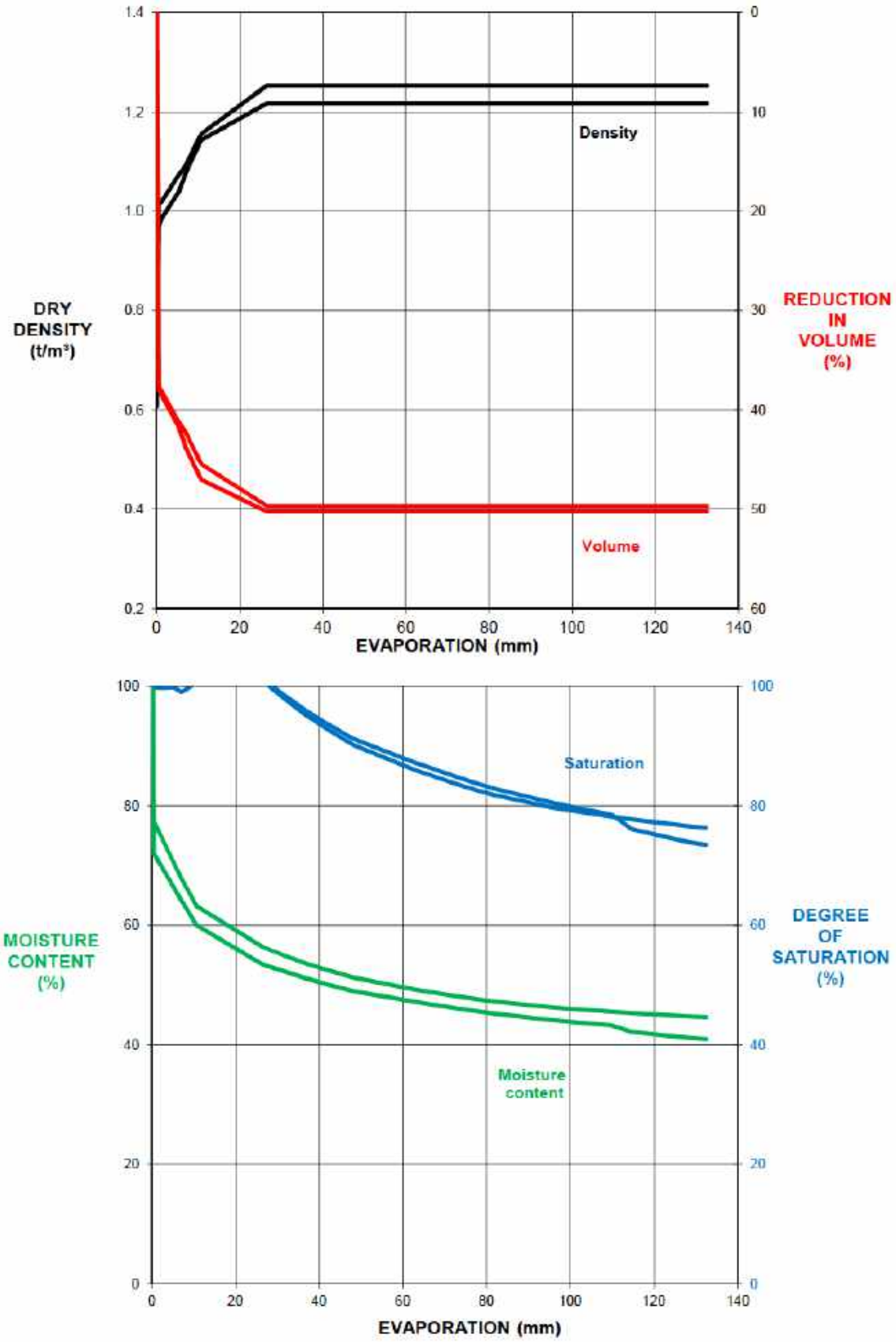

SUPERNATANT PERCENTAGE OF INITIAL WATER IN SLURRY (%)
0
10
20
30
40
50
60
70
80
Supernatant
0.0
0.5
1.0
1.5
2.0
TIME
(days)

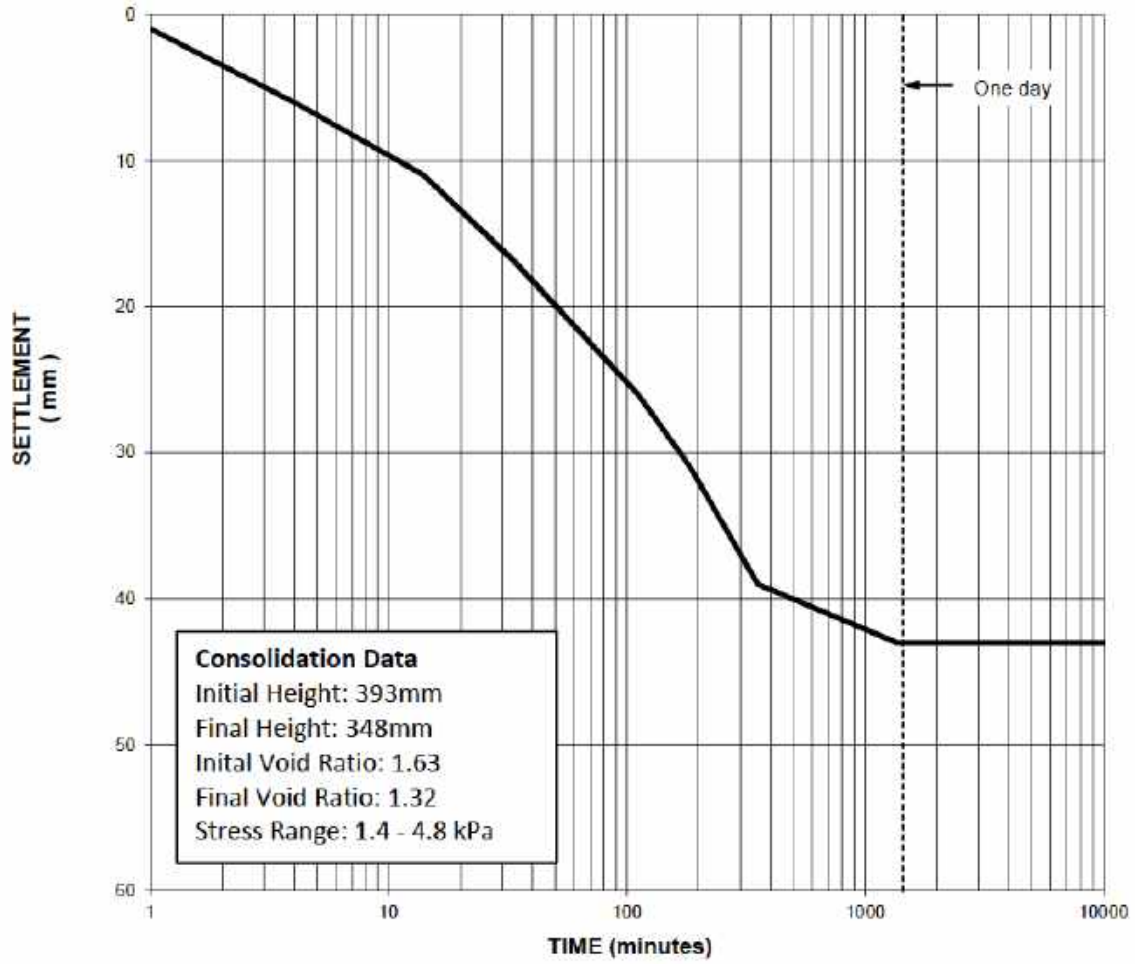

PERCENT SOLIDS (%)
70
60
50
40
30
20
10
0
0.0
0.5
1.0
1.5
2.0
TIME
(days)

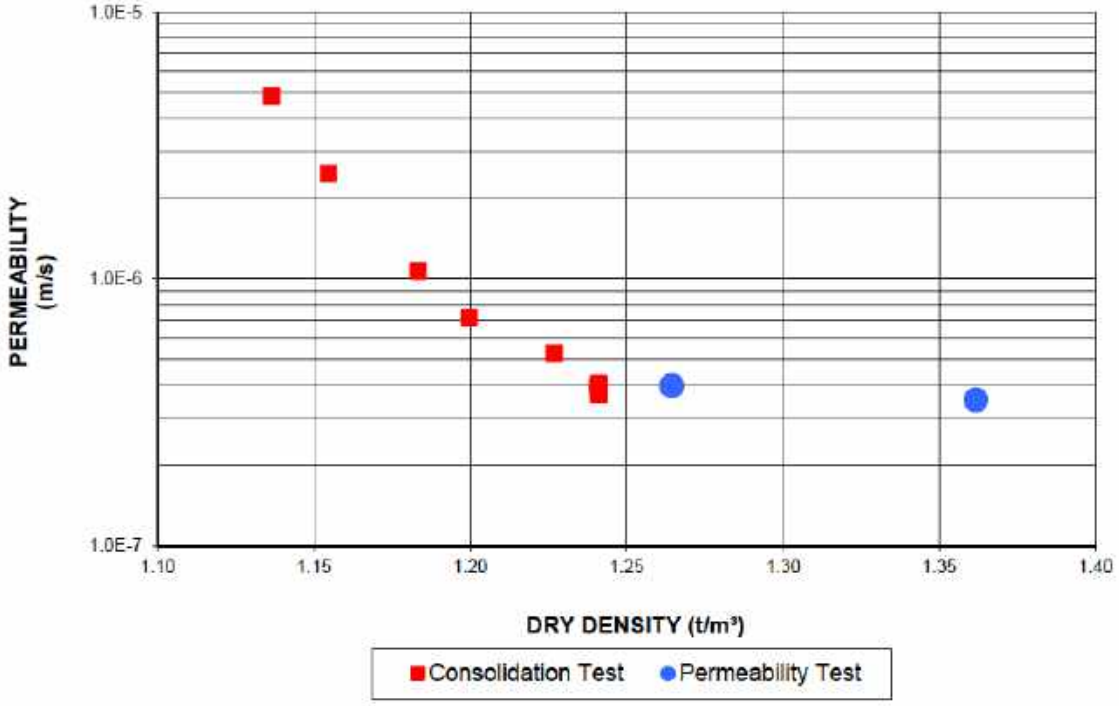

SUPERNATANT PERCENTAGE OF INITIAL WATER IN SLURRY, %
UNDERDRAINAGE PERCENTAGE OF INITIAL WATER IN SLURRY, %
Supernatant
Underdrainage
TIME (days)
0
20
40
60
80
100
0
1
2
3
4

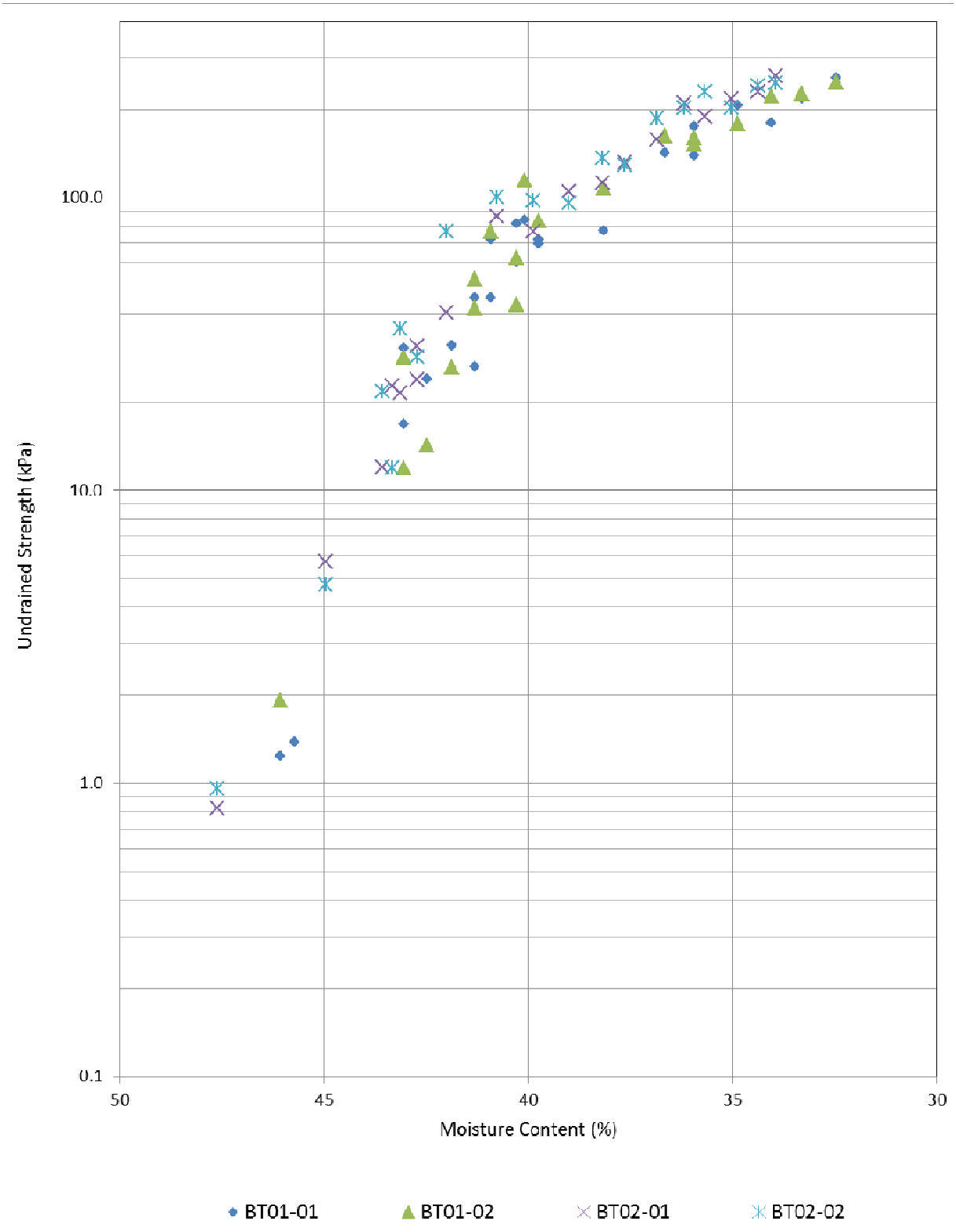

PERCENT SOLIDS (%)
TIME (days)
0
10
20
30
40
50
60
70
80
0
1
2
3
4


DRY DENSITY (t/m³)
1.70
1.65
1.60
1.55
1.50
1.45
1.40
1.35
1.30
1.25
1.20
1.15
1.10
1.05
1.00
80
70
60
50
40
30
20
10
0
MOISTURE CONTENT (%)
100%
85%
70%
Degree of Saturation
Frogs Leg Sample
White Foil Sample
Operating Sample May 2015


DRY DENSITY (t/m³)
REDUCTION IN VOLUME (%)
Density
Volume
EVAPORATION (mm)
MOISTURE CONTENT (%)
DEGREE OF SATURATION (%)
Saturation
Moisture content
EVAPORATION (mm)


SETTLEMENT (mm)
0
10
20
30
40
50
60
One day
Consolidation Data
Initial Height: 393mm
Final Height: 348mm
Inital Void Ratio: 1.63
Final Void Ratio: 1.32
Stress Range: 1.4 - 4.8 kPa
1
10
100
1000
10000
TIME (minutes)


PERMEABILITY (m/s)
1.0E-5
1.0E-6
1.0E-7
1.10
1.15
1.20
1.25
1.30
1.35
1.40
DRY DENSITY (t/m³)
Consolidation Test
Permeability Test


Undrained Strength (kPa)
100.0
10.0
1.0
0.1
50
45
40
35
30
Moisture Content (%)
BT01-01
BT01-02
BT02-01
BT02-02

APPENDIX A

Trilab Laboratory Testing

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

Test Method: AS 1289 2.1.1, 3.9.1, 3.2.1, 3.3.1, 3.4.1

Client	Knight Piesold Pty Ltd	**Report No.**	15060743-AL
Project	Hope Downs 4, Mahenge, Mungari	**Test Date**	19/6/15-20/6/15
		Report Date	22/06/2015

Sample No.	15060743	15060744	-	-	-	-
Client ID	Mahenge Tailings Sample	Mungari Operating Sample May 2015	-	-	-	-
Depth (m)	Not Supplied	~53% MC	-	-	-	-
Liquid Limit (%)	29	19	-	-	-	-
Plastic Limit (%)	21	15	-	-	-	-
Plasticity Index (%)	8	4	-	-	-	-
Linear Shrinkage (%)	1.0	0.5	-	-	-	-
Moisture Content (%)	70.0	85.4	-	-	-	-

NOTES/REMARKS: The samples were tested oven dried, dry sieved and in a 125-250mm mould.

Sample/s supplied by the client * Cracking occurred + Curling occurred

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
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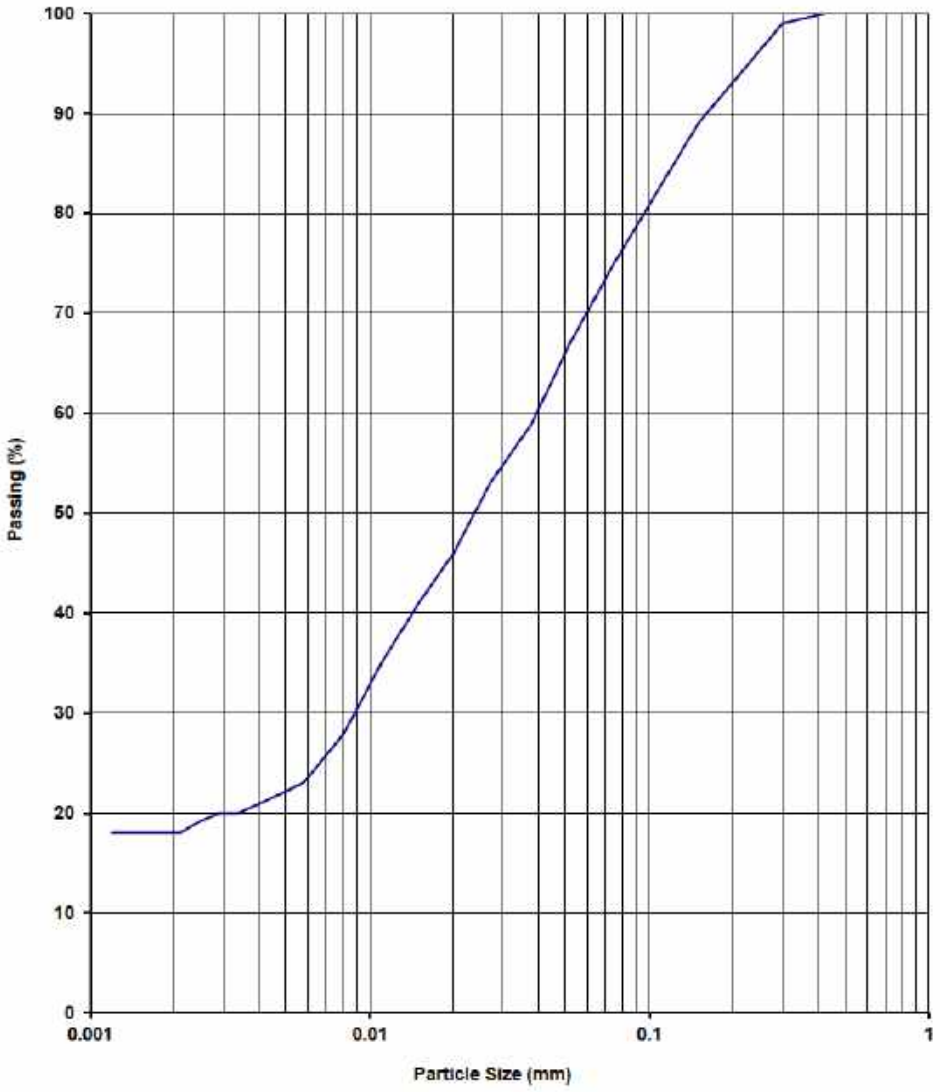
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.3, 3.5.1

Client	Knight Piesold Pty Ltd	**Report No.**	P 15060008-G
Project	Hope Downs 4, Mahenge, Mungari	**Test Date**	16/06/2015-19/06/2015
		Report Date	19/06/2015
Client ID	Mungari Operating Sample May 2015	**Depth (m)**	~53% MC

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	100
0.300	99
0.150	89
0.075	75
0.052	67
0.038	59
0.027	53
0.02	46
0.015	41
0.011	35
0.008	28
0.006	23
0.004	21
0.003	20
0.003	20
0.002	19
0.002	18
0.001	18



NOTES/REMARKS:

Moisture Content 85.4% -2.36mm Soil Particle Density(t/m^3) 2.89

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Perth Laboratory

[redacted]

NATA
TECHNICAL COMPETENCE

Laboratory No. 9926

Knight Piésold
CONSULTING

MEMORANDUM

To:	**Evolution Mining Ltd**	**Date:**	12th October 2015
[redacted]	[redacted]	**Our Ref:**	PE15-01016
		KP File Ref.:	**PE801-00137/10-A dss M15011**
cc:		**From:**	[redacted]

RE: MUNGARI PROJECT – MAY 2015 OPERATING SAMPLE TAILINGS GEOCHEMICAL CHARACTERISATION

1. INTRODUCTION

Evolution Mining Ltd has been operating the Mungari Gold Project located 20 km west of Kalgoorlie, Western Australia since 2014. Pilot plant samples of tailings (White Foil and Frog's Leg orebodies) were tested for geochemical properties as part of the original TSF design in 2011. As part of the annual audit of the TSF, an operating sample was requested to validate some of the design assumptions.

An operating plant sample was provided by La Mancha Resources to the Knight Piésold (KP) laboratory in May 2015. The sample is referred to as the "Operating Sample" for this memo. The sample arrived at approximately 40% solids (w/w). It was sampled direct from the tailings delivery pipeline at the plant and dosed with potassium permanganate prior to shipping to prevent leaching.

The Mungari Mill processes a blend of ore from both White Foil and Frog's Leg Mines. The ratios of each vary on a daily basis. The Operating Sample is therefore a mix of material from both ore bodies.

This memorandum provides details of the tailings geochemical testwork conducted on the Operating Sample. Physical tailings behaviour characteristics testwork is reported separately.

2. GEOCHEMISTRY TESTWORK

2.1 ACID BASE ACCOUNTING

Acid base accounting (ABA) assesses the sample's potential to form acid from oxidation of sulfides and the ability to neutralise acid by the dissolution of minerals, especially carbonates, contained in the sample.

The ABA test work was conducted by Genalysis, Perth. Total sulfur, total carbon and total inorganic carbon were determined by LECO induction furnace, with infrared detection. Sulfate sulfur was determined by 10% Na_2CO_3 extraction, with $BaSO_4$ precipitation. The test work methods used are based on the ABA methodology defined in the Mine Environment Neutral Drainage (MEND) Acid Rock Drainage Prediction Manual (Ref. 1) and Guidelines for Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia (Ref. 2).

Acid Neutralising Capacity (ANC) was determined by digestion in a standard solution of HCl, followed by back titration with NaOH to determine the amount of acid consumed. The technique used was based on Sobek *et al.* (Ref. 3).

The results of the ABA test work are used to calculate the Maximum Potential Acidity (MPA) which is a measure of the maximum amount of sulfuric acid which can be produced from the total oxidation of all sulfides within the sample, assuming all sulfide is present as pyrite.

2.2 STATIC NET ACID GENERATION

Static Net Acid Generation (NAG) test work is a direct measure of the sample's ability to produce acid through sulfide oxidation. The addition of hydrogen peroxide to samples causes rapid oxidation of the contained sulfides to produce sulfuric acid.

NAG test work was conducted by Genalysis. The procedure employed is based upon the Static NAG Test (Ref. 4 and 5). Fifteen percent hydrogen peroxide solution was adjusted to pH 4.5 before addition to the samples. The samples were then left to stand overnight at room temperature before pH measurement. The samples are then boiled for 2 to 3 hours and allowed to cool before being made back up to 250 mL followed by pH measurement and titration to pH 7.0.

2.3 ACID FORMATION POTENTIAL

The acid formation potential of a sample is calculated based on the acid base accounting, i.e. the balance between a sample's ability to produce acid from the oxidisation of sulfide minerals (Maximum Potential Acidity, MPA) and the sample's ability to neutralise acid by the dissolution of alkaline minerals contained within the sample (Acid Neutralising Capacity, ANC). The balance between the MPA and the ANC is termed the Net Acid Producing Potential (NAPP), where a negative NAPP indicates an excess of acid neutralising capacity and the positive NAPP indicates an excess potential acidity.

Historically a safety margin was applied to ratio between the ANC and MPA to allow for variability in the rates of acid production and neutralisation processes and the potential for geographic separation of the acid producing and acid neutralising phases. This safety margin was generally set by industry at 2 in North America and 3 in Australia.

With recent advances in the understanding and acceptance of the NAG test there has been a move away from this method of classifying materials based solely on the ANC and MPA as these calculated parameters do not take into consideration the true availability of acid producing and acid neutralising phases.

Knight Piésold prefers to utilise the results of the Acid Base Accounting in combination with the NAG testing results to classify the acid formation potential of materials. Knight Piésold's classification system is given in Table 2.1 and is based on the Australian Government's Guidelines on Managing Acidic and Metalliferous Drainage (Ref. 6) and is broadly similar to the classification system contained within the AMIRA ARD Test Handbook (Ref. 7), which is advocated by the Global Acid Rock Drainage Guidelines (Ref. 8).

Table 2.1: Acid Formation Potential Classification System

Acid Formation Potential Class	NAPP (kg H_2SO_4 /t)	NAG pH
Potentially Acid Forming (PAF)	>10	<4.5
Potentially Acid Forming – Low Capacity (PAF-LC)	0 to 10	<4.5
Non Acid Forming (NAF)	Negative	≥4.5
Acid Consuming (AC)	Less than -100	≥4.5
Uncertain (UC)	Positive	≥4.5
	Negative	<4.5

2.4 MULTI-ELEMENT ANALYSIS

Multi-element analysis of the samples was conducted to assess elemental enrichments within the samples. The testing was conducted by Genalysis in Perth. The acid digestion method employed results in near total digestion of the samples to assess the geochemistry of the samples.

Multi-element analysis results were compared to the average crustal abundance to give the geochemical abundance indices. The Geochemical Abundance Index (GAI) quantifies an assay result for a particular element in terms of average crustal abundance. The GAI is calculated from the following formula:

$$\mathbf{GAI = Log_2 (C_n / (1.5 \times B_n))}$$

Where:

Cn = measured concentration of element in sample

Bn = average crustal abundance (Bowen, (Ref. 9))

The GAI is expressed on a scale of 0 to 6, with 0 indicating the concentration of the element is less than or similar to average crustal abundance. A GAI of 3 corresponds to a 12 fold increase above the average crustal abundance, and so forth up to a GAI of 6 which represents a 96 fold increase or greater.

Knight Piésold has assigned an arbitrary scale to the GAI with indices of 0 and 1 being unenriched, indices of 2 being classified as slightly enriched, indices of 3 and 4 being classed as significantly enriched and indices of 5 and 6 being classified as highly enriched.

2.5 SUPERNATANT WATER QUALITY

Characterisation of the tailings supernatant was conducted to assess the potential for the supernatant to cause environmental impacts to surface water or near surface groundwater. These tests differ from the multi-element tests in that they only record the readily soluble elements whereas the multi-element tests give the total elemental enrichment of the tailings solids.

The supernatant characterisation was conducted at Genalysis Laboratories in Perth. A sample of slurry was sent to the laboratory. The pH and the conductivity of the slurry were measured and the bottles left to stand for a minimum of 3 hours. The supernatant was siphoned off and filtered through 0.45 µm membrane before preservation of the solution by acid addition prior to analysis. The analysis was by Inductively Coupled Plasma Mass Spectrometry or Inductively Coupled Plasma Optical Emission Spectrometry depending on the element being analysed and the detection limits required.

The supernatant water quality test results were compared to a set of reference water quality standards, which are detailed in the following section.

2.6 REFERENCE WATER QUALITY STANDARDS

To allow assessment of the results of the supernatant analysis a set of reference values has been established. These reference values were compiled from internationally accepted guidelines for water quality for release from mining operations (IFC environmental, health and safety guidelines (Ref. 10 & 11) and the ANZECC water quality guideline for livestock drinking water (Ref. 12). The use of several guidelines is required as no single guideline contains target concentrations for all parameters. Where a target concentration for a specific element is at different levels in more than one guideline the lowest concentration has been adopted. These reference values are given in Table 2.2. In addition, because the local groundwater is hypersaline, a comparison with the existing groundwater concentrations was made.

The establishment of these reference water quality values is to allow for evaluation only and it is not implied by inclusion of these that the Mungari project will be required to meet these reference levels or that these reference levels should be used as the regulatory framework.

Table 2.2: Reference Release Water Quality Standards

Parameter	Unit	ANZECC Livestock	IFC 2004	IFC 2007	Adopted Reference Level	Local Groundwater*
pH	S.U.		6 to 9	6 to 9	6 to 9	6.97
TDS	mg/kg	2000			2000	192650
Aluminum	mg/L	5			5	0.19
Antimony	mg/L				N/G	N/D
Arsenic	mg/L	0.5	0.1	0.1	0.1	0.025
Barium	mg/L				N/G	N/D
Boron	mg/L	5			5	N/D
Cadmium	mg/L	0.01	0.1	0.05	0.01	0.006
Calcium	mg/L	1000			1000	826
Chloride	mg/L				N/G	99500
Chromium	mg/L	1			1	0.022
Cobalt	mg/L	1			1	0.018
Copper	mg/L	0.4	0.5	0.3	0.3	0.035
Cyanide-Total	mg/L			1	1	N/D
Cyanide-Free	mg/L			0.1	0.1	N/D
Cyanide-WAD	mg/L		0.5	0.5	0.5	N/D
Fluoride	mg/L	2	20		2	N/D
Iron	mg/L		3.5	2	2	1.61
Lead	mg/L	0.1	0.1	0.2	0.1	0.052
Magnesium	mg/L	2000			2000	8300
Manganese	mg/L				N/G	0.97
Mercury	mg/L	0.002	0.01	0.002	0.002	N/D
Molybdenum	mg/L	0.15			0.15	N/D
Nickel	mg/L	1	0.5	0.5	0.5	0.014
Phosphorus	mg/L				N/G	N/D
Selenium	mg/L	0.02	0.1		0.02	0.019
Silver	mg/L		0.5		0.5	N/D
Sodium	mg/L				N/G	56400
Sulfate	mg/L	1000			1000	17200
Tin	mg/L				N/G	N/D
Uranium	mg/L	0.2			0.2	N/D
Vanadium	mg/L				N/G	N/D
Zinc	mg/L	20	2	0.5	0.5	0.17

N/G – No guideline.
N/D – Element not determined in the groundwater testing.
*Groundwater sample from White Foil pit sump (average concentration from January 2010 to August 2011).

3. GEOCHEMICAL CHARACTERISTICS

3.1 GENERAL

Laboratory test certificates for all the tailings analytical testing conducted by Genalysis on the Operating Sample are provided in Appendix A, with the results presented and discussed in the following sections.

It is noted that the results of the tests on the Operating Sample are the average values of initial and duplicate tests. These are compared against the earlier Frog's Leg and White Foil test results. Full details of the earlier testwork are presented in KP Memorandum PE13-00546.

3.2 TAILINGS ACID BASE ACCOUNTING

The total sulfur content of the tailings was determined by Leco combustion. In addition, the samples were analysed for Na_2CO_3 soluble sulfate. The difference between these two values was assumed to be equal to the sulfide content of the samples. The results of the analysis are given in Table 3.1.

Table 3.1: Tailings Sulfur Analysis Results

Sample	Total Sulfur (%)	Sulfate Sulfur (%)	Sulfide Sulfur (%)	Maximum Potential Acidity (kg H_2SO_4 /t)
Frog's Leg	1.85	0.21	1.64	50.4
White Foil	1.40	0.19	1.21	37.0
Operating Sample	1.55	0.23	1.32	40.4

The results of the analysis indicate that the total sulfur content of the tailings samples ranged from 1.40 to 1.85%. The sulfide content of the samples was calculated as between 1.21 and 1.64%, considered to be a high content. The results of the speciated sulfur analysis indicate that the majority sulfur is present as sulfide. Accordingly, the maximum potential acidity calculated from the sulfide sulfur content ranged from 37.0 to 50.4 kg H_2SO_4 / tonne of tailings, which is also high. The results of the Operating Sample and the historical samples from Frogs Leg and White Foil are similar.

The acid neutralising capacity (ANC) of the samples was determined along with the carbonate content. The two results can be used as a check against one another and to identify the contribution of ANC from carbonates and other non carbonate minerals. The results of the analysis are given in Table 3.2.

Table 3.2: Summarised Tailings Carbonate and Acid Neutralising Capacity Results

Sample	Carbonate (as % Calcite)	CO_3-ANC [1] (kg H_2SO_4 /t)	ANC [2] (kg H_2SO_4 /t)
Frog's Leg	5.0	50.4	98.5
White Foil	4.0	40.0	58.0
Operating Sample	4.2	41.7	76.0

[1] Calculated ANC from carbonate content, [2] Measured Sobek ANC

The results of the carbonate analyses indicate that the tailings samples had a carbonate content of between 4.0 and 5.0%, which is high. The results also indicate that all samples have additional neutralising capacity available from non-carbonate minerals when subjected to strongly acidic conditions. The measured acid neutralising capacity of the samples ranged from high (58.0 kg H_2SO_4/t) to very high (98.5 kg H_2SO_4/t). The results of

the Operating Sample and the historical samples from Frog's Leg and White Foil are similar.

The Net Acid Producing Potential (NAPP) of the samples was calculated from the MPA and the ANC and is given in Table 3.3 along with the ANC/MPA ratio. The net acid producing potential of the samples was negative with ANC/MPA ratios of 1.6 and 2.0, indicating that there is excess neutralising capacity in the samples. The results of the Operating Sample and the historical samples from Frogs Leg and White Foil are similar.

Table 3.3: Tailings Net Acid Producing Potential Results

Sample	ANC (kg H_2SO_4 /t)	MPA (kg H_2SO_4 /t)	NAPP (kg H_2SO_4 /t)	ANC/MPA (-)
Frog's Leg	98.5	50.2	-48.3	2.0
White Foil	58.0	37.0	-21.0	1.6
Operating Sample	76.0	40.4	-35.6	1.9

3.3 TAILINGS NET ACID GENERATION

The net acid generation (NAG) test aids in interpretation of acid formation potential classifications. It also identifies if the sulfides and neutralising minerals contained in the samples are readily available to produce or consume acid.

The results of the net acid generation test are given in Table 3.4 and indicate that no measurable acid was produced by any of samples when exposed to extreme oxidising conditions. The final NAG pH of the tailings after complete oxidation was between 8.3 and 9.4, indicating that weak alkaline pH conditions are likely to prevail within the tailings pore waters, should complete oxidation of the tailings solids occur. The results of the Operating Sample and the historical samples from Frogs Leg and White Foil are similar.

Table 3.4: Tailings Net Acid Generation Results

Sample	NAG (7.0) (kg H_2SO_4/t)	NAG pH
Frog's Leg	0	9.0
White Foil	0	9.4
Operating Sample	0	8.3

3.4 TAILINGS ACID FORMATION POTENTIAL

The acid formation potential is determined based on the acid base accounting results and the NAG test. All three samples recorded negative net acid producing potentials, with the NAG test resulting in a NAG pH of 8.3 and 9.4. The samples are therefore classified as NON ACID FORMING. The classification of the samples is shown in Figure 3.1.

3.5 TAILINGS SOLIDS GEOCHEMICAL ENRICHMENTS

Multi-element analysis of the tailings solids was conducted to assess elemental enrichments within the solid portion of the tailings material. Multi-element analysis results were compared to the average crustal abundance to give the geochemical abundance indices. The Geochemical Abundance Index (GAI) quantifies an assay result for a particular element in terms of average crustal abundance.

The assay results, average crustal abundance (ACA) and corresponding geochemical abundance indices (GAI) are given in Table 3.5. The results of the analysis show that the

tailings samples have low to moderate levels of enrichments. All three samples were found to be enriched in a similar set of elements.

Arsenic, chloride and sulfur were classed as highly enriched in all samples. The Frog's Leg sample had a significant enrichment of cadmium, lead, antimony and selenium. The Operating Sample was found to have a higher level of enrichment in boron, being classified as significantly enriched in this element.

Table 3.5: Tailings Multi-Element Results & Geochemical Abundance Indices

Element	Unit	Frog's Leg		White Foil		Operating Sample	
		Assay Result	GAI	Assay Result	GAI	Assay Result	GAI
Ag	ppm	0.6	2	0.5	2	0.2	0
Al	ppm	71896	0	59803	0	72161	0
As	ppm	667	6	83	6	273.0	6
B	ppm	69	2	53	2	173	3
Ba	ppm	352	0	500	0	570	0
Be	ppm	0.88	0	1.3	0	1.4	0
Bi	ppm	0.31	2	0.24	2	0.19	1
Ca	ppm	49458	0	32361	0	41898	0
Cd	ppm	3.2	4	0.47	2	1.3	2
Cl	ppm	96600	6	91700	6	8000	5
Co	ppm	35	0	22	0	26.2	0
Cr	ppm	110	0	18	0	76	0
Cu	ppm	107	1	19	0	81	0
F	ppm	305	0	407	0	377	0
Fe	ppm	60250	0	84500	0	71100	0
Hg	ppm	0.02	0	0.01	0	0.03	0
K	ppm	18150	0	12717	0	18803	0
Mg	ppm	20607	0	10111	0	14199	0
Mn	ppm	1204	0	1223	0	1346	0
Mo	ppm	1.2	0	1.6	0	1	0
Na	ppm	18706	0	30060	0	18988	0
Ni	ppm	68.5	0	11	0	38	0
P	ppm	373	0	1083	0	738	0
Pb	ppm	164	3	28	0	37.0	0
S	ppm	18500	6	14000	5	15500	5
Sb	ppm	3.5	4	0.84	1	2.3	2
Se	ppm	0.92	4	0.21	1	0.52	2
Sn	ppm	1.9	0	2.2	0	2.4	0
Sr	ppm	182	0	193	0	199	0
Th	ppm	2.4	0	10	0	6.4	0
U	ppm	0.65	0	2.5	0	1.8	0
V	ppm	155	0	27	0	91	0
Zn	ppm	411	2	130	0	269	1

Legend

GAI = 0 or 1	Non Enriched
GAI = 2	Slightly Enriched
GAI = 3 or 4	Significantly Enriched
GAI = 5 or 6	Highly Enriched

The results of the analysis have also been compared to a set of soil intervention guidelines compiled from Australian National Environmental Protection Measures investigations levels for assessment of site contamination (Ref. 13), the Netherlands National Institute of Public Health and Environment intervention levels for soil (Ref. 14), and ecological threshold concentrations for antimony in water and soil published by the European Centre for Risk Assessment (Ref. 15).

The results of the comparison are given in Table 3.6 and indicate that arsenic and sulfur exceed the guideline values in all samples. The Frog's Leg and Operating Sample also exceeding the guideline values for sulfate. However overall the three samples were similar.

The results of this comparison indicate that a cover system would likely be required on closure to isolate the tailings from the environment.

Table 3.6: Tailings Solid Multi-Element Results & Site Contamination Guidelines

Element	Ecological - interim Urban[1] (ppm)	Health levels - Category A[2] (ppm)	Intervention Values for Soil [3] (ppm)	Level adopted for site assessment	Multi-Element Analysis Results (ppm)		
					Frog's Leg	White Foil	Operating Sample
Antimony			15	15	3.5	0.8	2.26
Arsenic	20	100	55	55	667	83	273
Barium	300		625	625	352	500	569.8
Beryllium		20	30	20	0.88	1.3	1.4
Boron		3000		3000	69	53	173
Cadmium	3	20	12	12	3.2	0.47	1.3
Chromium (total)			380	380	110	18	76
Cobalt		100	240	100	35	22	26.2
Copper	100	1000	190	190	107	19	81
Lead	600	300	530	300	164	28	37
Manganese	500	1500		1500	1204	1223	1346
Mercury (inorganic)	1	15	10	1	0.02	0.01	0.03
Molybdenum			200	200	1.15	1.6	1.3
Nickel	60	600	210	210	69	11	38
Phosphorus	2000			2000	373	1083	738
Selenium			100	100	0.92	0.21	0.52
Silver			15	15	0.56	0.50	0.2
Sulfur	600			600	18500	14000	15500
Sulfate	2000			2000	2100	1900	2300
Tin			900	900	1.9	2.2	2.4
Vanadium	50		250	250	155	27	91
Zinc	200	7000	720	720	411	130	269

1 = National Environmental Protection Council - National Environmental Protection Measures – Soil Investigation levels for assessment of site contamination 2 = Netherlands National Institute of Public Health and Environment, 3 = European Centre for Risk Assessment.

3.6 SUPERNATANT WATER QUALITY

The supernatant water quality was assessed to examine the solubility of the various parameters when the ore is processed within the process plant. The results of the testing

give an indication of the water quality which is likely within the supernatant pond during operation, but cannot be used to predict long term seepage quality from the facility. This would require leach and/or kinetic testing of the tailings solids which is beyond the scope of this geochemical assessment.

The results of the supernatant testing have been compared to the reference water quality standard for release of water from mining operations and livestock drinking water, as detailed in Table 2.2. The results of the supernatant testing are provided in Table 3.7.

As expected from the use of hypersaline water in the process all supernatant samples were found to be hypersaline, with a total dissolved solids (TDS) value of between 183,231 and 200,320 mg/L. As a result, the samples had to be diluted by the laboratory to enable the analysis to be completed and, consequently, the detection limits of many elements were increased. Therefore, the limit of detection for numerous elements exceeded the assessment criteria. As such, even though several determinants were found to be below the laboratory limits of detection, it is not possible to ascertain whether they exceed the assessment criteria. Further, where an element is indicated to be below the detection limit in the laboratory results, Knight Piésold conservatively assumes that the element is present at the detection limit concentration. This is also how the results are presented in Table 3.7, with elements highlighted in orange indicating that the laboratory limit of detection exceeds the reference water quality value and elements highlighted in red indicating that the testwork confirms the element genuinely exceeds the criteria value.

The results indicate that the TDS, Magnesium and Sulfate exceed the release guidelines in all three samples. Total cyanide and WAD cyanide were found to exceed release guidelines in the White Foil and Operating Sample. Arsenic and Selenium exceed the guidelines in the Frog's Leg and White Foil samples but were found to be below the guideline in the Operating Sample. Parameters which were in question in the past assessment because of poor detection limits achieved by the laboratory, namely copper, mercury and zinc were found to be below guideline concentration in the Operating Sample when the laboratory was able to achieve lower detection limits. In addition, although there are no guideline values for chloride or sodium, the concentrations of these determinants were found to be extremely high, which is indicative of hypersaline water.

A comparison of the supernatant water results with the local groundwater quality was also carried out to identify any elements which were found to be elevated in the supernatant compared to the groundwater, as shown in Table 3.8.

The results of the comparison indicate that the supernatant pH, TDS, calcium, chloride, lead, magnesium, sodium and sulfate concentrations were similar to the average groundwater concentrations (i.e. within approximately 10%). However, some elements were found to have higher concentrations in the supernatant when compared to the groundwater. These elements were as follows:

- Arsenic and selenium were found to be high in the Frog's Leg and White Foil samples but similar to groundwater in the Operating Sample.
- Chromium, copper and nickel had high detection limits in the Frog's Leg and White Foil samples making drawing a conclusion from these results impossible. However the detection limit for the recent sample was lower and indicates that chromium, copper and nickel are elevated in the supernatant when compared to groundwater.
- Cobalt and manganese were found to be elevated compared to groundwater in all three samples.

- There was uncertainty about aluminium and zinc in the Frog's Leg and White Foil samples due to high detection limits but the concentrations of these elements were found to be similar to groundwater in the Operating Sample.

The results indicate that the supernatant is of a similar quality to the local groundwater, with only a limited number of elements being elevated in the supernatant when compared to the groundwater.

Table 3.7: Supernatant Comparison to Release and Livestock Guidelines

Parameter	Reference Value (mg/L)	Assay Results (mg/L)		
		Frog's Leg	White Foil	Operating Sample
pH	6 to 9	7.40	7.10	7.40
TDS	2000	**183231***	**192022***	**200320***
Aluminum	5	1	1	0.1
Antimony	N/G	0.044	0.008	0.018
Arsenic	0.1	**0.24**	**0.21**	0.03
Barium	N/G	0.11	0.17	0.28
Boron	5	1	1	0.1
Cadmium	0.01	0.002	0.002	0.0023
Calcium	1000	845	892	**2225**
Chloride	N/G	93881	93354	104949.5
Chromium (total)	1	1	1	0.1
Cobalt	1	0.08	0.03	0.2025
Copper	0.3	**1**	**1**	0.15
Cyanide-Total	1	0.75	**1.6**	**3**
Cyanide-Free	0.1	N/D	N/D	<0.1
Cyanide-WAD	0.5	0.5	**1**	**0.6**
Fluoride	2	0.1	0.1	0.6
Iron	2	1	1	0.1
Lead	0.1	0.06	0.05	0.005
Magnesium	2000	**7684**	**7770**	**4173**
Manganese	N/G	3	4	9.3
Mercury	0.002	**0.01**	**0.01**	0.001
Molybdenum	0.15	0.043	0.032	0.050
Nickel	0.5	**1**	**1**	0.55
Phosphorus	N/G	10	10	1.5
Selenium	0.02	**0.78**	**0.76**	0.014
Silver	0.5	0.001	0.004	0.0072
Sodium	N/G	49275	49955	61764.5
Sulfate	1000	**16179**	**15722**	**5328**
Tin	N/G	0.01	0.01	0.005
Uranium	0.2	0.002	0.005	0.0013
Vanadium	N/G	1	1	0.15
Zinc	0.5	**1**	**1**	0.1

Notes:
Elements highlighted in **orange** indicate that the laboratory limit of detection exceeds the reference water quality value and elements highlighted in **red** indicate that an element genuinely exceeds the criteria value.
N/D = Not determined.
* TDS results converted to mg/L based on supernatant density of 1.12 kg/L.

Table 3.8: Supernatant Comparison to Local Groundwater

Parameter	Average Groundwater (mg/L)	Assay Results (mg/L)		
		Frog's Leg	White Foil	Operating Sample
pH	6.97	7.40	7.10	7.40
TDS	192650	183231*	192022*	200320*
Aluminum	0.19	**1**	**1**	0.1
Antimony	N/D	0.044	0.008	0.018
Arsenic	0.025	**0.24**	**0.21**	0.03
Barium	N/D	0.11	0.17	0.28
Boron	N/D	1	1	0.1
Cadmium	0.006	0.002	0.002	0.0023
Calcium	826	845	892	2225
Chloride	99500	93881	93354	104949
Chromium (total)	0.02	**1**	**1**	**0.1**
Cobalt	0.02	**0.08**	**0.03**	**0.203**
Copper	0.035	**1**	**1**	**0.15**
Cyanide-Total	N/D	0.75	1.6	3
Cyanide-Free	N/D	N/D	N/D	<0.1
Cyanide-WAD	N/D	0.5	1	0.6
Fluoride	N/D	0.1	0.1	0.6
Iron	1.61	1	1	0.1
Lead	0.05	0.06	0.05	0.005
Magnesium	8300	7684	7770	4173
Manganese	0.97	**3**	**4**	**9.3**
Mercury	N/D	0.01	0.01	0.001
Molybdenum	N/D	0.04	0.03	0.050
Nickel	0.01	**1**	**1**	**0.55**
Phosphorus	N/D	10	10	1.5
Selenium	0.02	**0.78**	**0.76**	0.014
Silver	N/D	0.001	0.004	0.0072
Sodium	56400	49275	49955	61765
Sulfate	17200	16179	15722	5328
Tin	N/D	0.01	0.01	0.005
Uranium	N/D	0.002	0.005	0.0013
Vanadium	N/D	1	1	0.15
Zinc	0.17	**1**	**1**	0.1

Notes:
Elements highlighted in **orange** indicate that the laboratory limit of detection exceeds the average groundwater monitoring concentration and elements highlighted in **red** indicate that an element exceeds the average groundwater monitoring concentration.
N/D = Not determined. * indicated converted from mg/kg to mg/L based on supernatant SG of 1.2

4. CONCLUSIONS

Results of the geochemical testing of the sample of from the Mungari Gold Mine indicate the following:

- The Operating Sample has very similar properties to the pre-production samples provided from the Frog's Leg and White Foil deposits.
- The Operating Sample was found to be non-acid forming and have similar sulfur contents, acid neutralising capacities and carbonate contents, net acid producing potential and ANC/MPA ratio as the pre-production samples tested from the Frog's Leg and White Foil deposits.
- Multi-element analysis results of the solids were compared to the average crustal abundance to calculate geochemical abundance indices. The results of the analysis show that the sample had a similar number of enrichments in similar elements as the pre-production samples tested from the Frog's Leg and White Foil deposits.
- The supernatant water quality has been compared with reference water quality standards for release from mining operations and livestock and wildlife drinking water. All samples were found to be hypersaline and have a range of elements above the guideline values making the supernatant unsuitable for release.
- The supernatant water quality was also compared with local groundwater. The results of the comparison indicate that the supernatant is of a similar quality to the local groundwater, with only arsenic, manganese and selenium found to be significantly higher in the supernatant than in the groundwater.
- The current level of seepage control meets the geochemical assessment requirements.
- The testing has verified original design assumptions and no changes to the TSF design are considered necessary.

We trust the above information is suitable for your current requirements however should you require further please contact the undersigned.

[redacted]

REFERENCES

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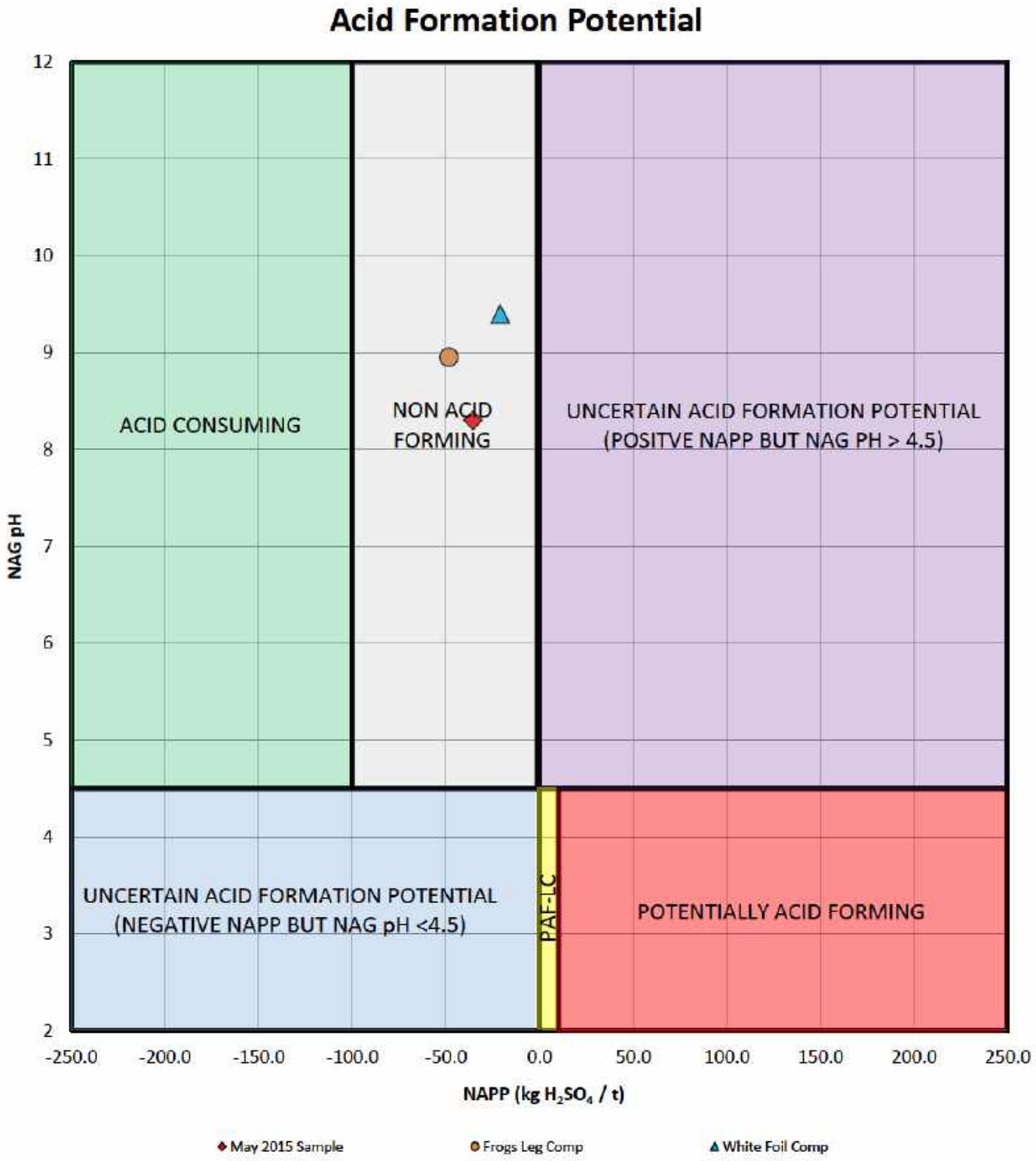
FIGURE

Figure 3.1 AFP



Acid Formation Potential	NAPP (kg H_2SO_4 / t)	NAG pH
Potential Acid Forming (PAF)	>10	<4.5
Potential Acid Forming - Low Capacity (PAF - LC)	0 to 10	<4.5
Non Acid Forming (NAF)	Negative	≥4.5
Acid Consuming (AC)	Less than - 100	≥4.5
Uncertain	Positve	≥4.5
	Negative	<4.5

APPENDIX A

Genalysis Results

ANALYTICAL REPORT

KNIGHT PIESOLD PTY LIMITED
PO Box 6837
EAST PERTH, W.A. 6892
AUSTRALIA

JOB INFORMATION

JOB CODE	:	752.0/1508119
No. of SAMPLES	:	2
No. of ELEMENTS	:	46
CLIENT O/N	:	P13942 (Job 1 of 2)
SAMPLE SUBMISSION No.	:	PE301-00552/01&PE801-00137/10
PROJECT	:	MUNGARI&MAHENGE
STATE	:	Taillings
DATE RECEIVED	:	23/06/2015
DATE COMPLETED	:	27/07/2015
DATE PRINTED	:	27/07/2015
ANALYSING LABORATORY	:	Intertek Genalysis Perth

LEGEND

X	= Less than Detection Limit
N/R	= Sample Not Received
*	= Result Checked
( )	= Result still to come
I/S	= Insufficient Sample for Analysis
E6	= Result X 1,000,000
UA	= Unable to Assay
>	= Value beyond Limit of Method
OV	= Value over-range for Package

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SAMPLE DETAILS

DISCLAIMER

Intertek Genalysis wishes to make the following disclaimer pertaining to the accompanying analytical results.

All work is performed in accordance with the Intertek Minerals Standard Terms and Conditions of work http://www.intertek.com/terms/

This report relates specifically to the sample(s) that were drawn and/or provided by the client or their nominated third party. The reported result(s) provide no warranty or verification on the sample(s) representing any specific goods and/or shipment and only relate to the sample(s) as received and tested. This report was prepared solely for the use of the client named in this report. Intertek accepts no responsibility for any loss, damage or liability suffered by a third party as a result of any reliance upon or use of this report.

The results provided are not intended for commercial settlement purposes.

SIGNIFICANT FIGURES

It is common practice to report data derived from analytical instrumentation to a maximum of two or three significant figures. Some data reported herein may show more figures than this. The reporting of more than two or three figures in no way implies that the third, fourth and subsequent figures may be real or significant.

Intertek Genalysis accepts no responsibility whatsoever for any interpretation by any party of any data where more than two or three significant figures have been reported.

SAMPLE STORAGE DETAILS

GENERAL CONDITIONS

SAMPLE STORAGE OF SOLIDS

Bulk Residues and Pulps will be stored for 60 DAYS without charge. After this time all Bulk Residues and Pulps will be stored at a rate of $4.00 per cubic metre per day until your written advice regarding collection or disposal is received. Expenses related to the return or disposal of samples will be charged to you at cost. Current disposal cost is charged at $150.00 per cubic metre.

SAMPLE STORAGE OF SOLUTIONS

Samples received as liquids, waters or solutions will be held for 60 DAYS free of charge then disposed of, unless written advice for return or collection is received.

NOTES

1. Note: Detection Limit only apply when TDS <100mg/l for MS and TDS<5000mg/l for OES except when indicated in spreadsheet

ANALYSIS

ELEMENTS	Ag	Al	ANC	As	B	Ba
UNITS	ppm	ppm	kgH2SO4/t	ppm	ppm	ppm
DETECTION LIMIT	0.1	50	1	1	50	0.1
DIGEST	4AB/	4AB/	ANCx/	4AB/	FP1/	4AB/
ANALYTICAL FINISH	MS	OE	VOL	MS	OE	MS
SAMPLE NUMBERS						
0001 Mungari (PE301-00552/01)- May 2015	0.2	7.22%	76	273	173	569.8
0002 Mahenge (PE801-00137/10)- Tails Sample	1.0	5.57%	5	13	96	1850.6
CHECKS						
0001 Mahenge (PE801-00137/10)- Tails Sample	0.9	5.65%	5	13	97	1844.3
STANDARDS						
0001 0.5%NaCl						
0002 AMIS0343						
0003 HgSTD-6						
0004 OREAS 185					X	
0005 OREAS 45e						
0006 OREAS 922	0.9	7.44%		7		474.7
0007 OREAS 97.01						
0008 PD-1						
BLANKS						
0001 Control Blank	X	X	0	X	X	0.2
0002 Control Blank	X	X		X	X	0.8
0003 Acid Blank	X	X		X	X	X

ANALYSIS

ELEMENTS	Be	Bi	C	Ca	Cd	Cl
UNITS	ppm	ppm	%	ppm	ppm	%
DETECTION LIMIT	0.1	0.01	0.01	50	0.1	0.02
DIGEST	4AB/	4AB/		4AB/	4AB/	CL1/
ANALYTICAL FINISH	MS	MS	/CSA	OE	MS	COL
SAMPLE NUMBERS						
0001 Mungari (PE301-00552/01)- May 2015	1.4	0.19	0.57	4.19%	1.3	0.80
0002 Mahenge (PE801-00137/10)- Tails Sample	1.3	0.12	0.15	1073	X	X
CHECKS						
0001 Mahenge (PE801-00137/10)- Tails Sample	1.3	0.12	0.15	1099	0.2	X
STANDARDS						
0001 0.5%NaCl						0.33
0002 AMIS0343						
0003 HgSTD-6						
0004 OREAS 185						
0005 OREAS 45e			0.54			
0006 OREAS 922	2.3	10.20		4916	0.3	
0007 OREAS 97.01						
0008 PD-1						
BLANKS						
0001 Control Blank	X	X	X	60	X	X
0002 Control Blank	X	0.01	X	X	X	
0003 Acid Blank	X	X		X	X	

ANALYSIS

ELEMENTS		ColourChange	Cr	Cu	EC	F
UNITS	ppm	NONE	ppm	ppm	mS/cm	ppm
DETECTION LIMIT	0.1	0	5	1	0.01	50
DIGEST	4AB/	ANCx/	4AB/	4AB/	Paste/	FC7/
ANALYTICAL FINISH	MS	QUAL	OE	OE	MTR	SIE
SAMPLE NUMBERS						
0001 Mungari (PE301-00552/01)- May 2015	26.2	No	76	81	31.30	377
0002 Mahenge (PE801-00137/10)- Tails Sample	4.6	No	209	104	0.09	503
CHECKS						
0001 Mahenge (PE801-00137/10)- Tails Sample	4.7	No	173	104		506
STANDARDS						
0001 0.5%NaCl						
0002 AMIS0343						2307
0003 HgSTD-6						
0004 OREAS 185						
0005 OREAS 45e						
0006 OREAS 922	20.6		72	2199		
0007 OREAS 97.01						
0008 PD-1						
BLANKS						
0001 Control Blank	X		X	2		X
0002 Control Blank	X		X	2		
0003 Acid Blank	X		X	X		

ANALYSIS

ELEMENTS	Fe	Final-pH	Fizz-Rate	Hg	K	Mg
UNITS	%	NONE	NONE	ppm	ppm	ppm
DETECTION LIMIT	0.01	0.1	0	0.01	20	20
DIGEST	4AB/	ANCx/	ANCx/	HG1/	4AB/	4AB/
ANALYTICAL FINISH	OE	MTR	QUAL	CV	OE	OE
SAMPLE NUMBERS						
0001 Mungari (PE301-00552/01)- May 2015	7.11	1.8	1.0000000	0.03	1.88%	1.42%
0002 Mahenge (PE801-00137/10)- Tails Sample	2.53	1.8	0.0000000	0.05	1.41%	3366
CHECKS						
0001 Mahenge (PE801-00137/10)- Tails Sample	2.53	1.8	0.0000000	0.05	1.40%	3398
STANDARDS						
0001 0.5%NaCl						
0002 AMIS0343						
0003 HgSTD-6				1.61		
0004 OREAS 185						
0005 OREAS 45e						
0006 OREAS 922	5.49				2.53%	1.56%
0007 OREAS 97.01						
0008 PD-1						
BLANKS						
0001 Control Blank	X	1.5		X	X	X
0002 Control Blank	X				X	X
0003 Acid Blank	X				X	X

ANALYSIS

ELEMENTS	Mn	Mo	Na	NAG	NAGpH	NAG(4.5)
UNITS	ppm	ppm	ppm	kgH2SO4/t	NONE	kgH2SO4/t
DETECTION LIMIT	1	0.1	20	1	0.1	1
DIGEST	4AB/	4AB/	4AB/	NAGx/	NAGx/	NAGx/
ANALYTICAL FINISH	OE	MS	OE	VOL	MTR	VOL
SAMPLE NUMBERS						
0001 Mungari (PE301-00552/01)- May 2015	1346	1.3	1.90%	0	8.3	0
0002 Mahenge (PE801-00137/10)- Tails Sample	120	35.7	1402	1	5.8	0
CHECKS						
0001 Mahenge (PE801-00137/10)- Tails Sample	120	36.3	1384	1	5.8	0
STANDARDS						
0001 0.5%NaCl						
0002 AMIS0343						
0003 HgSTD-6						
0004 OREAS 185						
0005 OREAS 45e						
0006 OREAS 922	855	0.8	4290			
0007 OREAS 97.01						
0008 PD-1						
BLANKS						
0001 Control Blank	X	X	43	5	4.6	0
0002 Control Blank	X	X	73			
0003 Acid Blank	X	X	67			

ANALYSIS

ELEMENTS	Ni	P	Pb	pH	pH Drop	S
UNITS	ppm	ppm	ppm	NONE	NONE	%
DETECTION LIMIT	1	50	2	0.1	0.1	0.01
DIGEST	4AB/	4AB/	4AB/	Paste/	ANCx/	
ANALYTICAL FINISH	OE	OE	MS	MTR	MTR	/CSA
SAMPLE NUMBERS						
0001 Mungari (PE301-00552/01)- May 2015	38	738	37	7.7	3.0	1.55
0002 Mahenge (PE801-00137/10)- Tails Sample	77	975	16	7.8		0.07
CHECKS						
0001 Mahenge (PE801-00137/10)- Tails Sample	77	1004	17			0.07
STANDARDS						
0001 0.5%NaCl						
0002 AMIS0343						
0003 HgSTD-6						
0004 OREAS 185						
0005 OREAS 45e						0.06
0006 OREAS 922	37	654	61			
0007 OREAS 97.01						
0008 PD-1						
BLANKS						
0001 Control Blank	X	X	X			X
0002 Control Blank	X	X	X			0.01
0003 Acid Blank	X	X	X			

ANALYSIS

ELEMENTS	S-SO4	Sb	Se	Sn	Sr	Th
UNITS	%	ppm	ppm	ppm	ppm	ppm
DETECTION LIMIT	0.01	0.05	0.01	0.1	0.05	0.01
DIGEST	S71/	4AB/	SE1/	4AB/	4AB/	4AB/
ANALYTICAL FINISH	OE	MS	MS	MS	MS	MS
SAMPLE NUMBERS						
0001 Mungari (PE301-00552/01)- May 2015	0.23	2.26	0.52	2.4	198.71	6.39
0002 Mahenge (PE801-00137/10)- Tails Sample	0.04	0.11	8.46	1.4	86.52	12.91
CHECKS						
0001 Mahenge (PE801-00137/10)- Tails Sample	0.04	0.17	8.44	1.4	87.28	13.08
STANDARDS						
0001 0.5%NaCl						
0002 AMIS0343						
0003 HgSTD-6						
0004 OREAS 185						
0005 OREAS 45e						
0006 OREAS 922		1.38		9.9	58.57	17.35
0007 OREAS 97.01			0.66			
0008 PD-1	4.26					
BLANKS						
0001 Control Blank	X	X	0.01	X	0.18	X
0002 Control Blank		X	X	X	0.24	0.01
0003 Acid Blank		X	X	X	X	X

ANALYSIS

ELEMENTS	TIC	U	V	Zn
UNITS	%	ppm	ppm	ppm
DETECTION LIMIT	0.01	0.01	2	1
DIGEST	C72/	4AB/	4AB/	4AB/
ANALYTICAL FINISH	CSA	MS	OE	OE
SAMPLE NUMBERS				
0001 Mungari (PE301-00552/01)- May 2015	0.50	1.79	91	269
0002 Mahenge (PE801-00137/10)- Tails Sample	0.01	23.26	834	58
CHECKS				
0001 Mahenge (PE801-00137/10)- Tails Sample	0.03	23.90	829	61
STANDARDS				
0001 0.5%NaCl				
0002 AMIS0343				
0003 HgSTD-6				
0004 OREAS 185				
0005 OREAS 45e				
0006 OREAS 922		3.36	93	267
0007 OREAS 97.01				
0008 PD-1				
BLANKS				
0001 Control Blank		X	X	45
0002 Control Blank		X	X	2
0003 Acid Blank		X	X	X

METHOD CODE DESCRIPTION

Method Code	Analysing Laboratory	NATA Scope of Accreditation

/CSA Intertek Genalysis Perth

Induction Furnace Analysed by Infrared Spectrometry

4AB/MS Intertek Genalysis Perth **4AB/ : MPL_W001, MS : ICP_W003**

Multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids in Teflon Beakers. Analysed by Inductively Coupled Plasma Mass Spectrometry.

4AB/OE Intertek Genalysis Perth **4AB/ : MPL_W001, OE : ICP_W004**

Multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids in Teflon Beakers. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.

ANCx/MTR Intertek Genalysis Perth

Acid Neutralizing Capacity Digestion Procedure. Analysed with Electronic Meter Measurement

ANCx/QUAL Intertek Genalysis Perth

Acid Neutralizing Capacity Digestion Procedure. Analysed by Qualitative Inspection

ANCx/VOL Intertek Genalysis Perth

Acid Neutralizing Capacity Digestion Procedure. Analysed by Volumetric Technique.

C72/CSA Intertek Genalysis Perth **ENV_W017, CSA : ENV_W017**

Digestion by hot acid(s) Analysed by Infrared Spectrometry

CL1/COL Intertek Genalysis Perth **ENV_W014, COL : ENV_W014**

Carbonate leach specific for Chlorine. Analysed by UV-Visible Spectrometry.

FC7/SIE Intertek Genalysis Perth **ENV_W012, SIE : ENV_W012**

Alkaline fusion (Nickel crucible) specific for Fluorine. Analysed by Specific Ion Electrode.

FP1/OE Intertek Genalysis Perth **FP1/ : MPL_W011, OE : ICP_W004**

Sodium peroxide fusion (Zirconia crucibles) and Hydrochloric acid to dissolve the melt. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.

HG1/CV Intertek Genalysis Perth

Low temperature Perchloric acid digest specific for Mercury. Analysed by Cold Vapour Generation Atomic Absorption Spectrometry.

NAGx/MTR Intertek Genalysis Perth

Net Acid Generation Extraction of samples with H2O2 Analysed with Electronic Meter Measurement

NAGx/VOL Intertek Genalysis Perth

Net Acid Generation Extraction of samples with H2O2 Analysed by Volumetric Technique.

Paste/MTR Intertek Genalysis Perth

Water Extraction using a specific sample:water ratio. Analysed with Electronic Meter Measurement

S71/OE Intertek Genalysis Perth

Digestion to eliminate sulphides. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.

METHOD CODE DESCRIPTION

Method Code	Analysing Laboratory	NATA Scope of Accreditation
SE1/MS	Intertek Genalysis Perth	

Aqua-Regia digest followed by Precipitation and Concentration. Specific for Selenium. Analysed by Inductively Coupled Plasma Mass Spectrometry.

ANALYTICAL REPORT

KNIGHT PIESOLD PTY LIMITED
PO Box 6837
EAST PERTH, W.A. 6892
AUSTRALIA

JOB INFORMATION

JOB CODE	:	752.0/1508121
No. of SAMPLES	:	2
No. of ELEMENTS	:	39
CLIENT O/N	:	P13942 (Job 1 of 1)
SAMPLE SUBMISSION No.	:	PE301-00552/01&PE801-00137/10
PROJECT	:	MUNGARI&MAHENGE
STATE	:	Solutions
DATE RECEIVED	:	23/06/2015
DATE COMPLETED	:	02/10/2015
DATE PRINTED	:	02/10/2015
ANALYSING LABORATORY	:	Intertek Genalysis Perth

LEGEND

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N/R	= Sample Not Received
*	= Result Checked
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SAMPLE DETAILS

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NOTES

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ANALYSIS

ELEMENTS	Ag	Al	As	B	Ba	Be
UNITS	ug/l	mg/l	ug/l	mg/l	ug/l	ug/l
DETECTION LIMIT	0.1	0.1	1	0.1	0.5	1
DIGEST						
ANALYTICAL FINISH	/MS	/OE	/MS	/OE	/MS	/MS
SAMPLE NUMBERS						
0001 Mungari (PE301-00552/01)- May 2015	7.5	X	25	X	286.3	9
0002 Mahenge (PE801-00137/10)- Tails Sample	X	0.1	X	0.5	192.3	X
CHECKS						
0001 Mungari (PE301-00552/01)- May 2015	6.9	X	27	X	275.8	6
STANDARDS						
0001 Alcoa12-OES		1.9		1.0		
0002 MSC-5						
0003 SOLN-001						
0004 TMDW	X		X		X	X
BLANKS						
0001 Control Blank	X	X	X	X	X	X

ANALYSIS

ELEMENTS	Bi	Ca	Cd	Cl	Co	Cr
UNITS	ug/l	mg/l	ug/l	mg/l	ug/l	mg/l
DETECTION LIMIT	0.05	0.1	0.2	2	1	0.1
DIGEST						
ANALYTICAL FINISH	/MS	/OE	/MS	/COL	/MS	/OE
SAMPLE NUMBERS						
0001 Mungari (PE301-00552/01)- May 2015	0.75	2205.0	2.4	105389	205	0.1
0002 Mahenge (PE801-00137/10)- Tails Sample	X	17.1	X	66	X	X
CHECKS						
0001 Mungari (PE301-00552/01)- May 2015	0.69	2245.0	2.2	104510	200	X
STANDARDS						
0001 Alcoa12-OES		50.1				0.5
0002 MSC-5						
0003 SOLN-001						
0004 TMDW	X		X		X	
BLANKS						
0001 Control Blank	X	X	X	X	X	X

ANALYSIS

ELEMENTS	Cu	EC	F	Fe-Sol	Hg	K
UNITS	mg/l	mS/cm	mg/l	mg/l	ug/l	mg/l
DETECTION LIMIT	0.1	0.01	0.1	0.1	1	1
DIGEST						
ANALYTICAL FINISH	/OE	/MTR	/SIE	/OE	/MS	/OE
SAMPLE NUMBERS						
0001 Mungari (PE301-00552/01)- May 2015	0.2	>10000.00	0.5	X	X	634
0002 Mahenge (PE801-00137/10)- Tails Sample	X	0.37	0.8	X	X	3
CHECKS						
0001 Mungari (PE301-00552/01)- May 2015	X	>10000.00	0.7	0.1	1	665
STANDARDS						
0001 Alcoa12-OES	0.5			2.0		4
0002 MSC-5						
0003 SOLN-001			1.1			
0004 TMDW					X	
BLANKS						
0001 Control Blank	X		X	X	X	X

ANALYSIS

ELEMENTS	Mg	Mn	Mo	CN-Tot	CN-WAD	FreeCN
UNITS	mg/l	mg/l	ug/l	mg/l	mg/l	mg/l
DETECTION LIMIT	0.1	0.1	0.5	0.1	0.1	0.1
DIGEST						
ANALYTICAL FINISH	/OE	/OE	/MS	/COL	/COL	/COL
SAMPLE NUMBERS						
0001 Mungari (PE301-00552/01)- May 2015	4141.1	9.1	50.3	3.0	0.6	X
0002 Mahenge (PE801-00137/10)- Tails Sample	3.5	X	69.4	0.2	0.2	X
CHECKS						
0001 Mungari (PE301-00552/01)- May 2015	4204.8	9.5	48.7			
STANDARDS						
0001 Alcoa12-OES	47.7	0.5				
0002 MSC-5						
0003 SOLN-001						
0004 TMDW			X			
BLANKS						
0001 Control Blank	X	X	X	X	X	X

ANALYSIS

ELEMENTS	Na	Ni	P	Pb	pH	S
UNITS	mg/l	mg/l	mg/l	ug/l	NONE	mg/l
DETECTION LIMIT	1	0.1	1	5	0.1	1
DIGEST						
ANALYTICAL FINISH	/OE	/OE	/OE	/MS	/MTR	/OE
SAMPLE NUMBERS						
0001 Mungari (PE301-00552/01)- May 2015	61068	0.5	1	X	7.4	1761
0002 Mahenge (PE801-00137/10)- Tails Sample	52	X	X	X	7.8	5
CHECKS						
0001 Mungari (PE301-00552/01)- May 2015	62461	0.6	2	X	7.4	1796
STANDARDS						
0001 Alcoa12-OES	243	0.5	1			20
0002 MSC-5						
0003 SOLN-001						
0004 TMDW				X		
BLANKS						
0001 Control Blank	X	X	X	X		X

ANALYSIS

ELEMENTS	Sb	Se	Sn	Sr	TDSEva	Th
UNITS	ug/l	ug/l	ug/l	ug/l	mg/Kg	ug/l
DETECTION LIMIT	0.1	5	1	0.2	20	0.05
DIGEST						
ANALYTICAL FINISH	/MS	/MS	/MS	/MS	/GR	/MS
SAMPLE NUMBERS						
0001 Mungari (PE301-00552/01)- May 2015	18.3	12	3	18052.8	167780	0.45
0002 Mahenge (PE801-00137/10)- Tails Sample	0.1	X	X	101.4	209	X
CHECKS						
0001 Mungari (PE301-00552/01)- May 2015	17.0	16	7	17905.0	166087	0.45
STANDARDS						
0001 Alcoa12-OES						
0002 MSC-5					1497	
0003 SOLN-001						
0004 TMDW	X	X	X	X		X
BLANKS						
0001 Control Blank	X	X	X	X	X	X

ANALYSIS

ELEMENTS	U	V	Zn
UNITS	ug/l	mg/l	mg/l
DETECTION LIMIT	0.05	0.1	0.1
DIGEST			
ANALYTICAL FINISH	/MS	/OE	/OE
SAMPLE NUMBERS			
0001 Mungari (PE301-00552/01)- May 2015	1.25	0.2	X
0002 Mahenge (PE801-00137/10)- Tails Sample	0.71	X	X
CHECKS			
0001 Mungari (PE301-00552/01)- May 2015	1.30	0.1	X
STANDARDS			
0001 Alcoa12-OES		0.5	0.5
0002 MSC-5			
0003 SOLN-001			
0004 TMDW	X		
BLANKS			
0001 Control Blank	X	X	X

METHOD CODE DESCRIPTION

Method Code	Analysing Laboratory	NATA Scope of Accreditation

/COL Intertek Genalysis Perth

No digestion or other pre-treatment undertaken. Analysed by UV-Visible Spectrometry.

/GR Intertek Genalysis Perth

Analysed by Gravimetric Technique.

/MS Intertek Genalysis Perth

No digestion or other pre-treatment undertaken. Analysed by Inductively Coupled Plasma Mass Spectrometry.

/MTR Intertek Genalysis Perth

No digestion or other pre-treatment undertaken. Analysed with Electronic Meter Measurement

/OE Intertek Genalysis Perth

Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.

/SIE Intertek Genalysis Perth

No digestion or other pre-treatment undertaken. Analysed by Specific Ion Electrode.

Knight Piésold CONSULTING

MEMORANDUM

To: **Evolution Mining** [redacted]	**Date:** 14th May 2018 **Our Ref:** PE18-00431 **KP File Ref.:** PE801-00137/20-A dss M18003 **From:** [redacted]

RE: MUNGARI GOLD PROJECT –TAILINGS SUITABILITY TESTING

This memorandum details the testing results of tailings sampled from the Mungari Tailings Storage Facility (TSF) Cell 2 beach in April 2018.
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1. INTRODUCTION

Knight Piésold Pty Ltd (KP) is currently providing design and construction services to Evolution Mining (Evolution) as part of the Mungari Gold Project TSF. Evolution requested KP to undertake a tailings investigation programme to assess the suitability of tailings for future embankment fill. This would reduce the need for external borrow sources but also compete with paste reclaim which is generally undertaken when the tailings on the beach has dried sufficiently.

The current Stage 4 raise design utilises tailings as a "freeboard infill" zone between the tailings level near the embankment up to 300mm below the embankment crest. This zone is traffic compacted with the top layer tested to ensure it meets 95% of SMDD before Zone A (low permeability clay material) is placed. If there is minimal freeboard however, this zone is not used. The tailings is generally dry at surface in the construction period such that traffic compaction does not cause liquefaction.

2. FIELD INVESTIGATION

Four (4) samples were taken from tailings which had been dozed up for paste reclaim within Cell 2. The stockpiles were dozed from approximately 50 m away from the embankments hence would be a good representation of the different materials that would be used for construction. One sample was taken from each embankment in Cell 2 (shown in Figure 2.1) and labelled as the North, East (divider), South and West as per Table 2.1.

Table 2.1: Summary of sampling

Embankment Location	Laboratory Sample No.	Sample Coordinates (Zone 51J)	
		Easting	Northing
North	5022/s/35569	331134	6595667
East (Divider)	5022/s/35567	331269	6595481
South	5022/s/35570	331090	6595149
West	5022/s/35568	330877	6594404

3. LABORATORY TESTING

Samples of tailings were delivered to Construction Sciences soils laboratory in Bunbury for testing. The purpose of the testing was to classify and characterise the tailings in order to assess their suitability for use in embankment construction. Tests were carried

out in accordance with Australian Standard AS1289: Methods of Testing Soil for Engineering Purposes. A summary of the laboratory test results is presented in Table 3.1 and the laboratory test reports are presented in Appendix A.

4. RESULTS AND ANALYSIS

The results were compared to the Zone A and Zone C specification for Stage 4 in terms of characterisation and design intent as well as a Mungari operating tailings sample tested in May 2015 (Ref: PE15-00887) by KP.

4.1 ATTERBERG LIMITS

The Atterberg Limit tests indicated that all samples are non/very low plasticity with little to no linear shrinkage. This correlates with the operating sample tested in 2015 and typical crushed rock tailings characteristics.

4.2 PARTICLE SIZE DISTRIBUTION

The Particle Size Distribution (PSD) for the four samples are plotted in Figure 4.1. Using the Unified Soil Classification System, the samples would be classified as a SILT with clay/sand with P80 of around 130 to 210 µm. The samples are marginally coarser than the operating sample tested in 2015 but could be related to the sampling near the embankment rather than an all-in sample.

The samples fall within the Zone A grading requirement but well outside the Zone C grading requirements, intended to be waste rock. The samples also fall within the zones for potential liquefiable soils (USNRC 1985) and should be subject to a liquefaction analysis.

4.3 PARTICLE DENSITY AND COMPACTION

Particle density is consistent at around 2.79 – 2.82 t/m^3 for the samples and similar to previous testing. Standard compaction testing on the material is consistent between samples with an averaged Standard Maximum Dry Density (SMDD) of 1.90 t/m^3 and an averaged Optimum Moisture Content (OMC) of 13% as shown in Figure 4.2.

Field samples of natural moisture content should be conducted to determine how much wetting or drying of insitu material is required to achieve material close to OMC for constructability and permeability control. It is noted Zone A requires compaction to 98% SMDD while Zone C or freeboard infill is compacted to 95% SMDD.

4.4 PERMEABILITY

Laboratory permeability testing on samples compacted to 98% of SMDD and near OMC yielded a permeability range of 5 x 10^{-8} m/s to 1 x 10^{-7} m/s. A graph of permeability versus fines content (percentage passing 75 µm) is shown in Figure 4.3.

The Zone A embankment fill permeability target is less than 1 x 10^{-8} m/s, and the testwork indicates this is not achievable with tailings material. Despite the PSD meeting the Zone A specification, without plasticity in the sample, the target permeability is unlikely to be achievable using tailings. The achieved permeability's are however about half an order of magnitude lower than the settled tailings.

Table 3.1: Summary of sampling

Sample	Material Type	Atterberg Limits				Particle Size Distribution				Compaction		Particle density	Falling Head Perm[3] (AS1289 6.7.2)	Direct Shear Test[3]				
		LL	PL	PI	LS	Gravel	Sand	Silt	Clay	SMDD (t/m^3)	OMC (%)	(t/m^3)	m/s	Normal Stress (kPa)	c' (Peak kPa)	Φ' (Peak degs)	c' (Residual kPa)	Φ' (Residual degs)
North (5022/s/35569)	Dark Grey Silty Sand	NO[1]	NO	NP[2]	1.0	0	44	53.3	2.7	1.89	13.5	2.794	5×10^{-8}	At 50, 100, 200kPa	12.0	36	11.5	32
East (5022/s/35567)	Dark Grey Silty Sand	NO	NO	NP	0.0	0	58	37.9	4.1	1.90	13.0	2.792	1×10^{-7}	At 50, 100, 200kPa	0.0	38	0.0	34
South (5022/s/35570)	Dark Grey Silty Sand	NO	NO	NP	1.0	0	50	47.3	2.7	1.90	12.5	2.788	8×10^{-8}	At 50, 100, 200kPa	8.5	42	1.5	39
West (5022/s/35568)	Dark Grey Silty Sand	NO	NO	NP	1.0	0	41	56.9	2.1	1.91	12.5	2.824	8×10^{-8}	At 50, 100, 200kPa	1.0	43	0.5	40

1. NO: Not Obtainable
2. NP: Non-Plastic
3. Compacted sample to 98% SMDD at OMC

4.5 STRENGTH

Strength testing of remoulded samples were determined from standard 60mm shear box direct shear tests. The plots of various displacements and normal/shear stress are provided in Appendix A test certificates. The peak and residual effective strength parameters were obtained and reported in Table 3.1.

The majority of results show contractive behaviour (indicating a loose sample) despite being compacted to 98% SMDD in the test. A typical maximum drained effective strength parameter of 0 kPa cohesion and 32° friction angle is recommended for modelling purposes. The contractive behaviour must be considered if saturated and subject to rapid construction or seismic loading.

5. CONCLUSION

The tailings sampled from the dozed up paste reclaim stockpiles within Cell 2 are not considered suitable to completely replace the Zone A material due to the non/very low plasticity and higher than required permeability. It can however be used to replace some of the Zone A material on the upstream side as well as being used as an embankment freeboard infill as the compacted performance would be better than insitu deposited and air dried tailings.

It is recommended that a minimum width of 4 m of Zone A material is always utilised. Also that the tailings is likely erodible hence requires erosion protection at every spigot dropper location on the upstream side. For the future Cell 3 construction, tailings use as a replacement for Zone A material is not recommended for Stages 1 to 2 for permeability control purposes.

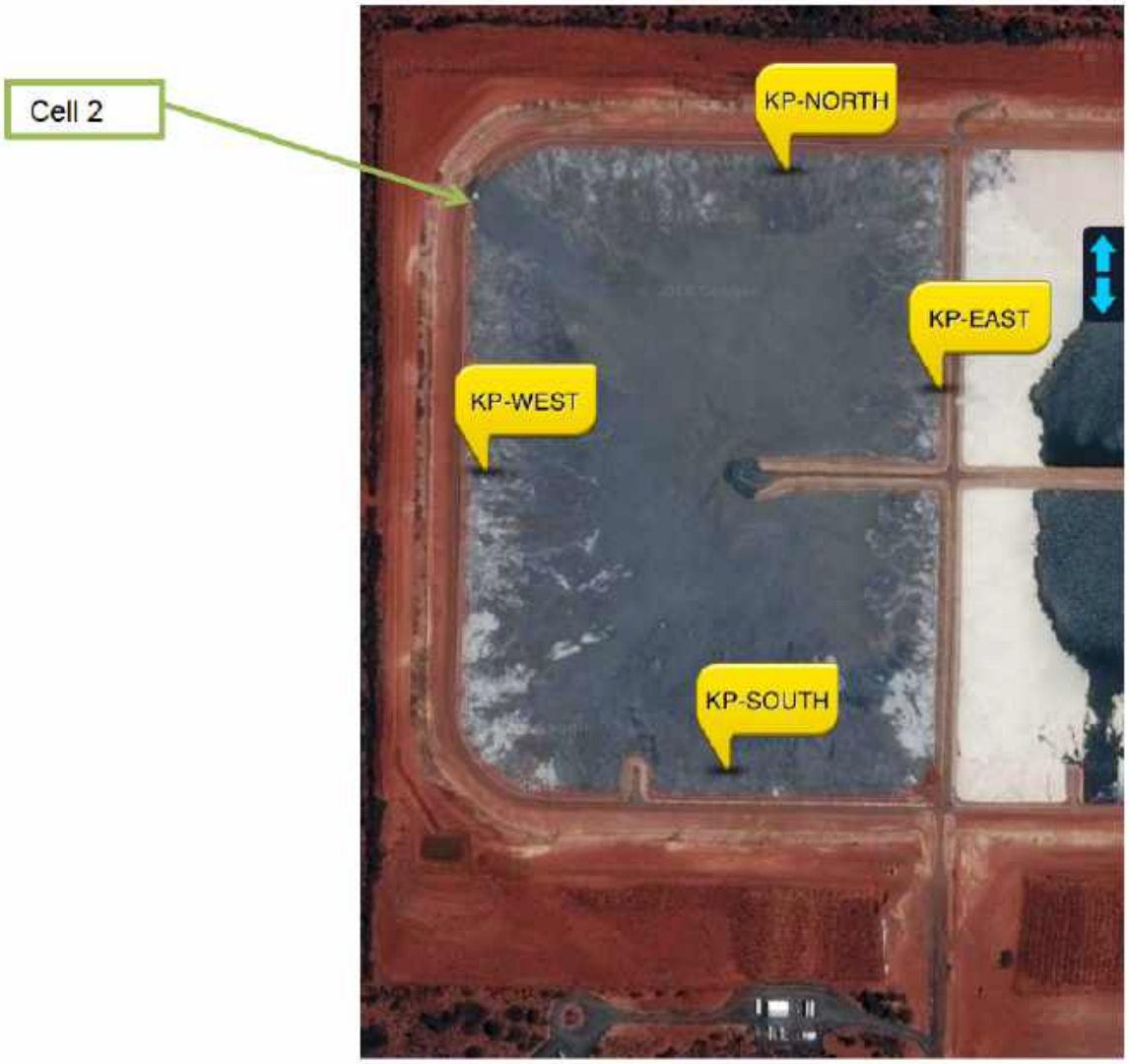
6. RECOMMENDATIONS

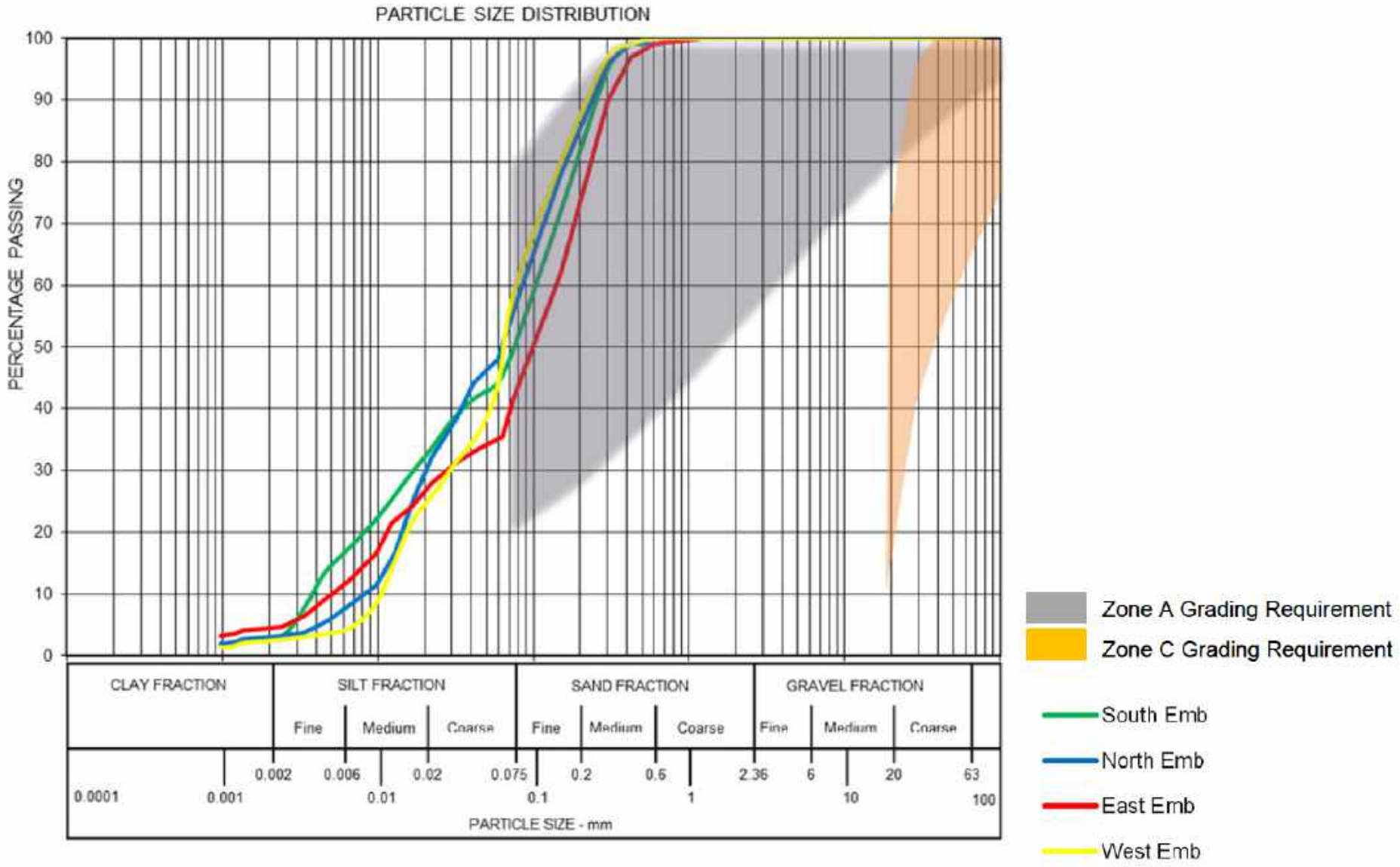
A greater portion of the proposed Zone A cross section could use compacted tailings to reduce the Zone A external borrow demand. However, this would need to compete with paste reclaim which is generally conducted at the same time, and may limit availability and production. The soon to be conducted Stage 5 design should consider the profile similar to that shown in Figure 6.1 to utilise more tailings. The tender however should allow for complete Zone A sourced from borrow, but request a tailings sourced rate, to ensure adequate budget is allowed for.

We trust that the information provides adequate information for your purposes. Please contact us should you require clarification or additional information.

[redacted]

FIGURES

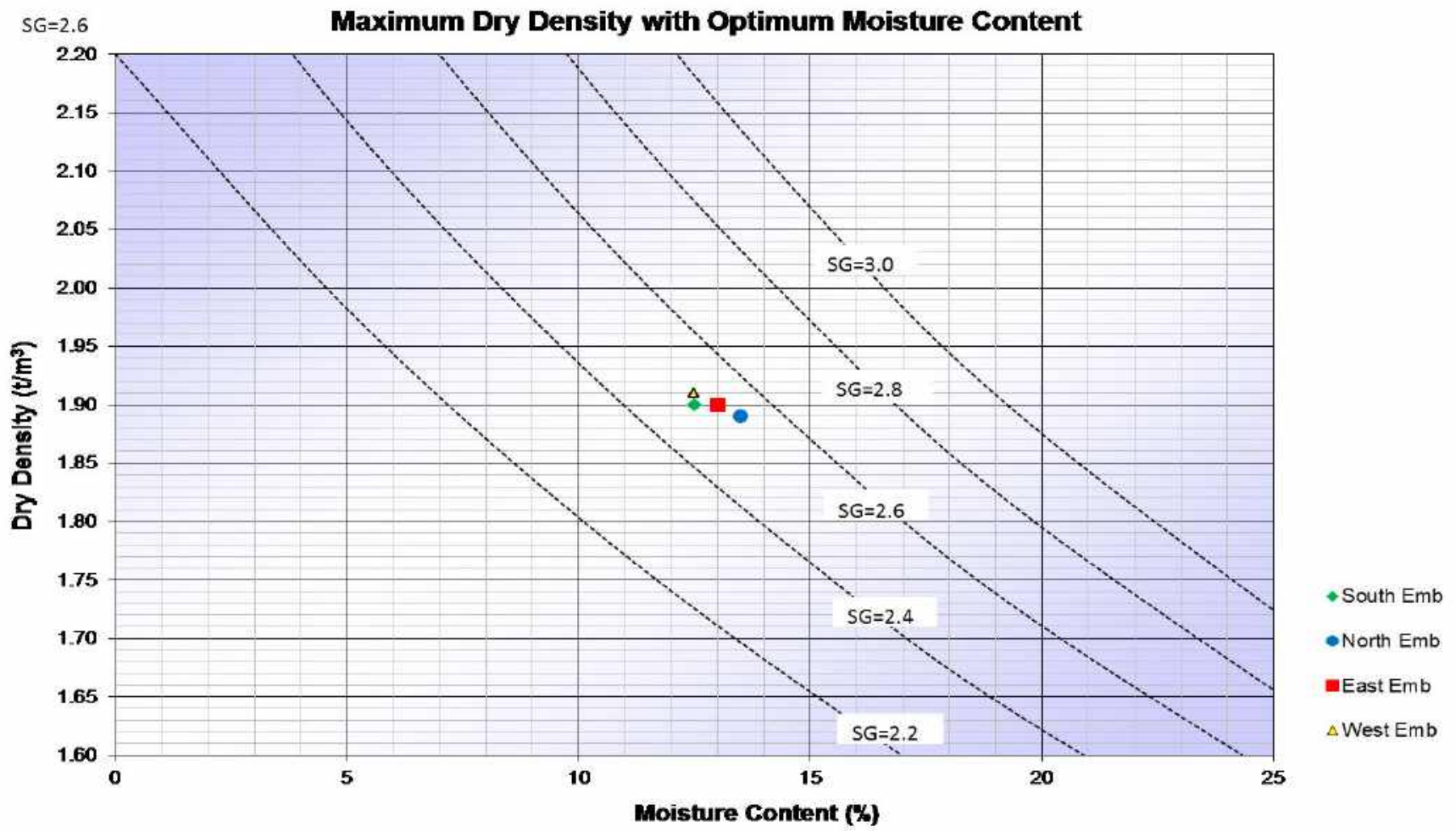

Cell 2
KP-NORTH
KP-EAST
KP-WEST
KP-SOUTH

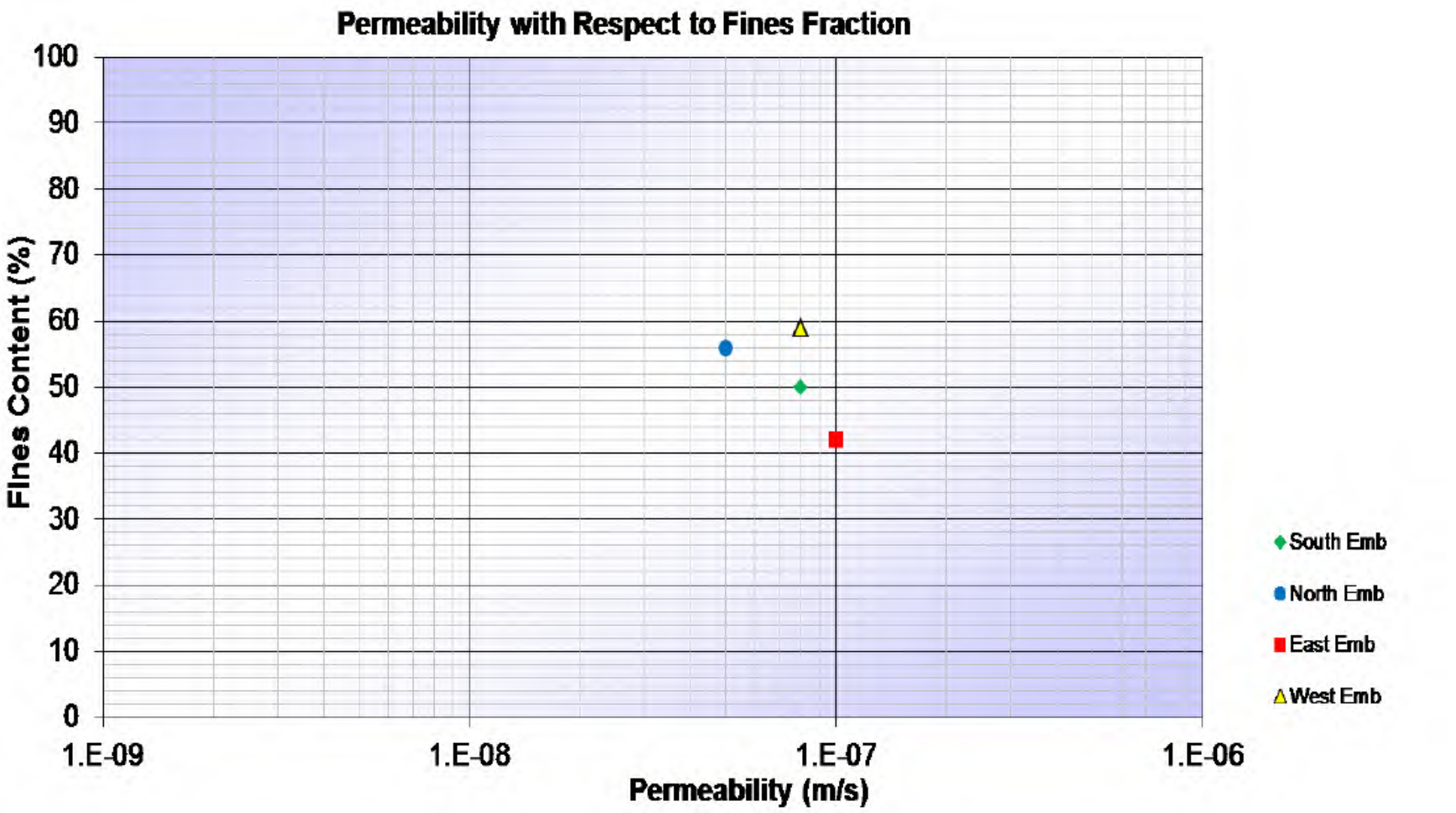


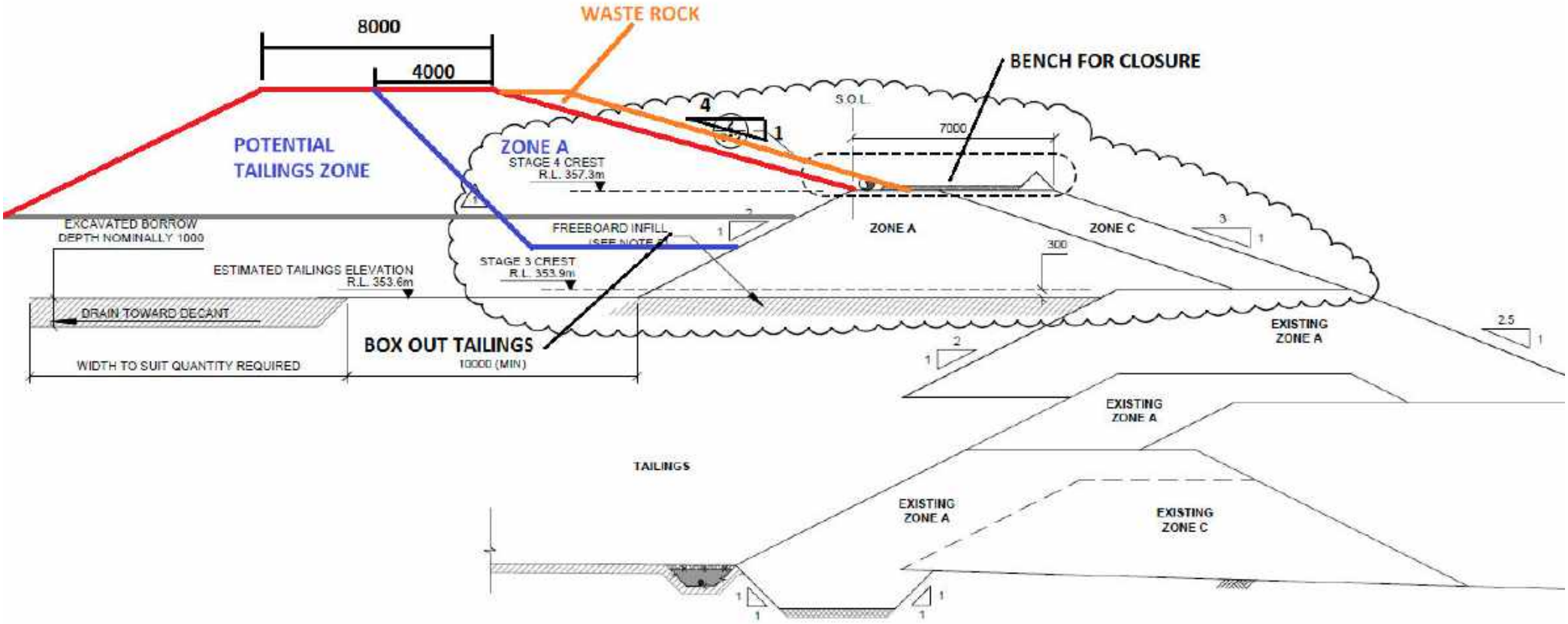
Knight Piésold CONSULTING

MUNGARI GOLD PROJECT
TAILINGS SUITABILITY TESTING
PARTICLE SIZE DISTRIBUTION

Ref: PE801-00137/M18003
Figure 4.1


SG=2.6
Maximum Dry Density with Optimum Moisture Content
Dry Density (t/m³)
2.20
2.15
2.10
2.05
2.00
1.95
1.90
1.85
1.80
1.75
1.70
1.65
1.60
SG=3.0
SG=2.8
SG=2.6
SG=2.4
SG=2.2
0
5
10
15
20
25
Moisture Content (%)
South Emb
North Emb
East Emb
West Emb


Permeability with Respect to Fines Fraction
Fines Content (%)
100
90
80
70
60
50
40
30
20
10
0
1.E-09
1.E-08
1.E-07
1.E-06
Permeability (m/s)
South Emb
North Emb
East Emb
West Emb


8000
4000
WASTE ROCK
BENCH FOR CLOSURE
S.O.L
7000
4
1
POTENTIAL
TAILINGS ZONE
ZONE A
STAGE 4 CREST
R.L. 357.3m
EXCAVATED BORROW
DEPTH NOMINALLY 1000
FREEBOARD INFILL
ZONE A
ZONE C
3
1
300
ESTIMATED TAILINGS ELEVATION
R.L. 353.6m
STAGE 3 CREST
R.L. 353.9m
DRAIN TOWARD DECANT
BOX OUT TAILINGS
10000 (MIN)
WIDTH TO SUIT QUANTITY REQUIRED
EXISTING
ZONE A
2.5
2
1
EXISTING
ZONE A
TAILINGS
EXISTING
ZONE A
EXISTING
ZONE C
1
1
1
1

APPENDIX A
Laboratory Testing

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
72 McCombe Road,
Davenport WA 6230

Laboratory: **Bunbury**
Phone: 08 9726 2187
Fax: 08 9721 2348
Email: Bunbury@constructionsciences.net

SOIL PARTICLE DENSITY REPORT

Client:	Knight Piesold Pty Ltd	Report Number:	5022/R/19624-1
Client Address:	Level 1 / 184 Adelaide Terrace, East Perth	Project Number:	5022/P/1056
Project:	Mungari Tailings Assessment	Lot Number:	North Wall
Location:	Coolgardie WA	Internal Test Request:	5022/T/6740
Supplied To:	n/a	Client Reference/s:	P16776
Area Description:	Cell 2	Report Date / Page:	20/04/2018 Page 1 of 1

Test Procedures:	AS1289.3.5.1		
Sample Number	5022/S/35569	Sample Location	
Sampling Method	Tested As Received	Test Request	
Date Sampled	13/04/2018	Area	
Sampled By	Client Sampled	Location	
Date Tested	19/04/2018		
Material Source	Client	Material Type	Dark grey silty SAND

Soil Particle Density (Fine)		Soil Particle Density (Coarse)	
Percent of Fine Fraction (%)	100.0	Percent of Coarse Fraction (%)	0.0
Temperature of Test (C°)	21	Temperature of Test (C°)	-
Supplied Result Reference	-	Supplied Result Reference	-
Average Particle Density Fine (t/m³)	**2.79**	Average Particle Density Coarse (t/m³)	**-**

Soil Particle Density (t/m³) 2.79

Remarks

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
Accredited for compliance with ISO/IEC 17025 - Testing

Accreditation Number: 1986
Corporate Site Number: 5022

[redacted]

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
72 McCombe Road,
Davenport WA 6230

Laboratory: Bunbury
Phone: 08 9726 2187
Fax: 08 9721 2348
Email: Bunbury@constructionsciences.net

PERMEABILITY OF A SOIL

Client:	Knight Piesold Pty Ltd	Report Number:	5022/R/19908-1
Client Address:	Level 1 / 184 Adelaide Terrace, East Perth	Project Number:	5022/P/1056
Project:	Mungari Tailings Assessment	Lot Number:	North Wall
Location:	Coolgardie WA	Internal Test Request:	5022/T/6740
Supplied To:	n/a	Client Reference/s:	P16776
Area Description:	Cell 2	Report Date / Page:	3/05/2018 Page 1 of 1

Test Procedures:	AS1289.6.7.2		
Sample Number	5022/S/35569	Sample Location	
Sampling Method	Tested As Received	Test Request	
Date Sampled	13/04/2018	Area	
Sampled By	Client Sampled	Location	
Date Tested	30/04/2018		
Material Source	Client	Material Type	Dark grey silty SAND

Soil Description:			
Retained on 19.0 mm Sieve (%)	0.0	Compaction Method:	Standard AS1289.5.1.1

Maximum Dry Density (t/m³)	1.88700	Optimum Moisture Content (%)	13.5
Dry Density of Sample (t/m³)	1.845	Moisture at Compaction (%)	13.9
Achieved Dry Density Ratio (%)	**97.8**	**Achieved Moisture Ratio (%)**	**103.0**

Surcharge Mass (kg)	2.317	Surcharge Pressure (kPa)	2.8
Moisture % After Permeability (%)	16.7	Hydraulic Gradient	1.4

Coefficent of Permeability (Falling Head)	5E-008 m/s (5E-006 cm/s)

Remarks

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
Accredited for compliance with ISO/IEC 17025 - Testing

Accreditation Number: 1986
Corporate Site Number: 5022

[redacted]

Construction Sciences
Bunbury Laboratory
72 McCombe Road, Davenport WA 6230

Report for

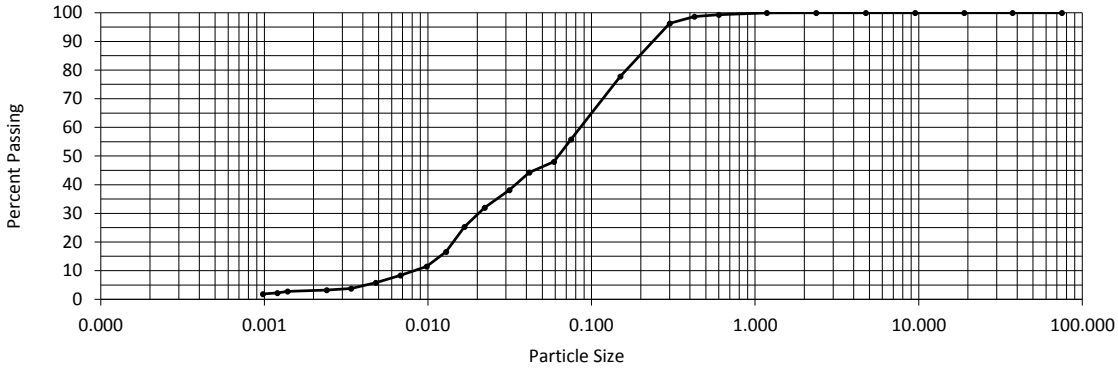
PARTICLE SIZE DISTRIBUTION (AS 1289 3.6.1 / 3.6.3)

[redacted]

Client:	Knight Piesold Pty Ltd	**Report No:**	**5022/R/HYD/35569-1**
Client Address:	Level 1 / 184 Adelaide Terrace, East Perth, WA 6004		
Project:	Mungari Tailings Assessment	**Test Request:**	5022/T/6740
Project Location:	Coolgardie, WA		
Test Location:	North Wall		
Material Description:	Dark grey silty SAND		
Sampled By:	Client	**Sample Date:**	13/04/2018
Tested By:	Paul Kent	**Test Date:**	17/04/2018
Sampling Method:	Tested as received	**Sample No:**	5022/S/35569

Hydrometer Type:	ASTM E100 152H, Grams per litre
Dispersant Type:	Sodium Hexametaphosphate and Anhydrous Sodium Carbonate
Pre-treatment:	AS 1289.3.6.3 - 6.1(a)
Loss on Pre-treatment:	None

Particle Size Distribution



Soil Particle Density (AS1289.3.5.1) -2.36mm (t/m3)

2.794

Soil Particle Density Sample No.

5022/S/33569

Soil Particle Density Report No.

5022/R/19624-1

PSD - AS1289.3.6.1

Sieve Size (mm)	Percent Passing
75.0	100
37.5	100
19.0	100
9.5	100
4.75	100
2.36	100
1.18	100
0.600	99
0.425	99
0.300	96
0.150	78
0.075	56

PSD Hydrometer - AS1289.3.6.3

Sieve Size (µm)	Percent Passing
58.845	48.0
41.61	44.3
31.44	38.1
22.23	32.0
16.73	25.3
12.90	16.6
9.80	11.5
6.78	8.4
4.80	5.8
3.39	3.8
2.40	3.3
1.38	2.7
1.20	2.2
0.98	1.9

[redacted]

Construction Sciences
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PO BOX 5004, Bunbury DC, WA 6230, Australia
Phone: +61 8 9726 2187 Fax: +61 8 9721 2348
www.cardno.com.au

Accreditation Number 1986
Corporate Site Number 5022
72 McCombe Road, Bunbury, WA 6230
NATA

SPECIMEN		1	2	3
DATE TESTED		24/04/2018	24/04/2018	24/04/2018
INITIAL CONDITIONS				
Sample Length	(mm)	59.99	59.99	59.99
Sample Breadth	(mm)	60.00	60.00	60.00
Sample Height	(mm)	25.00	25.00	25.00
Moisture content	(%)	13.9	13.9	13.7
Bulk density	(t/m³)	2.10	2.10	2.10
Dry density	(t/m³)	1.84	1.84	1.85
Voids ratio		0.515	0.513	0.510
Degree of saturation	(%)	76	75	75
Rate of displacement	(mm/min)	0.5	0.5	0.5
SHEARING (at Peak Shear Strength)				
Voids ratio at start of shear		0.488	0.490	0.480
Normal stress	(kPa)	50	100	200
Peak shear stress	(kPa)	47	85	155
Horizontal displacement	(mm)	2.17	11.17	8.18
Vertical movement	(mm)	0.19	0.03	0.06
Residual at 9.5mm displacement				
Residual shear stress	(kPa)	45	83	150

Particle Density	(t/m³)	2.79 (Measured)
Specimens tested dry or submerged		Submerged
Undisturbed / Remoulded		Remoulded to 98% SMDD

Soil Description:	Dark grey silty SAND
Sampled by:	Client Sampled
Sample Date:	26/03/2018

Client:	**Knight Piesold Pty Ltd**	**Location:**	**North Wall**
Project Title:	**Mungari Tailings Assessment**	**Client ID:**	-
Sample ID:	**5022/S/35569**	**Report No:**	**5022/R/SB/35569**

DIRECT SHEAR TEST
STANDARD SHEAR BOX: SOIL - SOIL INTERFACE

Tested in accordance with AS1289.6.2.2

Accredited for compliance with ISO/IEC 17025

Approved Signato[redacted] Date: 3/05/2018

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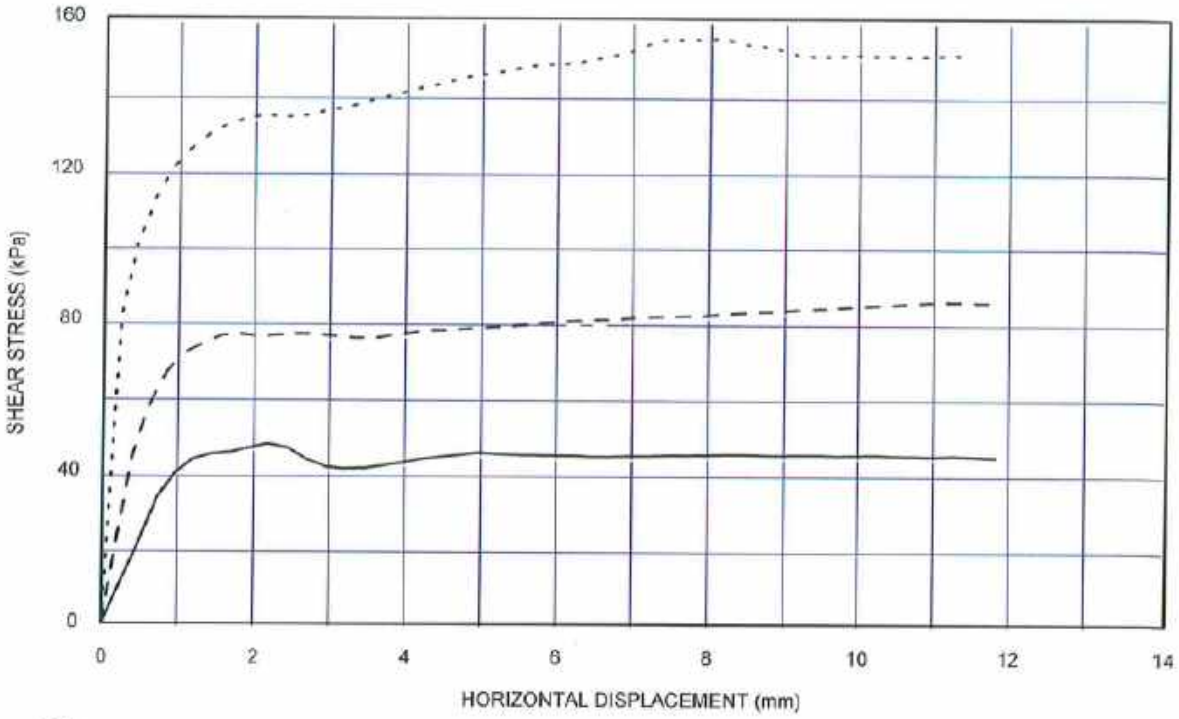
72 McCombe Road, Bunbury WA 6230
[redacted]
NATA

Drawn by: P.Kent Date: 02/05/2018



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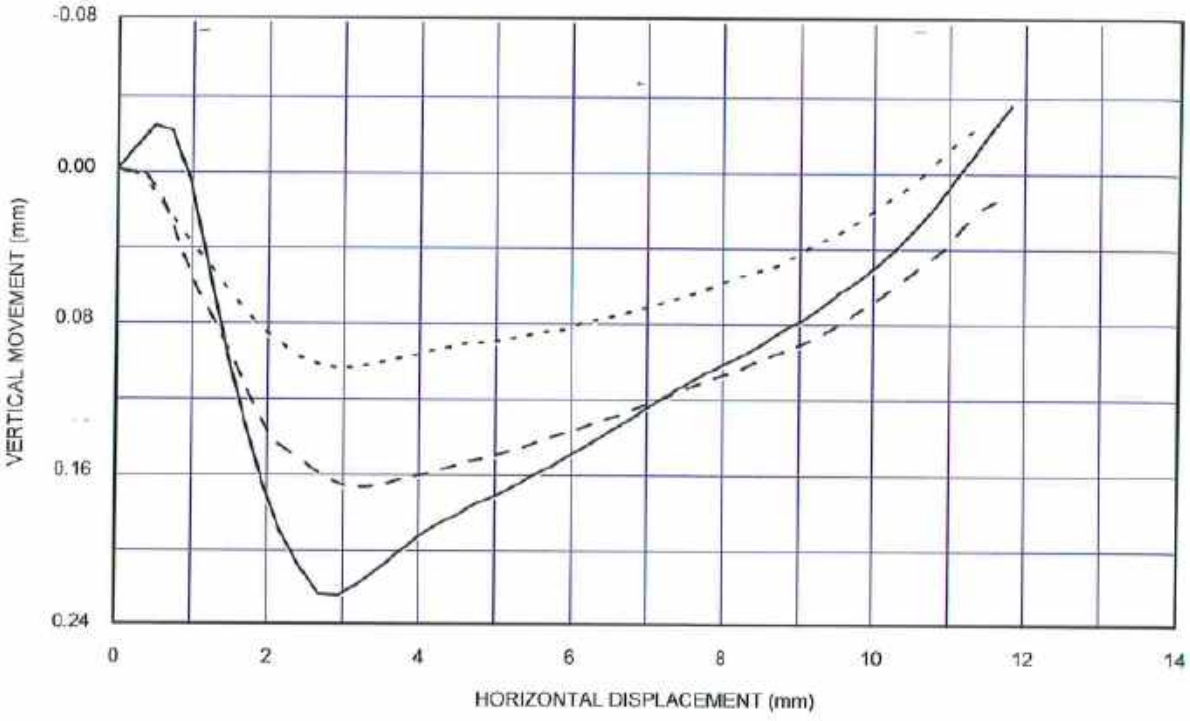

—— Specimen 1: Normal stress 50 kPa – – · Specimen 2: Normal stress 100 kPa · · · · Specimen 3: Normal stress 200 kPa	Location : North Wall Client ID : - Report No : 5022/R/SB/35569 Lab Sample ID 5022/S/35569

DIRECT SHEAR TEST
STANDARD SHEAR BOX: SOIL - SOIL INTERFACE
Tested in accordance with AS1289.6.2.2

Approved Sig[redacted] Date: 02/05/2018

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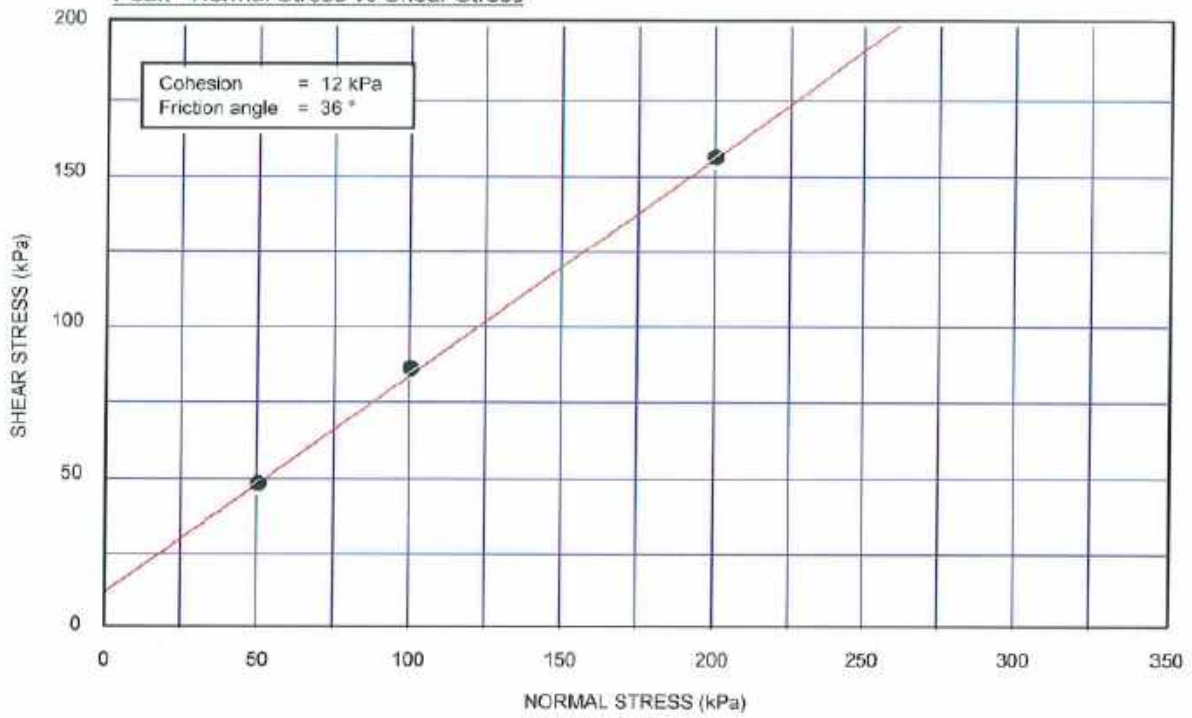
NATA

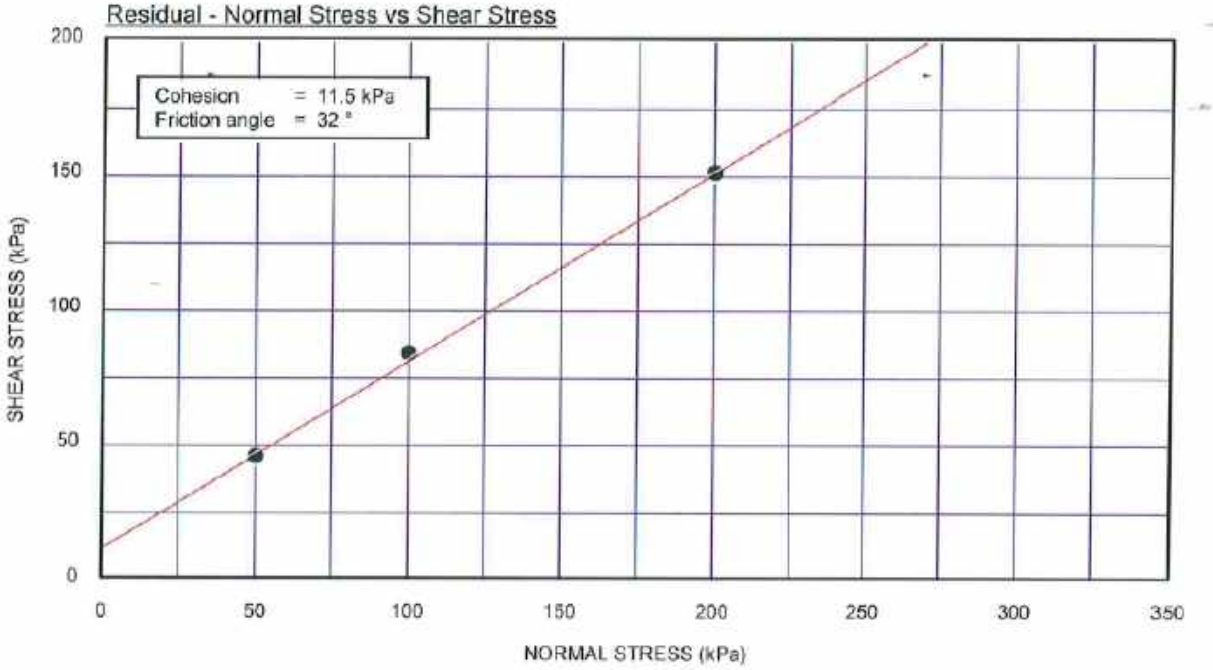
Drawn by: P.Kent Date: 02/05/2018

Template Issue: 2 Filename: P.Kent.OPJ

Peak - Normal Stress vs Shear Stress



Residual - Normal Stress vs Shear Stress



Specimen 1: Normal stress 50 kPa Specimen 2: Normal stress 100 kPa Specimen 3: Normal stress 200 kPa	Location : North Wall Client ID : - Report No : 5022/R/SB/35569 Lab Sample ID 5022/S/35569

DIRECT SHEAR TEST
STANDARD SHEAR BOX: SOIL - SOIL INTERFACE
Tested in accordance with AS1289.6.2.2

Approved Signatory [redacted] Date: 02/05/2018

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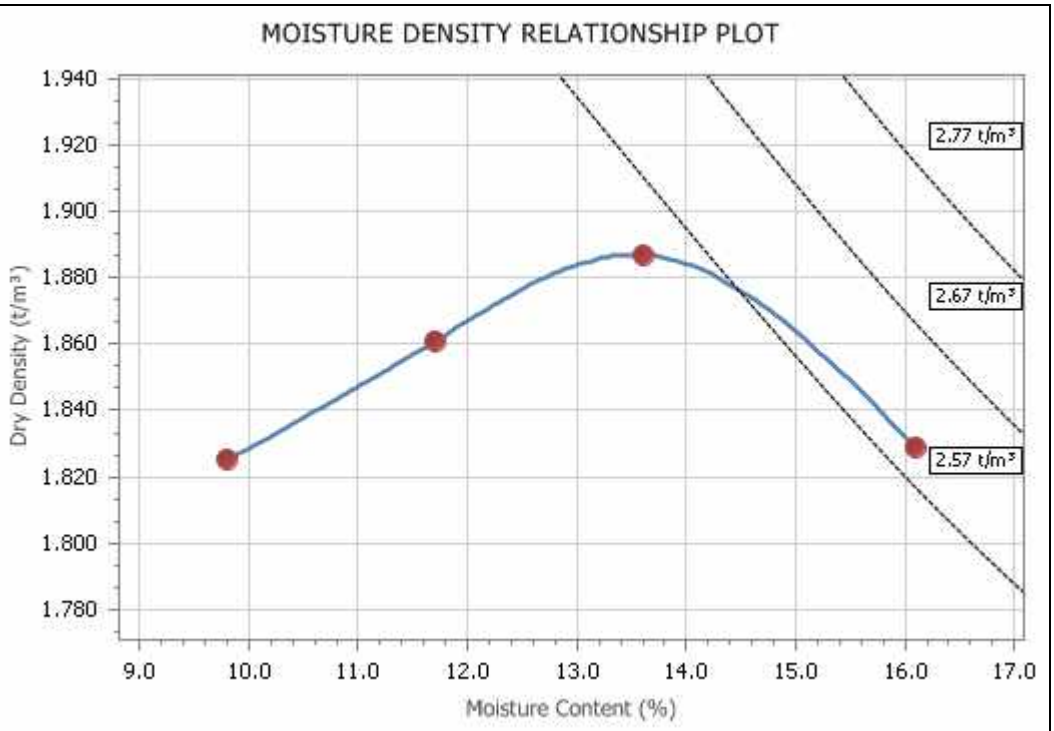
MOISTURE DENSITY RELATIONSHIP REPORT

Client:	Knight Piesold Pty Ltd	Report Number:	5022/R/19471-1
Client Address:	Level 1 / 184 Adelaide Terrace, East Perth	Project Number:	5022/P/1056
Project:	Mungari Tailings Assessment	Lot Number:	North Wall
Location:	Coolgardie WA	Internal Test Request:	5022/T/6740
Supplied To:	n/a	Client Reference/s:	P16776
Area Description:	Cell 2	Report Date / Page:	18/04/2018 Page 1 of 1

Test Procedures	AS1289.5.1.1, AS1289.2.1.1	Sample Location	
Sample Number	5022/S/35569	Test Request	
Sampling Method	Tested As Received	Area	
Date Sampled	13/04/2018	Location	
Sampled By	Client Sampled		
Date Tested	17/04/2018	Compactive Effort	Standard
Material Source	Client	Fraction Tested (mm)	< 19.0mm
Material Type		Percent Oversize (%)	0.0
Liquid Limit Method	Estimation	Total Curing Time (hrs)	2.0
Material Description	Fine Black SAND		

Moisture / Density Relationship Data

Moisture Content (%)	Dry Density (t/m³)
9.8	1.825
11.7	1.861
13.6	1.887
16.1	1.829



Maximum Dry Density (t/m³):	1.89	Optimum Moisture Content (%):	13.5

Remarks

NATA

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ATTERBERG LIMITS REPORT

Client:	Knight Piesold Pty Ltd	Report Number:	5022/R/19734-1
Client Address:	Level 1 / 184 Adelaide Terrace, East Perth	Project Number:	5022/P/1056
Project:	Mungari Tailings Assessment	Lot Number:	South Wall
Location:	Coolgardie WA	Internal Test Request:	5022/T/6740
Supplied To:	n/a	Client Reference/s:	P16776
Area Description:	Cell 2	Report Date / Page:	26/04/2018 Page 1 of 1

Test Procedures:	AS1289.3.1.1, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1726 (App. A)		
Sample Number	5022/S/35570	Sample Location	
Sampling Method	Tested As Received	Test Request	
Date Sampled	13/04/2018	Area	
Sampled By	Client Sampled	Location	
Date Tested	24/04/2018		
Att. Drying Method	Oven Dried	Material Source	Client
Atterberg Preparation	Dry Sieved	Material Type	Dark grey silty SAND
Material Description	Very dark grey SAND		

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**Not Obtainable**	
Plastic Limit (%)		**Not Obtainable**	
Plasticity Index (%)		**Non Plastic**	
Linear Shrinkage (%)		**1.0**	
Linear Shrinkage Defects:	-		

Remarks

NATA

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SOIL PARTICLE DENSITY REPORT

Client:	Knight Piesold Pty Ltd	Report Number:	5022/R/19625-1
Client Address:	Level 1 / 184 Adelaide Terrace, East Perth	Project Number:	5022/P/1056
Project:	Mungari Tailings Assessment	Lot Number:	South Wall
Location:	Coolgardie WA	Internal Test Request:	5022/T/6740
Supplied To:	n/a	Client Reference/s:	P16776
Area Description:	Cell 2	Report Date / Page:	20/04/2018 Page 1 of 1

Test Procedures:	AS1289.3.5.1		
Sample Number	5022/S/35570	Sample Location	
Sampling Method	Tested As Received	Test Request	
Date Sampled	13/04/2018	Area	
Sampled By	Client Sampled	Location	
Date Tested	19/04/2018		
Material Source	Client	Material Type	Dark grey silty SAND

Soil Particle Density (Fine)		Soil Particle Density (Coarse)	
Percent of Fine Fraction (%)	100.0	Percent of Coarse Fraction (%)	0.0
Temperature of Test (C°)	20	Temperature of Test (C°)	-
Supplied Result Reference	-	Supplied Result Reference	-
Average Particle Density Fine (t/m³)	**2.79**	Average Particle Density Coarse (t/m³)	**-**

Soil Particle Density (t/m³)	2.79

Remarks

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PERMEABILITY OF A SOIL

Client:	Knight Piesold Pty Ltd	Report Number:	5022/R/19983-1
Client Address:	Level 1 / 184 Adelaide Terrace, East Perth	Project Number:	5022/P/1056
Project:	Mungari Tailings Assessment	Lot Number:	South Wall
Location:	Coolgardie WA	Internal Test Request:	5022/T/6740
Supplied To:	n/a	Client Reference/s:	P16776
Area Description:	Cell 2	Report Date / Page:	7/05/2018 Page 1 of 1

Test Procedures:	AS1289.6.7.2		
Sample Number	5022/S/35570	Sample Location	
Sampling Method	Tested As Received	Test Request	
Date Sampled	13/04/2018	Area	
Sampled By	Client Sampled	Location	
Date Tested	3/05/2018		
Material Source	Client	Material Type	Dark grey silty SAND

Soil Description:			
Retained on 19.0 mm Sieve (%)	-	Compaction Method:	Standard AS1289.5.1.1

Maximum Dry Density (t/m³)	1.89900	Optimum Moisture Content (%)	12.5
Dry Density of Sample (t/m³)	1.853	Moisture at Compaction (%)	13.0
Achieved Dry Density Ratio (%)	**97.6**	**Achieved Moisture Ratio (%)**	**104.0**

Surcharge Mass (kg)	2.314	Surcharge Pressure (kPa)	1.3
Moisture % After Permeability (%)	17.4	Hydraulic Gradient	

Coefficent of Permeability (Falling Head)	8E-008 m/s (8E-006 cm/s)

Remarks

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Bunbury Laboratory
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Report for

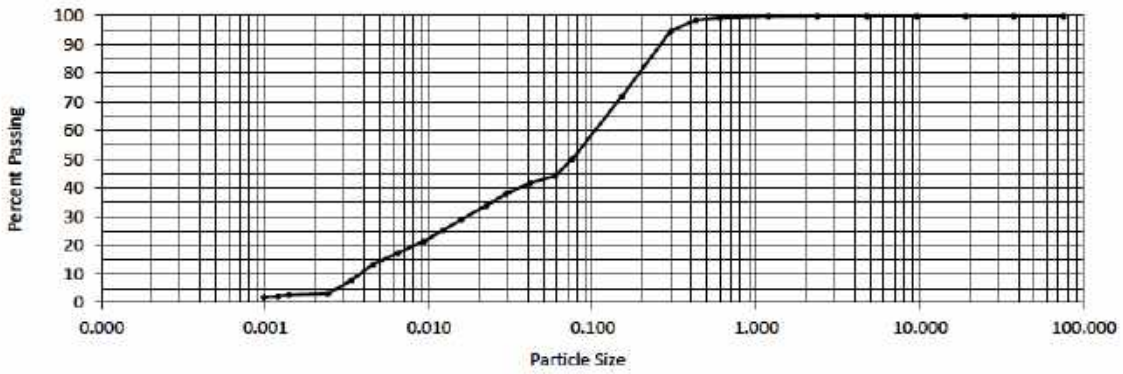
PARTICLE SI E DISTRIBUTION AS . . / . .

[redacted]

Client:	Knight Piesold Pty Ltd	**Report No:**	**5022/R/HYD/35570-1**
Client Address:	Level 1 / 184 Adelaide Terrace, East Perth, WA 6004		
Project:	Mungari Tailings Assessment	**Test Request:**	5022/T/6740
Project Location:	Coolgardie, WA		
Test Location:	South Wall		
Material Description:	Dark grey silty SAND		
Sampled By:	Client	**Sample Date:**	13/04/2018
Tested By:	[redacted]	**Test Date:**	17/04/2018
Sampling Method:	Tested as received	**Sample No:**	5022/S/35570

Hydrometer Type:	ASTM E100 152H, Grams per litre
Dispersant Type:	Sodium Hexametaphosphate and Anhydrous Sodium Carbonate
Pre-treatment:	AS 1289.3.6.3 - 6.1(a)
Loss on Pre-treatment:	None

Particle Size Distribution



Soil Particle Density (AS1289.3.5.1) -2.36mm (t/m3)

2.788

Soil Particle Density Sample No.

5022/S/33570

Soil Particle Density Report No.

5022/R/19625-1

PSD - AS1289.3.6.1

Sieve Size (mm)	Percent Passing
75.0	100
37.5	100
19.0	100
9.5	100
4.75	100
2.36	100
1.18	100
0.600	99
0.425	99
0.300	95
0.150	72
0.075	50

PSD Hydrometer - AS1289.3.6.3

Sieve Size (µm)	Percent Passing
58.971	44.2
41.70	41.7
29.49	37.9
22.29	33.7
15.76	29.0
12.23	25.3
9.29	21.5
6.46	17.3
4.57	13.5
3.39	7.9
2.40	3.2
1.38	2.7
1.20	2.2
0.98	1.9

[redacted]

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Accreditation Number 1986
Corporate Site Number 5022
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NATA

SPECIMEN		1	2	3
DATE TESTED		24/04/2018	24/04/2018	24/04/2018
INITIAL CONDITIONS				
Sample Length	(mm)	59.98	59.98	59.98
Sample Breadth	(mm)	59.99	59.99	59.99
Sample Height	(mm)	25.01	25.01	25.01
Moisture content	(%)	13.9	13.9	14.0
Bulk density	(t/m³)	2.09	2.09	2.10
Dry density	(t/m³)	1.84	1.84	1.84
Voids ratio		0.518	0.518	0.515
Degree of saturation	(%)	75	75	76
Rate of displacement	(mm/min)	0.5	0.5	0.5
SHEARING (at Peak Shear Strength)				
Voids ratio at start of shear		0.475	0.464	0.429
Normal stress	(kPa)	50	100	200
Peak shear stress	(kPa)	51	99	184
Horizontal displacement	(mm)	1.27	3.57	10.06
Vertical movement	(mm)	0.14	0.17	-0.22
Residual at 9.5mm displacement				
Residual shear stress	(kPa)	45	95	182

Particle Density	(t/m³)	2.79 (Measured)
Specimens tested dry or submerged		Submerged
Undisturbed / Remoulded		Remoulded to 98% SMDD

Soil Description:	Dark grey silty SAND
Sampled by:	Client Sampled
Sample Date:	26/03/2018

Client:	**Knight Piesold Pty Ltd**	**Location:**	**South Wall**
Project Title:	**Mungari Tailings Assessment**	**Client ID:**	-
Sample ID:	**5022/S/35570**	**Report No:**	**5022/R/SB/35570**

DIRECT SHEAR TEST
STANDARD SHEAR BOX: SOIL - SOIL INTERFACE

Tested in accordance with AS1289.6.2.2

Accredited for compliance with ISO/IEC 17025

Approved Signatory [redacted] Date: 3/05/2018

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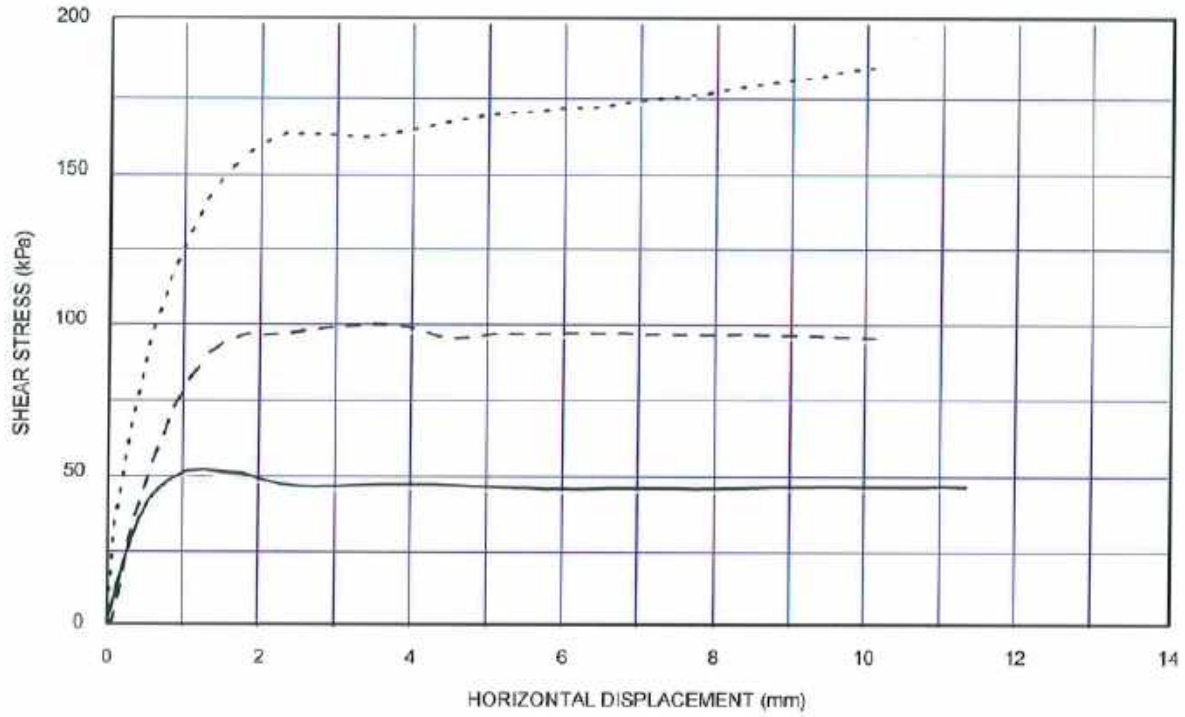
Drawn by: P.Kent Date: 02/05/2018



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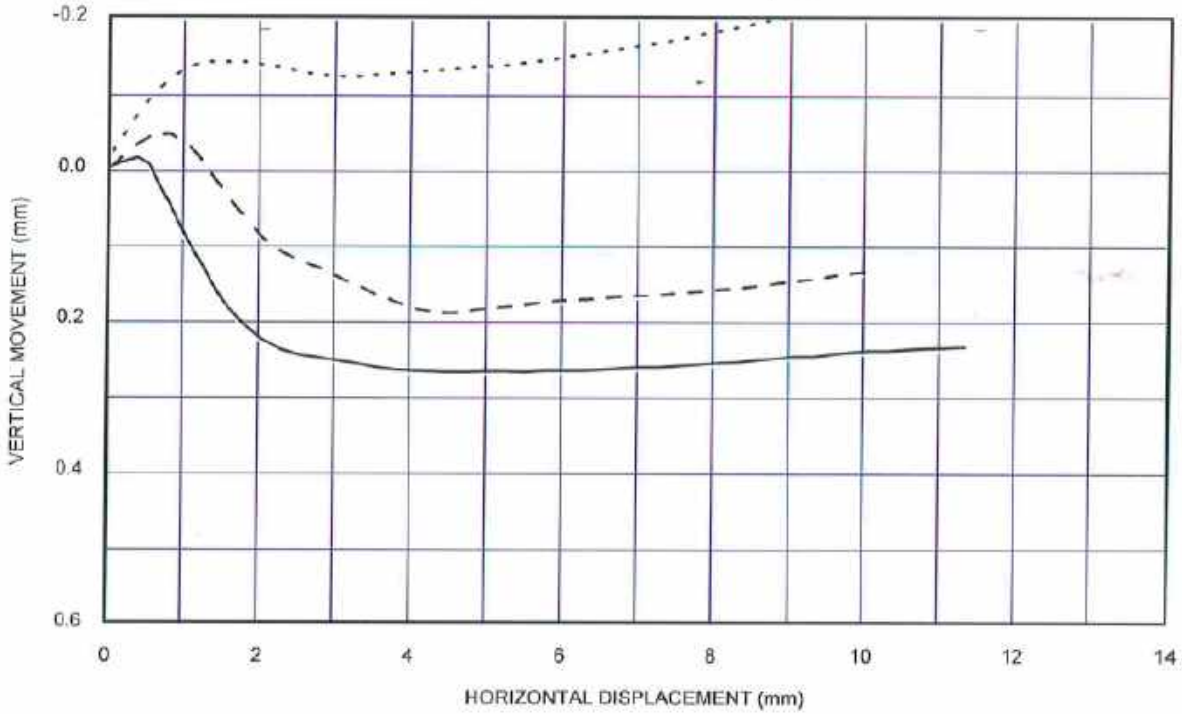

—— Specimen 1: Normal stress 50 kPa – – · Specimen 2: Normal stress 100 kPa · · · · Specimen 3: Normal stress 200 kPa	Location : South Wall Client ID : - Report No : 5022/R/SB/35570 Lab Sample ID 5022/S/35570

DIRECT SHEAR TEST
STANDARD SHEAR BOX: SOIL - SOIL INTERFACE
Tested in accordance with AS1289.6.2.2

[redacted]

Approved Signatory: P.Kent Date: 02/05/2018

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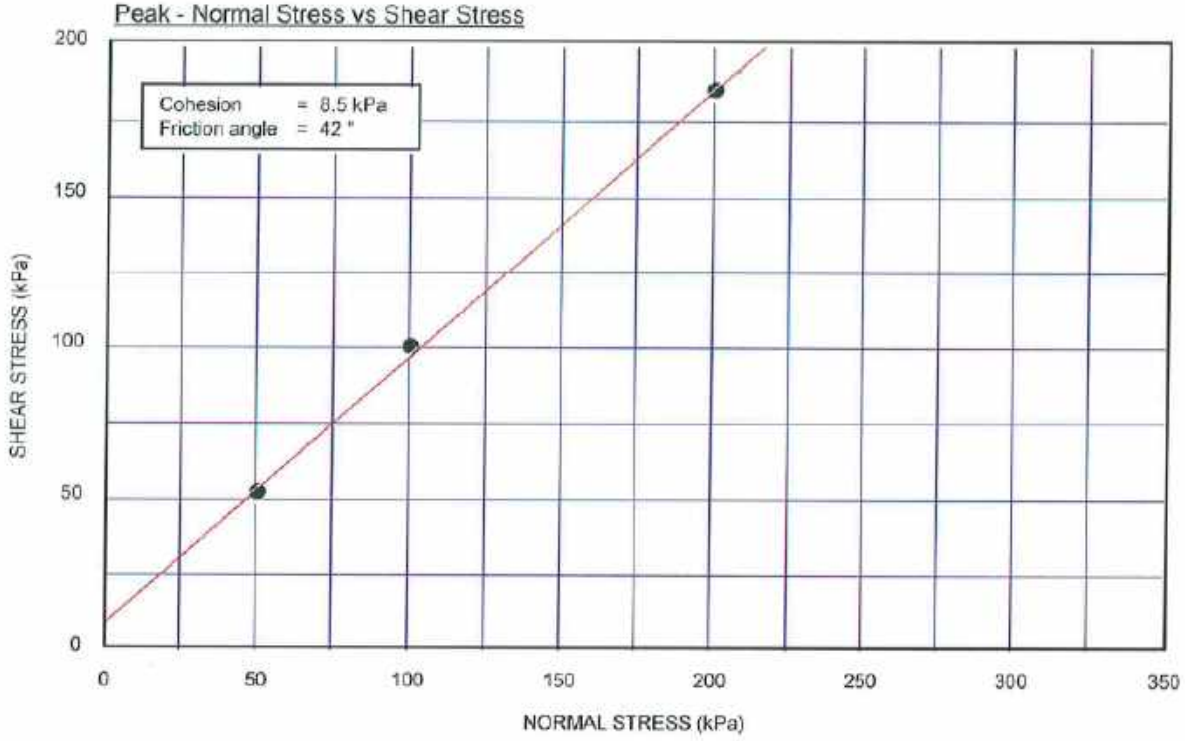
NATA

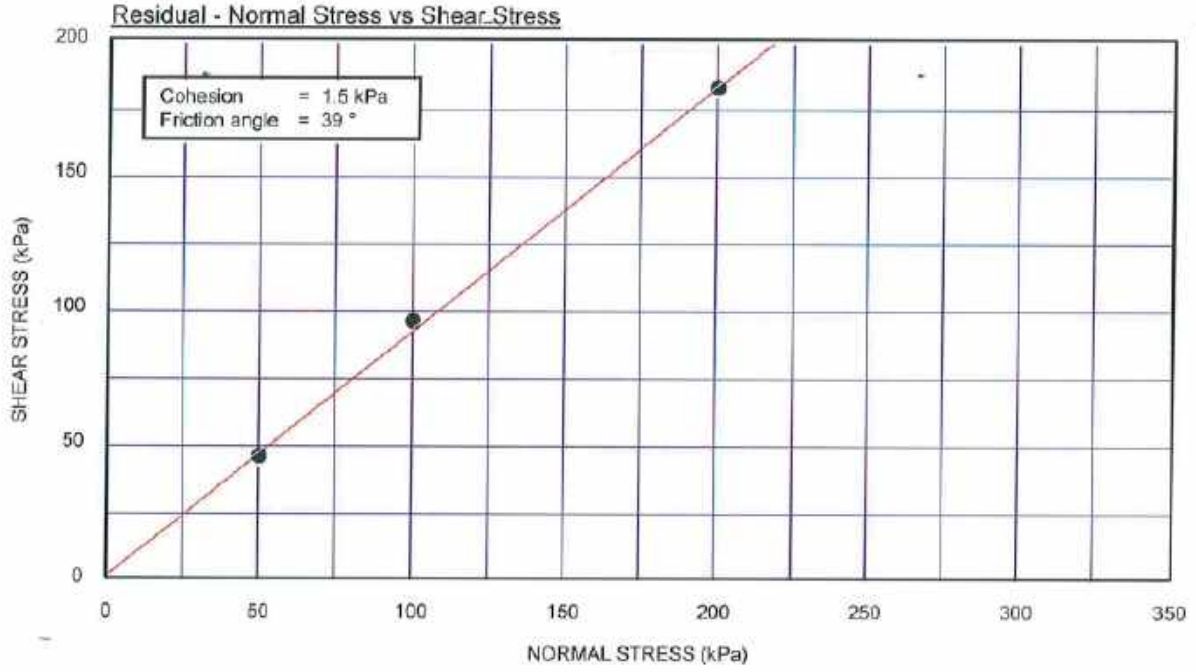
Drawn by: P.Kent Date: 02/05/2018

Template Issue: 2 Filename: P.Kent.OPJ

Peak - Normal Stress vs Shear Stress



Residual - Normal Stress vs Shear Stress



Specimen 1: Normal stress 50 kPa Specimen 2: Normal stress 100 kPa Specimen 3: Normal stress 200 kPa	Location : South Wall Client ID : - Report No : 5022/R/SB/35570 Lab Sample ID 5022/S/35570

DIRECT SHEAR TEST
STANDARD SHEAR BOX: SOIL - SOIL INTERFACE
Tested in accordance with AS1289.6.2.2

Approved Signa [redacted] Date: 02/05/2018

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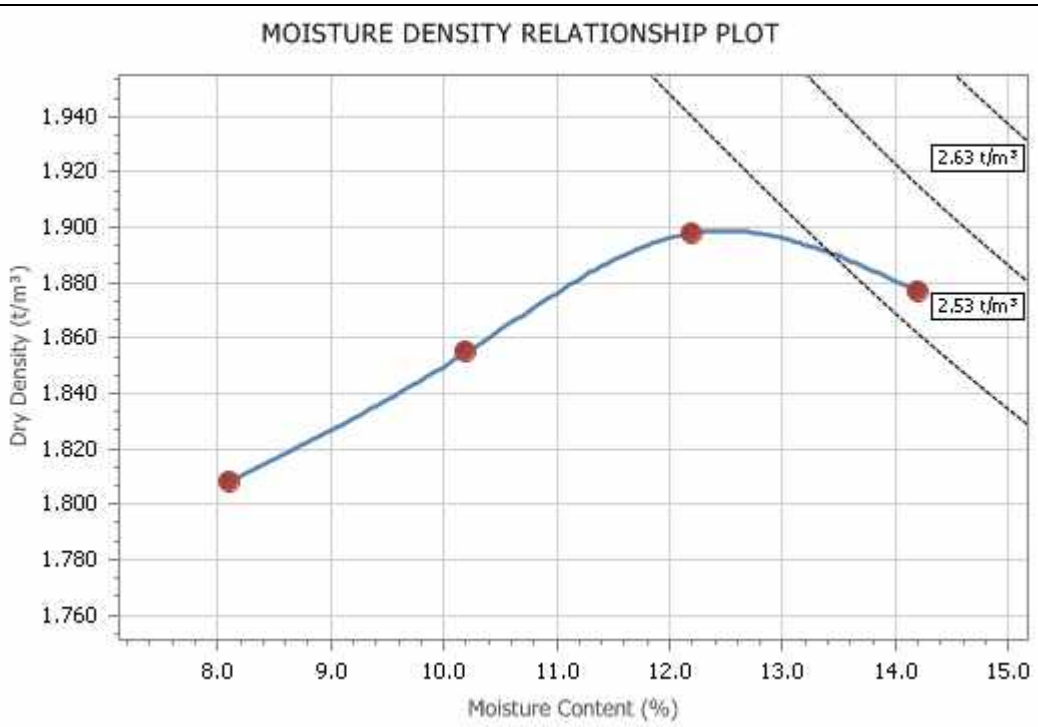
MOISTURE DENSITY RELATIONSHIP REPORT

Client:	Knight Piesold Pty Ltd	Report Number:	5022/R/19402-1
Client Address:	Level 1 / 184 Adelaide Terrace, East Perth	Project Number:	5022/P/1056
Project:	Mungari Tailings Assessment	Lot Number:	South Wall
Location:	Coolgardie WA	Internal Test Request:	5022/T/6740
Supplied To:	n/a	Client Reference/s:	P16776
Area Description:	Cell 2	Report Date / Page:	17/04/2018 Page 1 of 1

Test Procedures	AS1289.5.1.1, AS1289.2.1.1	Sample Location	
Sample Number	5022/S/35570	Test Request	
Sampling Method	Tested As Received	Area	
Date Sampled	13/04/2018	Location	
Sampled By	Client Sampled		
Date Tested	13/04/2018	Compactive Effort	Standard
Material Source	Client	Fraction Tested (mm)	< 19.0mm
Material Type		Percent Oversize (%)	0.0
Liquid Limit Method	Estimation	Total Curing Time (hrs)	n/a
Material Description	Very dark grey SAND		

Moisture / Density Relationship Data

Moisture Content (%)	Dry Density (t/m³)
8.1	1.808
10.2	1.855
12.2	1.898
14.2	1.877



Maximum Dry Density (t/m³):	1.90	Optimum Moisture Content (%):	12.5

Remarks

NATA

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ATTERBERG LIMITS REPORT

Client:	Knight Piesold Pty Ltd	Report Number:	5022/R/19732-1
Client Address:	Level 1 / 184 Adelaide Terrace, East Perth	Project Number:	5022/P/1056
Project:	Mungari Tailings Assessment	Lot Number:	West Wall
Location:	Coolgardie WA	Internal Test Request:	5022/T/6740
Supplied To:	n/a	Client Reference/s:	P16776
Area Description:	Cell 2	Report Date / Page:	26/04/2018 Page 1 of 1

Test Procedures:	AS1289.3.1.1, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1726 (App. A)		
Sample Number	5022/S/35568	Sample Location	
Sampling Method	Tested As Received	Test Request	
Date Sampled	13/04/2018	Area	
Sampled By	Client Sampled	Location	
Date Tested	24/04/2018		
Att. Drying Method	Oven Dried	Material Source	Client
Atterberg Preparation	Dry Sieved	Material Type	Dark grey silty SAND
Material Description	Fine Black SAND		

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**Not Obtainable**	
Plastic Limit (%)		**Not Obtainable**	
Plasticity Index (%)		**Non Plastic**	
Linear Shrinkage (%)		**1.0**	
Linear Shrinkage Mould Length / Defects:	Mould Length: 249.0mm / -		

Remarks

NATA

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SOIL PARTICLE DENSITY REPORT

Client:	Knight Piesold Pty Ltd	Report Number:	5022/R/19623-1
Client Address:	Level 1 / 184 Adelaide Terrace, East Perth	Project Number:	5022/P/1056
Project:	Mungari Tailings Assessment	Lot Number:	West Wall
Location:	Coolgardie WA	Internal Test Request:	5022/T/6740
Supplied To:	n/a	Client Reference/s:	P16776
Area Description:	Cell 2	Report Date / Page:	20/04/2018 Page 1 of 1

Test Procedures:	AS1289.3.5.1		
Sample Number	5022/S/35568	Sample Location	
Sampling Method	Tested As Received	Test Request	
Date Sampled	13/04/2018	Area	
Sampled By	Client Sampled	Location	
Date Tested	19/04/2018		
Material Source	Client	Material Type	Dark grey silty SAND

Soil Particle Density (Fine)		Soil Particle Density (Coarse)	
Percent of Fine Fraction (%)	100.0	Percent of Coarse Fraction (%)	0.0
Temperature of Test (C°)	20	Temperature of Test (C°)	-
Supplied Result Reference	-	Supplied Result Reference	-
Average Particle Density Fine (t/m³)	**2.82**	Average Particle Density Coarse (t/m³)	**-**

Soil Particle Density (t/m³) 2.82

Remarks

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PERMEABILITY OF A SOIL

Client:	Knight Piesold Pty Ltd	Report Number:	5022/R/19982-1
Client Address:	Level 1 / 184 Adelaide Terrace, East Perth	Project Number:	5022/P/1056
Project:	Mungari Tailings Assessment	Lot Number:	West Wall
Location:	Coolgardie WA	Internal Test Request:	5022/T/6740
Supplied To:	n/a	Client Reference/s:	P16776
Area Description:	Cell 2	Report Date / Page:	7/05/2018 Page 1 of 1

Test Procedures:	AS1289.6.7.2		
Sample Number	5022/S/35568	Sample Location	
Sampling Method	Tested As Received	Test Request	
Date Sampled	13/04/2018	Area	
Sampled By	Client Sampled	Location	
Date Tested	3/05/2018		
Material Source	Client	Material Type	Dark grey silty SAND

Soil Description:			
Retained on 19.0 mm Sieve (%)	-	Compaction Method:	Standard AS1289.5.1.1

Maximum Dry Density (t/m³)	1.91400	Optimum Moisture Content (%)	12.7
Dry Density of Sample (t/m³)	1.882	Moisture at Compaction (%)	12.3
Achieved Dry Density Ratio (%)	**98.3**	**Achieved Moisture Ratio (%)**	**96.9**

Surcharge Mass (kg)	2.312	Surcharge Pressure (kPa)	1.3
Moisture % After Permeability (%)	16.0	Hydraulic Gradient	

Coefficent of Permeability (Falling Head)	8E-008 m/s (8E-006 cm/s)

Remarks

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Accreditation Number: 1986
Corporate Site Number: 5022

[redacted]

Construction Sciences
Bunbury Laboratory
72 McCombe Road, Davenport WA 6230

Report for

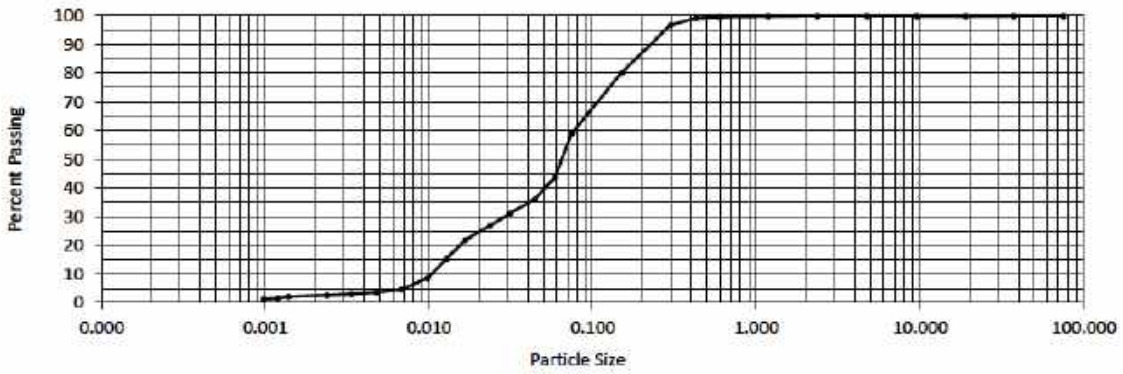
PARTICLE SI E DISTRIBUTION AS . . / . .

[redacted]

Client:	Knight Piesold Pty Ltd	**Report No:**	**5022/R/HYD/35568-1**
Client Address:	Level 1 / 184 Adelaide Terrace, East Perth, WA 6004		
Project:	Mungari Tailings Assessment	**Test Request:**	5022/T/6740
Project Location:	Coolgardie, WA		
Test Location:	West Wall		
Material Description:	Dark grey silty SAND		
Sampled By:	Client	**Sample Date:**	13/04/2018
Tested By:	[redacted]	**Test Date:**	17/04/2018
Sampling Method:	Tested as received	**Sample No:**	5022/S/35568

Hydrometer Type:	ASTM E100 152H, Grams per litre
Dispersant Type:	Sodium Hexametaphosphate and Anhydrous Sodium Carbonate
Pre-treatment:	AS 1289.3.6.3 - 6.1(a)
Loss on Pre-treatment:	None

Particle Size Distribution



Soil Particle Density (AS1289.3.5.1) -2.36mm (t/m3)

2.824

Soil Particle Density Sample No.

5022/S/33568

Soil Particle Density Report No.

5022/R/19623-1

PSD - AS1289.3.6.1

Sieve Size (mm)	Percent Passing
75.0	100
37.5	100
19.0	100
9.5	100
4.75	100
2.36	100
1.18	100
0.600	100
0.425	99
0.300	97
0.150	80
0.075	59

PSD Hydrometer - AS1289.3.6.3

Sieve Size (µm)	Percent Passing
58.616	43.6
44.38	36.1
31.38	31.2
23.58	26.7
16.67	21.8
12.86	15.4
9.76	8.5
6.75	4.6
4.77	3.6
3.38	3.1
2.39	2.6
1.38	2.1
1.19	1.6
0.97	1.3

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Accreditation Num er:
Corporate Site Num er:

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Accreditation Number 1986
Corporate Site Number 5022
72 McCombe Road, Bunbury, WA 6230
NATA

SPECIMEN		1	2	3
DATE TESTED		26/04/2018	26/04/2018	26/04/2018
INITIAL CONDITIONS				
Sample Length	(mm)	59.99	59.99	59.99
Sample Breadth	(mm)	59.98	59.98	59.98
Sample Height	(mm)	25.01	25.01	25.01
Moisture content	(%)	12.1	12.3	12.8
Bulk density	(t/m³)	2.11	2.12	2.12
Dry density	(t/m³)	1.89	1.88	1.88
Voids ratio		0.495	0.497	0.503
Degree of saturation	(%)	69	70	72
Rate of displacement	(mm/min)	0.5	0.5	0.5
SHEARING (at Peak Shear Strength)				
Voids ratio at start of shear		0.455	0.458	0.440
Normal stress	(kPa)	50	100	200
Peak shear stress	(kPa)	47	96	188
Horizontal displacement	(mm)	1.15	6.50	10.87
Vertical movement	(mm)	0.08	0.08	-0.05
Residual at 9.5mm displacement				
Residual shear stress	(kPa)	45	95	184

Particle Density	(t/m³)	2.82 (Measured)
Specimens tested dry or submerged		Submerged
Undisturbed / Remoulded		Remoulded to 98% SMDD

Soil Description:	Dark grey silty SAND
Sampled by:	Client Sampled
Sample Date:	26/03/2018

Client:	**Knight Piesold Pty Ltd**	**Location:**	**West Wall**
Project Title:	**Mungari Tailings Assessment**	**Client ID:**	-
Sample ID:	**5022/S/35568**	**Report No:**	**5022/R/SB/35568**

DIRECT SHEAR TEST
STANDARD SHEAR BOX: SOIL - SOIL INTERFACE

Tested in accordance with AS1289.6.2.2

Accredited for compliance with ISO/IEC 17025

Approved Signatory: [redacted] Date: 3/05/2018

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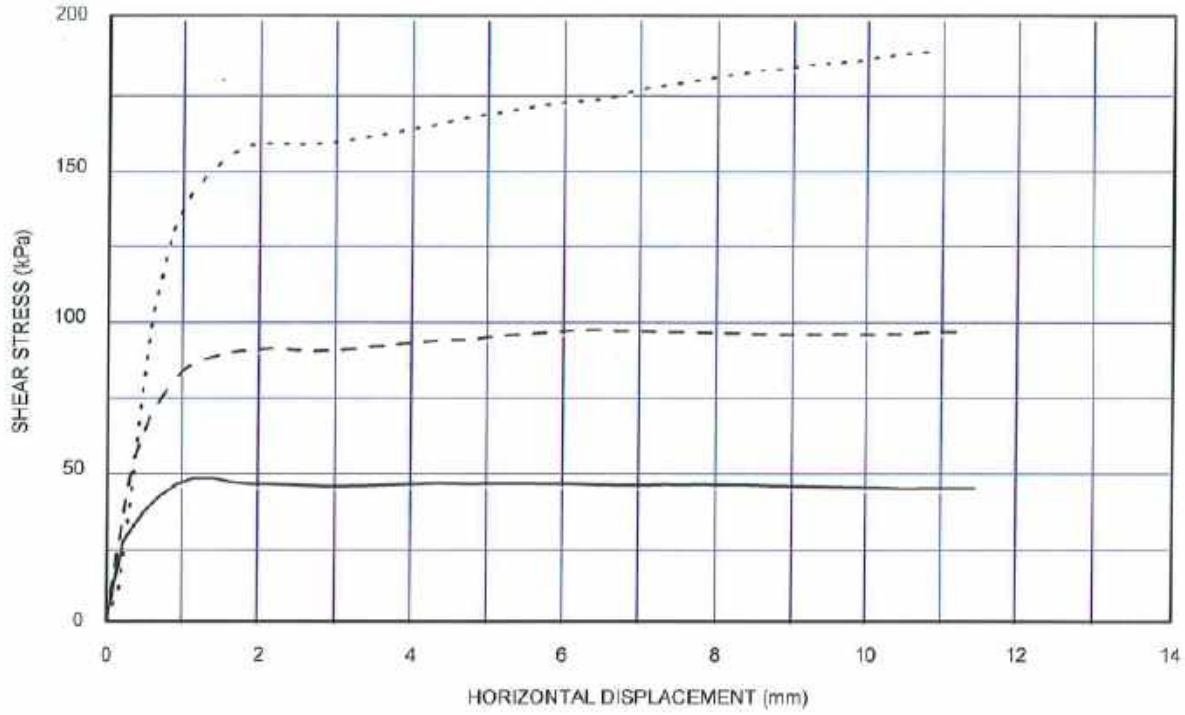
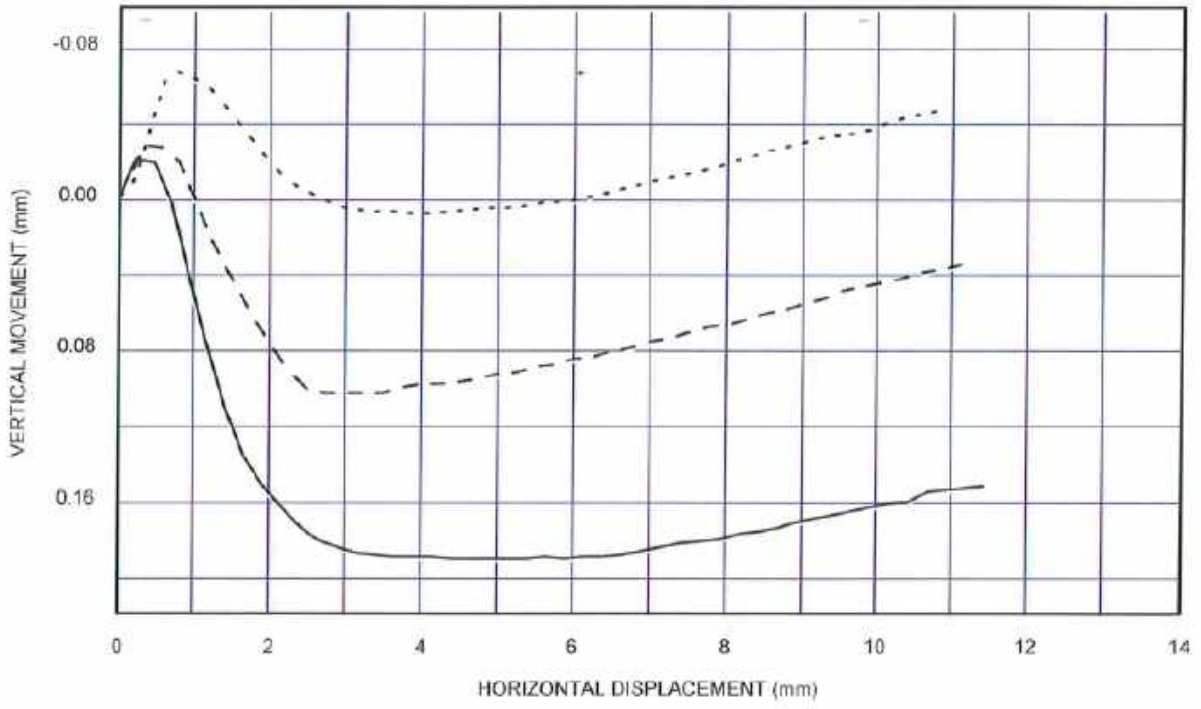
Bunbury Base Laboratory #5022
72 McCombe Road, Bunbury, WA 6230
[redacted]
NATA

Drawn by: P.Kent Date: 02/05/2018



Template Issue: 1 Tested By: P.Kent



—— Specimen 1: Normal stress 50 kPa – – · Specimen 2: Normal stress 100 kPa · · · · Specimen 3: Normal stress 200 kPa	Location : West Wall Client ID : - Report No : 5022/R/SB/35568 Lab Sample ID 5022/S/35568

DIRECT SHEAR TEST
STANDARD SHEAR BOX: SOIL - SOIL INTERFACE
Tested in accordance with AS1289.6.2.2

Approved Signatory [redacted] Date: 02/05/2018

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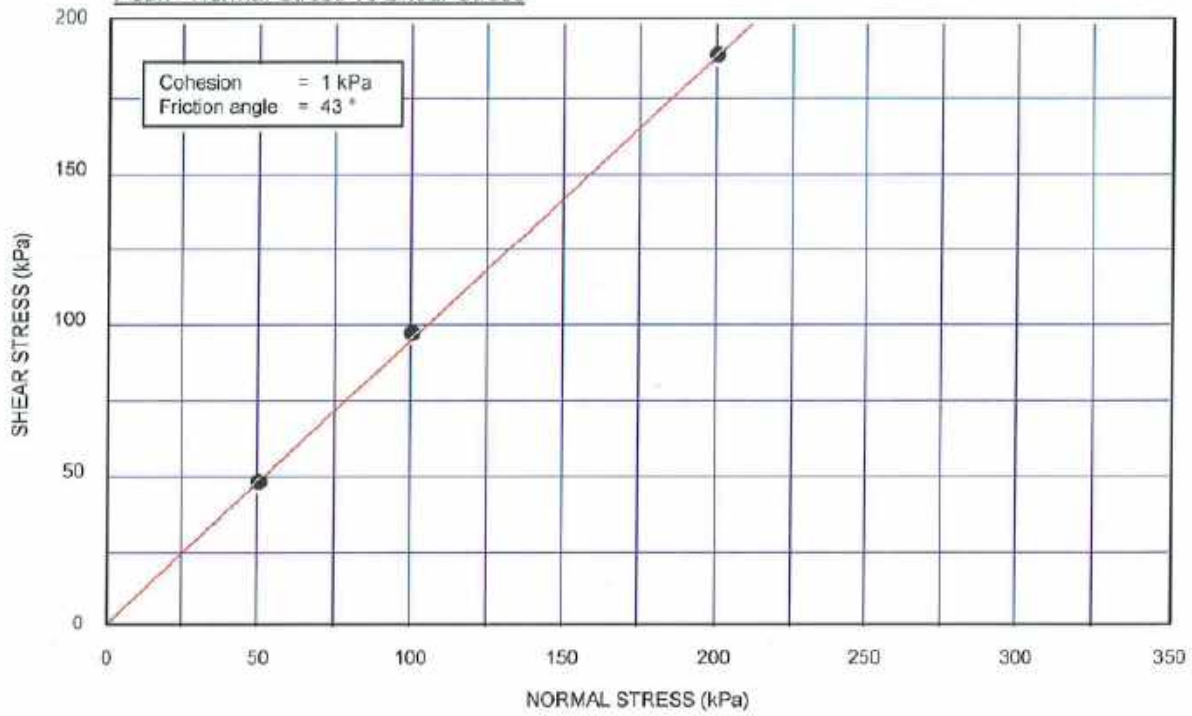
72 McCombe Road, Bunbury, WA 6230
[redacted]
NATA

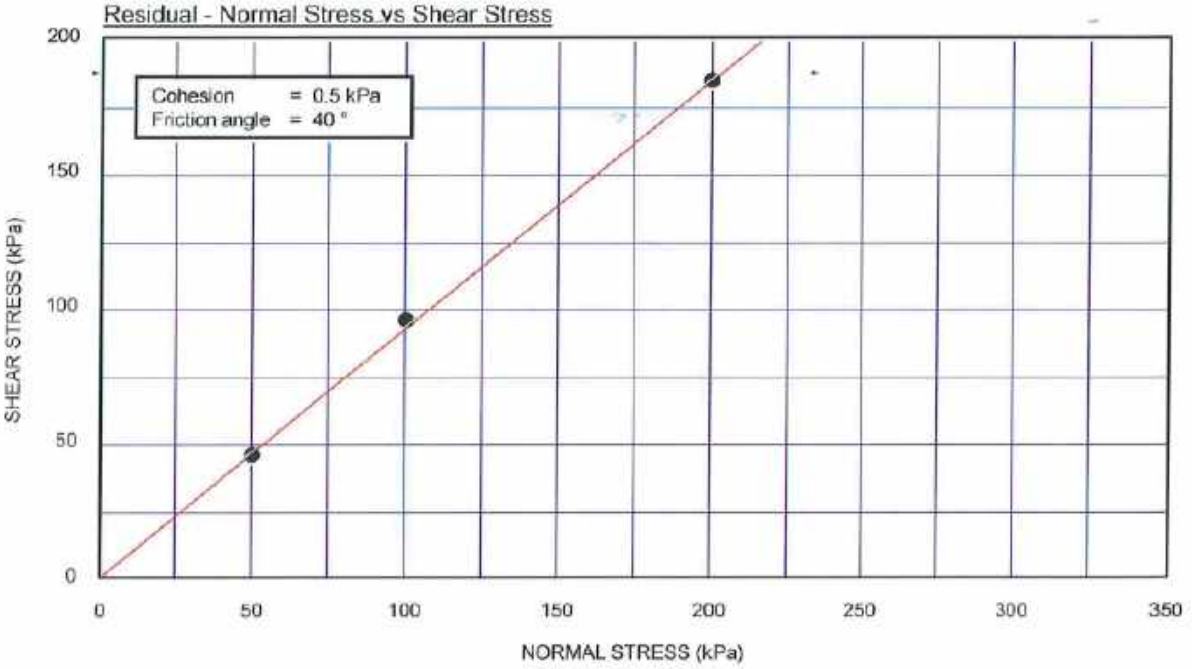
Drawn by: P.Kent Date: 02/05/2018

Template Issue: 2 Filename: P.Kent.OPJ

Peak - Normal Stress vs Shear Stress



Residual - Normal Stress vs Shear Stress



Specimen 1: Normal stress 50 kPa	Location : West Wall
Specimen 2: Normal stress 100 kPa	Client ID : -
Specimen 3: Normal stress 200 kPa	Report No : 5022/R/SB/35568
	Lab Sample ID 5022/S/35568

DIRECT SHEAR TEST
STANDARD SHEAR BOX: SOIL - SOIL INTERFACE
Tested in accordance with AS1289.6.2.2

Approved Signatory [redacted] Date: 02/05/2018

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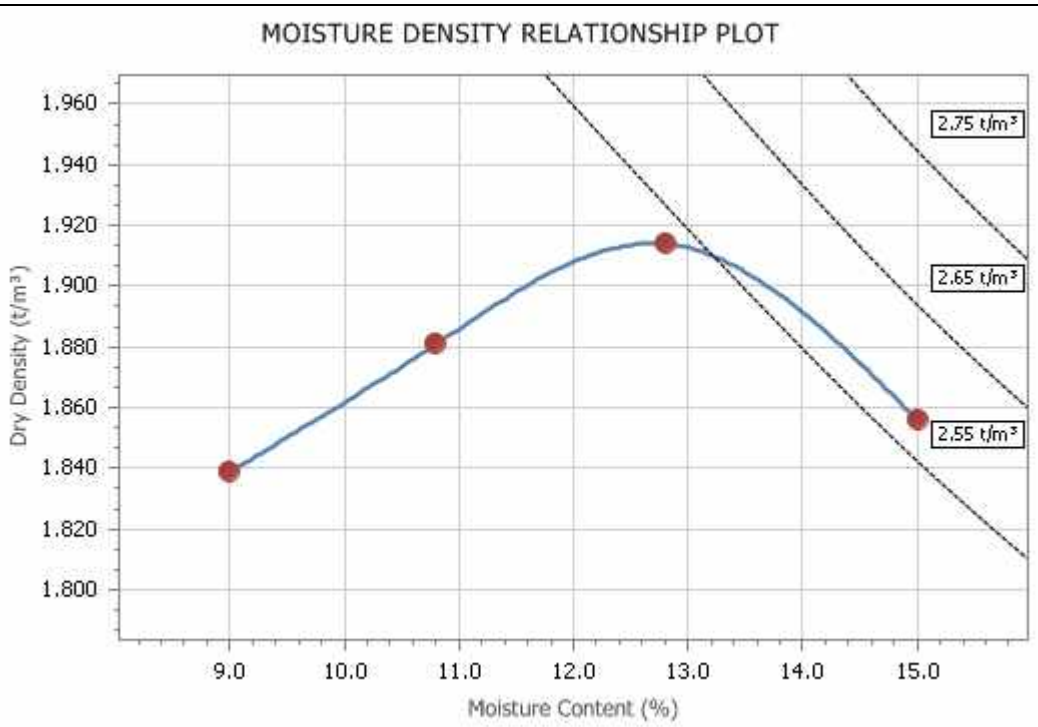
MOISTURE DENSITY RELATIONSHIP REPORT

Client:	Knight Piesold Pty Ltd	Report Number:	5022/R/19470-1
Client Address:	Level 1 / 184 Adelaide Terrace, East Perth	Project Number:	5022/P/1056
Project:	Mungari Tailings Assessment	Lot Number:	West Wall
Location:	Coolgardie WA	Internal Test Request:	5022/T/6740
Supplied To:	n/a	Client Reference/s:	P16776
Area Description:	Cell 2	Report Date / Page:	18/04/2018 Page 1 of 1

Test Procedures	AS1289.5.1.1, AS1289.2.1.1	Sample Location	
Sample Number	5022/S/35568	Test Request	
Sampling Method	Tested As Received	Area	
Date Sampled	13/04/2018	Location	
Sampled By	Client Sampled		
Date Tested	17/04/2018	Compactive Effort	Standard
Material Source	Client	Fraction Tested (mm)	< 19.0mm
Material Type		Percent Oversize (%)	0.0
Liquid Limit Method	Estimation	Total Curing Time (hrs)	2.0
Material Description	Fine Black SAND		

Moisture / Density Relationship Data

Moisture Content (%)	Dry Density (t/m³)
9.0	1.839
10.8	1.881
12.8	1.914
15.0	1.856



Maximum Dry Density (t/m³):	1.91	Optimum Moisture Content (%):	12.5

Remarks

NATA

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ATTERBERG LIMITS REPORT

Client:	Knight Piesold Pty Ltd	Report Number:	5022/R/19731-1
Client Address:	Level 1 / 184 Adelaide Terrace, East Perth	Project Number:	5022/P/1056
Project:	Mungari Tailings Assessment	Lot Number:	East Wall
Location:	Coolgardie WA	Internal Test Request:	5022/T/6740
Supplied To:	n/a	Client Reference/s:	P16776
Area Description:	Cell 2	Report Date / Page:	26/04/2018 Page 1 of 1

Test Procedures:	AS1289.3.1.1, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1726 (App. A)		
Sample Number	5022/S/35567	Sample Location	
Sampling Method	Tested As Received	Test Request	
Date Sampled	13/04/2018	Area	
Sampled By	Client Sampled	Location	
Date Tested	24/04/2018		
Att. Drying Method	Oven Dried	Material Source	Client
Atterberg Preparation	Dry Sieved	Material Type	Dark grey silty SAND
Material Description	Very dark grey SAND		

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**Not Obtainable**	
Plastic Limit (%)		**Not Obtainable**	
Plasticity Index (%)		**Non Plastic**	
Linear Shrinkage (%)		**0.0**	
Linear Shrinkage Mould Length / Defects:	Mould Length: 249.0mm / -		

Remarks

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SOIL PARTICLE DENSITY REPORT

Client:	Knight Piesold Pty Ltd	Report Number:	5022/R/19622-1
Client Address:	Level 1 / 184 Adelaide Terrace, East Perth	Project Number:	5022/P/1056
Project:	Mungari Tailings Assessment	Lot Number:	East Wall
Location:	Coolgardie WA	Internal Test Request:	5022/T/6740
Supplied To:	n/a	Client Reference/s:	P16776
Area Description:	Cell 2	Report Date / Page:	20/04/2018 Page 1 of 1

Test Procedures:	AS1289.3.5.1		
Sample Number	5022/S/35567	Sample Location	
Sampling Method	Tested As Received	Test Request	
Date Sampled	13/04/2018	Area	
Sampled By	Client Sampled	Location	
Date Tested	19/04/2018		
Material Source	Client	Material Type	Dark grey silty SAND

Soil Particle Density (Fine)		Soil Particle Density (Coarse)	
Percent of Fine Fraction (%)	100.0	Percent of Coarse Fraction (%)	0.0
Temperature of Test (C°)	20	Temperature of Test (C°)	-
Supplied Result Reference	-	Supplied Result Reference	-
Average Particle Density Fine (t/m³)	**2.79**	Average Particle Density Coarse (t/m³)	**-**

Soil Particle Density (t/m³) 2.79

Remarks

[redacted]