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ADDENDUM TO NOTICE OF INTENT FOR INCREASING THE CAPACITY OF THE FIMISTON I TAILINGS STORAGE FACILITY AT KCGM KALGOORLIE, WESTERN AUSTRALIA

Submitted to:

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EXECUTIVE SUMMARY

Introduction

This report has been prepared for Kalgoorlie Consolidated Gold Mines Pty Ltd (KCGM) as an addendum to the existing Notice of Intent and in support of a Works Approval application for increasing the capacity and overall height of the combined Croesus/Fimiston I (Fimiston I) tailings storage facility (TSF) at Kalgoorlie, Western Australia (Figure 1). The report has been structured around the recommendations provided in the relevant WA government guidelines.

The combined Fimiston I TSF is situated on mining lease M26/383, located on the eastern margin of Kalgoorlie and immediately adjacent to Bulong Road, which lies to the north of the TSF (Figure 2).

Ore from the Fimiston Pit and the Mt Charlotte underground is treated at the Fimiston mill. Approximately 12 Mtpa of tailings solids are pumped as a slurry to either the Croesus/Fimiston I TSF or the Fimiston II TSF. Between 2.0 - 2.2 Mtpa of the tailings solids are discharged into the Croesus/Fimiston I TSF at a slurry density of around 55 % solids.

The Fimiston I tailings storage area comprises the original two Croesus storage cells (Croesus North and South), the two cells now amalgamated to form Fimiston I West, designed by Australian Groundwater Consultants, and the two cells now amalgamated to form Fimiston I East, designed by Golder Associates. Tailings pipework and return water systems for Fimiston West and Fimiston East were designed by KCGM.

Rationalisation and amalgamation of the various cells has since taken place. The Croesus North and South cells were decommissioned in 1997 when the Croesus Plant ceased operations and was recommissioned in 2002 as a single cell. The amalgamated Croesus TSF has recently been combined with the Fimiston I West. The amalgamation of the combined Croesus/Fimiston I West TSF and the Fimiston I East TSF to form a single storage, Fimiston I, is scheduled to commence during the next 12 months. A revised Tailings Storage Data Sheet for the combined TSF is included as Appendix A.

A copy of the endorsements and tenement conditions that have been placed on lease M26/383 have been included in the report as Appendix B. The tenement conditions take precedence over referenced documents, which have also been referenced for the purpose of this report.

The Croesus/Fimiston I TSF is currently classified as a ***Category 1, Significant Hazard*** tailings storage facility, with a licenced maximum TSF height of 30 m. Under the present proposals to raise the combined TSF to a maximum height of 40 m, this classification will remain unchanged.

Outline of Project Proposals

The proposals put forward in this addendum provide for staged construction of the integrated Fimiston I TSF to a maximum final height of 40 m, 10 m higher than that currently approved under the terms of the original Works Approval. The increase in the maximum height of the storage will provide storage for an estimated additional 14.8 Mt of tailings, equating to approximately 7.4 years of additional storage life at the current discharge rate of 2 Mtpa and assuming an average dry density for the stored tailings of 1.6 t/m^3. The construction of the embankments would be staged over the additional life of the storage by progressively raising the perimeter embankments to the final elevation in height increments of between 1.0 and 2.0 m. Perimeter embankment construction will continue to utilise the upstream method of construction, requiring each successive lift to step inwards onto the tailings beach. Decant causeways and trainer walls will be progressively raised using the centreline method of construction as the beach level rises. There is provision for the incorporation of a bench on the outer embankment slope at a nominal vertical interval of 10 m above the last constructed bench. This will be achieved by increasing the distance of step-in of the relevant raise increment by approximately 5.0 m.

It is proposed that the embankment raises will continue to utilise tailings sourced from the adjacent tailings beach, as fill for construction of the lift increments. Borrow areas within the tailings will be limited to a depth of 1 m depth and be restricted to 200 m in length parallel to the adjacent perimeter embankment. The geometry of the proposed raises will have a crest width of 5 m, downstream batter slope of 1V:4H (14°) and a nominal upstream batter slope of 1V:1.5H (34°). The target dry density ratio for compaction of the placed fill will be 95% of Standard Maximum Dry Density (SMDD).

The strategy for closure at the end of the operating life of the TSF is to completely encapsulate the storage with waste rock. This will be achieved by extending the waste dump located on the southern side of the TSF over the top of the storage.

Stability modelling has been carried out to validate the proposed increase in storage height using shear strength parameters similar to those adopted for recent audit review assessments. The modelling indicates that the proposed embankment profile will have a factor of safety against failure in excess of 1.6 under a pseudo-static earthquake loading of 0.07 g.

A review of the likely seepage impacts resulting from an increased head has concluded that there is unlikely to be any change to the rate of seepage flow to the underlying formations as a result of the increased height of the TSF, assuming that the total area of free water on storage will be comparable to the current situation.

Environmental Commitments

Inherent in the design philosophy is provision to safeguard the environment from adverse impacts attributable to the TSF.

It is not intended that the proposed increase in the maximum height of the TSF will have any direct implications with respect to the continuance of existing monitoring programmes or changes to existing environmental commitments. The existing monitoring programmes and daily inspections will be continued and will be documented according to current procedures. Audits of the TSF will continue to be carried out on an annual basis in accordance with the *Guidelines on the Safe Design and Operating Standards for Tailings Storage*, DoIR[1], May 1999.

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[1] DoIR, Department of Industry and Resources, latterly the Department of Mineral and Petroleum Resources (DMPR), formerly the Department of Minerals and Energy (DME).

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1.0 INTRODUCTION

1.1 Background

This document details the proposals of the project proponent, KCGM Pty Ltd (KCGM), the current managers of the Fimiston gold mining and processing operations, to expand the amalgamated Fimiston I tailings storage facility (TSF) by increasing the maximum permissible height of the TSF to 40 m from the current height limit of 30 m. This will be achieved through raising the perimeter embankments in incremental lifts to final height. The Croesus/Fimiston I TSF is situated on mining lease M26/383 to the east of Kalgoorlie, Western Australia (Figure 1), immediately adjacent to Bulong Road, which lies to the north of the TSF (Figure 2).

Ore, sourced primarily from the Fimiston open pit and, to an appreciably lesser extent, from the Mt Charlotte underground mine, is treated through the Fimiston mill. Approximately 12 Mtpa of tailings solids are pumped as a slurry from the Fimiston mill to either the Croesus/Fimiston I TSF or to the Fimiston II facility. Between 2.0 - 2.2 Mtpa of the tailings solids are discharged into the combined Fimiston I TSF at a slurry density of around 55 % solids.

The Fimiston I TSF comprises an amalgamation of six cells; Croesus North and South and the four Fimiston I cells, A and B (Fimiston West) and C and D (Fimiston I East). Design of the original two Croesus storage cells (Croesus North and South) and the two Fimiston I cells A and B was carried out by Australian Groundwater Consultants. The two Fimiston I cells, C and D, were designed by Golder Associates. Tailings pipework and return water systems for Fimiston West and Fimiston East were designed by KCGM. It is estimated that approximately 28 x 10^6 tonnes of tailings solids have been deposited into the combined Fimiston I TSF since deposition commenced into the Croesus cells in 1988.

Currently, the maximum height permitted under the terms of the existing licence is 30 m (approximate RL386.7). As at November 2002, the crest elevation of the Fimiston 1 storage ranges from approximate RL385.2 along the embankment crest of Croesus/Fimiston 1 West to RL384.7 on the embankment crest of Fimiston 1 East, representing a maximum embankment height of approximately 28 m above the toe of the eastern embankment. The proposals presented in this document seek to increase the maximum allowable height of the combined TSF to 40 m, approximately RL396.7.

The Croesus/Fimiston I TSF is currently classified as a ***Category 1, Significant Hazard*** tailings storage facility, with a licenced maximum TSF height of 30 m. Under the present proposals to increase the maximum height to 40 m, this classification will remain unchanged. The relevant amendments to the licence conditions proposed in this submission are summarised as follows:

- maximum height of TSF permitted under current licence conditions: 30 m (approximately RL387 AHD)
- proposed revised maximum embankment height: 40 m (approximately RL397 AHD)
- anticipated extension to life of storage at current discharge rates: approximately 7.4 years.

This report has been prepared as an Addendum to the original NOI and provides technical supporting documentation for the Works Approval application to the regulatory authorities for the proposed incremental increase in the maximum permissible height of the Fimiston I TSF from the current 30 m limit to 40 m. The report has been structured around the recommendations provided in the DMPR[1] *Guidelines on the Safe Design and Operating Standards for Tailings Storage* (DMPR, 1999) and in accordance with the DMPR publication *Guidelines to Help You Get Environmental Approval for Mining Projects in Western Australia* (DMPR, 1998a). An updated tailings storage Data Sheet, reflecting the proposed increase in height and storage capacity, is included as Appendix A.

Figure 2 shows the position of the TSF relative to the surrounding mine infrastructure. The TSF is located on mining lease M26/383 and is centred approximately on AMG co-ordinates 357,150 mE and 6,597,385 mN. The area covered by the TSF has already been disturbed and there will be no further requirement for clearing native vegetation. Figure 3 shows the existing layout of the Fimiston I TSF. A copy of the endorsements and tenement conditions have been included as Appendix B. Where these conditions conflict with statements in this or other referenced documents, the tenement conditions take preference.

1.2 Ownership and Management Structure

KCGM Pty Ltd manages the assets of the Joint Venture partners, Newmont Australia Ltd and Barrick Gold of Australia Ltd, which includes the mining and milling operations. The tailings storage facilities, Fimiston I and Fimiston II are included amongst these assets.

1.3 TSF Rationalisation

The development of the Fimiston I TSF has it's origin in the Old Croesus TSF which provided storage for tailings from the Croesus mill. This storage was decommissioned in 1988 when two new cells, Croesus North and South, located on the eastern side of the old Croesus storage, were commissioned. Subsequently, four further cells comprising Fimiston 1 (cells A, B, C and D) were constructed in two stages, cells A and B forming Fimiston I West and cells C and D forming Fimiston I East. Cells A and B have since been combined into a single cell referred to as Fimiston I West and cells C and D were similarly combined to form

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[1] Department of Mineral and Petroleum Resources, formerly Department of Minerals and Energy, Western Australia.

Fimiston I East. Croesus North and South were decommissioned with the closing of the Croesus mill in July 1997. The Croesus cells were recently recommissioned as a single TSF cell in June 2002, which was, in turn, amalgamated with Fimiston I West to form Croesus/Fimiston 1 West TSF.

Available survey (November 2002) shows the crest elevation of the Croesus/Fimiston I West TSF to be approximately 1.2 m higher than the crest of the Fimiston I East TSF. In order to overcome this elevation differential and commence the process of amalgamating Fimiston I West and Fimiston I East, tailings are being deposited into Fimiston I East at a greater rate per unit area than into the western cell. The outcome of this amalgamation process will be a single integrated TSF, Fimiston I. The rationalisation of the original six cells is in line with the study carried out by Golder Associates in 1993[2], which anticipated final amalgamation of Fimiston I East and West into a single cell in 2004.

1.4 Scope of Work

The scope of work for the study is detailed in Golder Associates' letter proposal P034026 dated 21 January 2003 and authorized through KCGM Purchase Order O060078-Rev 0 dated 6 February 2003. The scope of work includes data collation, consolidation testwork, review of height/storage capacity relationships, stability, seepage and groundwater responses, together with the preparation of a technical report as an addendum to the existing Notice of Intent (NOI) and as supporting documentation for a Works Approval application.

1.5 Available Information

The relevant project information accessed for the purpose of the studies and for the preparation of this NOI documentation includes the TSF Operating Manual, and the various study reports and audit reports detailed in the Reference section of this report. These references include:

- Golder Associates audit reports: 96640010 (1996), 97640116 (1997), 98640152 (1998), 99640202 (1999), 00640174 (2000), 01640226 (2001) and 02640199 (2002)

- Golder Associates study reports: 93640025 (1993), 94640034 (1994), 95640082 (1995), 98640007 (1998), 00640034 (2000) and 00640174-B (2000)

- Knight Piesòld ref. 661/2_VI, Operating Manual Rev. 2 August 2000

1.6 Assumptions

The general assumption that is implicit in the proposed TSF height increase is that the physical and geochemical characteristics of the tailings and slurry liquor will remain unchanged from that currently discharged to the Fimiston I TSF.

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[2] Golder Associates Report 93640025, April 1993

2.0 TAILINGS CHARACTERISATION

2.1 Physical Characteristics

2.1.1 General

The Croesus and Fimiston TSFs have been in operation since 1988 and during the subsequent period data collection has been carried out at periodic intervals to supplement available data. The information provided below constitutes only a part of the total data set. Should additional information be required, the reader is referred to the documents referenced in this document and to the technical documentation that was submitted to the regulatory authorities in support of the relevant Works Approval Applications.

2.1.2 Particle Size Distribution

The most recent particle size distribution analyses of deposited tailings originating from the Fimiston Mill were carried out in October 2002 as part of the annual audit of the Fimiston TSFs (Golder Associates, 2002). Laser diffraction analyses were carried out on three representative push tube samples, two of which were collected adjacent to the perimeter embankments of Fimiston I (#7547) and Fimiston II (#7548), while the third sample (#7549) was collected adjacent to the decant of Cells A and B of Fimiston II. As the tailings originate from the same mill, the Fimiston II results are considered to be applicable to Fimiston I.

The results of the testwork indicate that the tailings at the centre of the TSF have 95% of particles (by volume) less than 75µm in size compared to the average grading of about 75% to 80% less than the 75µm size. The volume of material less than 75µm in size at the perimeter embankment is about 50%, indicating a level of segregation expected from the method of tailings placement.

Copies of laboratory test certificates are included in Appendix C.

2.1.3 Settling Characteristics

The slurry is discharged into the TSF at a slurry density of approximately 55% solids (by mass). Partial segregation of the coarse and fine components of the slurry stream occurs soon after discharge with a high proportion of the fine tailings particles being carried towards the centre of the tailings storage. This is evidenced by the significantly greater content of material less than 75µm in size measured in samples collected at the decant compared to that measured in samples collected adjacent to the perimeter embankment.

Representative beach slopes generated from the most recent survey of the tailings beach (November 2002) are presented in Figure 4 and indicate an approximate 0.7% average slope over the initial 200 m of beach and approximately 0.26% average slope beyond 200 m distance from the perimeter embankment.

2.1.4 Desiccation Behaviour and Dry Density

The tailings are deposited sub-aerially in layer thicknesses generally limited to a maximum of 200 mm on each discharge cycle. The time between deposition cycles is maximized to allow the deposited tailings time to dry and consolidate. The moisture contents of samples collected from the perimeter of the TSF during recent audits indicate values within the range of 8% to 31% (Table 1). The extent of drying will depend on a number of factors including thickness of the deposited layer, length of drying and climatic conditions.

Push tube samples of tailings have been collected regularly during the past operational audits (Golder Associates, 2001 and 2002) and determinations made of the *in situ* dry density and moisture content of the samples. Typical results obtained on samples collected during the 2001 and 2002 audits (Golder Associates, 2001 and 2002) are summarized in Table 1. Laboratory test certificates are included in Appendix C.

TABLE 1 : DRY DENSITY OF *IN SITU* TAILINGS

Dry Density (Moisture Content)			
Fimiston I West		**Fimiston II**	
Wall	**Decant**	**Wall**	**Decant**
Operating Audit 2001			
1.63 t/m^3 (8.0%)	1.37 t/m^3 (38.2%)	1.79 t/m^3 (30.9%)	1.31 t/m^3 (44.5%)
Operating Audit 2002			
1.69 t/m^3 (12.2%)	- -	1.81 t/m^3 (12.7%)	1.46 t/m^3 (34.6%)

The results are consistent with the range of results measured over the life of the operation and indicate an average dry density of the surface of the tailings somewhat greater than 1.5 t/m^3.

Previous estimates, based on the mass of tailings discharged to the TSF and surveyed volume of beached tailings, indicate an average dry density of the tailings mass at around 1.6 t/m^3. The value of 1.6 t/m^3 has been generally adopted for purposes of estimation and modelling.

2.1.5 Projected Rates of Rise

With the finalization of the Croesus/Fimiston I TSF amalgamation, the total paddock area for tailings storage will be approximately 100 Ha. At the assumed output of 2 Mtpa of tailings solids and at the adopted average tailings density of 1.6 t/m^3, the estimated annual rates of rise in the level of tailings at 30 m maximum height and at 40 m maximum height are expected to be 1.15 m/year and 1.35 m/year respectively. The storage characteristics of the expanded

TSF are summarized in the time vs height vs capacity relationship curves included as Figure 5.

2.1.6 Permeability

Estimates of the permeability of the tailings, determined from consolidation tests on a tube sample collected from the tailings storage indicate values within the range of permeability (k) of 10^{-8} to 10^{-9} m/s, depending on the consolidation load. It is expected that the hydraulic conductivity of the tailings mass will be influenced by the presence of shrinkage cracking and layering caused by particle segregation after discharge.

Electric friction-cone penetrometer testwork was carried out in the Fimiston I and Fimiston II TSFs during 2000. Permeability estimates derived from dissipation tests at various levels within the tailings mass using indicated permeability coefficients within the range of 10^{-7} to 10^{-8} m/s.

2.1.7 Shear Strength

During the life of the Fimiston I and II operations, consolidated undrained triaxial shear tests have been carried out periodically on Fimiston tailings samples. The results of the testing has been summarised in Table 2.

TABLE 2 : TAILINGS SHEAR STRENGTH PARAMETERS

Reference	Location	Sample Depth (m)	Cohesion (c′ kPa)	Friction Coefficient (ϕ′)
Golder[3]	Fim I E	surface	3	40.5
GHD[4]	Fim 1 – BH1	7.25	0	28
GHD[4]	Fim 1 – BH3	2.3	10	41
GHD[4]	Fim 1 – BH4	2.1	10	35
GHD[4]	Fim 1 – BH5	1.8	70	34
GHD[4]	Fim 1 – BH5	4.95	10	39
GHD[4]	Sample 3	-	15	33
Golder[5]	Fim 2 – C cell	surface	1	40

The results show a spread of values for the effective angle of internal friction (ϕ′) of between 28° and 41° and of effective cohesion (c′) of 0 to 70 kPa. For the purpose of modelling the

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[3] Golder Associates Report No. 93640025, dated April 1993

[4] Gutteridge Haskins & Davey, 1991, *Notice of Intent, Fimiston Project – Phase II, New Tailings Storage*, Consultants Report submitted to KCGM, March 1991

[5] Golder Associates Report No. 00640178-B, dated December 2000

stability of the upgraded Fimiston I TSF, zero cohesion has been assumed and the effective friction angle discounted to values below 35°.

2.2 Chemical Characteristics

2.2.1 Geochemical Characterisation of Tailings Solids

Geochemical testwork was carried out on a representative sample of blended ore from the Fimiston and Mt Charlotte ores (Graeme Campbell & Assocs, 1994). The multi-element composition of the tailings solids is reproduced in Table 3.

TABLE 3 : MULTI-ELEMENT COMPOSITION AND INDICATED ELEMENT ENRICHMENT FOR TAILINGS SOLIDS

Element	Total Element Concentration (mg/kg or %)	Element	Total Element Concentration (mg/kg or %)	Element	Total Element Concentration (mg/kg or %)
Ag	0.1	Cu	24	Sb	0.2
Al	5.8%	Fe	9.8%	Se	0.4
As	28	Hg	0.18	Sn	1
B	40	K	1.4%	Sr	140
Ba	190	Mg	2.2%	Te	0.8
Be	1.4	Mn	1800	Th	1.4
Bi	< 0.1	Mo	1.0	Tl	0.4
Ca	4.6%	Na	2.5%	U	0.5
Cd	< 0.1	Ni	17	V	260
Ce	20	P	640	W	66
Co	23	Pb	10	Zn	110
Cr	20	S	0.75%		

Source: Table 4.1, Graeme Campbell & Associates, 1994

The accompanying report (Graeme Campbell & Associates, 1994) concluded in part that the results indicated a significant enrichment in Arsenic (As), Tellurium (Tl) and Tungsten (W).

The results of acid-base analyses on the tailings blended samples from the Fimiston and Mt Charlotte tailings are summarized in Table 4.

TABLE 4: ACID-BASE AND NET-ACID GENERATION FOR TAILINGS SOLIDS

Slurry pH	Slurry EC (µS/cm)	Total-S (%)	SO4-S	ANC	NAPP	NAG	NAG pH
				kg/H_2SO_4/Tonne			
8.1	95,000	0.75 (0.76)	0.06 (0.10)	210 (200)	-180	< 0.5	8.1

Notes EC: Electrical Conductivity; ANC: Acid-Neutralisation Capacity; NAPP: Net-Acid Producing Potential; NAG: Net-Acid Generation.

Slurry pH and EC correspond measured directly on as-received tailings sample

All results expressed on an oven-dry basis (except for slurry pH, slurry EC and NAG pH)

Values in parentheses represent duplicates

Source: Table 3.1, Graeme Campbell & Associates, 1994

The study report concluded that the NAPP results indicated the tailings to be non-acid forming and this was supported by the NAG test results.

2.2.2 Waste Liquor Characterisation

Geochemical testwork was carried out on a sample of tailings slurry water during the same study (Graeme Campbell & Associates, 1994). The results are summarized in Table 5.

TABLE 5 : QUALITY OF TAILINGS SLURRY WATER

Element/Parameter	Tailings Slurry Water	Element/Parameter	Tailings Slurry Water
Major Parameters		*Minor Ions*	
pH	8.6	Al	0.16
Total dissolved salts	130,000	Mn	0.02
Major Ions		Cd	< 0.05
Na	46,000	Pb	< 0.2
K	350	Cr	< 0.02
Mg	2,600	Co	< 0.1
Ca	2,500	As	< 0.01
Cl	92,000	Sb	< 0.05
SO_4	5,200	Bi	< 0.05
HCO_3	80	Se	0.0005
CO_3	20	Te	< 0.1
Nutrients		B	0.1
NO_3-N	49	Si	1.3
P	< 0.2	F	< 0.1

TABLE 5 : QUALITY OF TAILINGS SLURRY WATER

Element/Parameter	Tailings Slurry Water	Element/Parameter	Tailings Slurry Water
Major Parameters		*Minor Ions*	
Cyanide Forms		Mo	< 0.05
CN_{tot}	170	Ag	< 0.05
CN_{wad}	99	Ba	< 0.1
CN_{free}	< 0.05	Sr	2.8
CNO	20	Ce	< 0.01
SCN	32	Tl	< 0.02
Cyanide-Complexing Metals		V	0.02
Fe	12	Be	< 0.01
Hg	0.042	Sn	< 0.1
Cu	*2.4*	W	< 0.1
Ni	0.12	U	< 0.01
Zn	0.90	Th	< 0.01

Note: All values in mg/L
Source: Table 5.1, Graeme Campbell & Associates, 1994

The conclusions included in the accompanying report are, in summary, as follows:

- Tailings slurry water is hypersaline due to the use of hypersaline groundwater for processing and poses the greatest concern for tailings leachate control and storage rehabilitation

- Ex-mill slurry water is expected to have total cyanide (CN_{tot}) concentrations within the range 150-200 mg/L which are dominated by weakly complexed forms of cyanide.

The report further concluded that the weakly dissociable forms of cyanide were expected to degrade rapidly to the extent that the weak acid dissociable cyanide (CN_{wad}) concentrations would be less than the 50 mg/L guideline value for protection of wildlife.

3.0 DESIGN CONSIDERATIONS

3.1 Climate

The Kalgoorlie area is characterized by hot summers and mild winters with mean daily temperatures ranging from a maximum of 33.7°C in January to a minimum of 4.9ºC in July. Highest and lowest recorded daily temperatures range from 46.5°C in January to -3.4ºC in July.

Rainfall in the Kalgoorlie area is influenced in summer by the monsoonal systems in the tropics, with occasional cyclonic storms carrying through to the goldfields. In winter the rainfall generally originates from broad frontal lows moving in from the south west. The mean annual rainfall for Kalgoorlie is 269.8 mm, distributed fairly evenly throughout the year, although showing a noticeable decrease during the months of September to December. The annual rainfall may be highly variable from one year to the next, with wet years through to drought years.

The mean annual precipitation of 2664.5 mm significantly outstrips rainfall by an order of magnitude, with mean daily evaporation ranging from a high of 12.7 mm/day in January to a low of 2.6 mm/day in June.

The climate statistics are summarized in Table 6.

TABLE 6 : TEMPERATURE, RAINFALL AND EVAPORATION STATISTICS

	Mean Daily Maximum Temperature (°C)	**Mean Daily Maximum Temperature (°C)**	**Mean Monthly Rainfall (mm)**	**Mean Daily Evaporation (mm)**
January	33.7	18.2	22.4	12.7
February	32.0	17.7	30.5	11.0
March	29.5	16.0	24.2	8.7
April	25.0	12.5	22.4	5.7
May	20.5	8.5	28.4	3.5
June	17.4	6.1	31.0	2.6
July	16.6	4.9	25.9	2.7
August	18.4	5.4	21.9	3.7
September	22.2	7.9	14.3	5.7
October	25.6	10.9	15.1	8.3
November	28.9	14.0	17.8	10.2
December	31.9	16.5	15.8	12.1
Mean Annual	**25.1**	**11.5**	**269.8**	**2664.5**

3.2 Geotechnical Site Characteristics

The proposed increase in the Fimiston I storage capacity will not extend the area of footprint of the TSF as the increase in capacity will accrue through the incremental raising of the existing perimeter embankment using the upstream construction method. Consequently, there has been no perceived need to carry out additional geotechnical investigations of the subsurface profile.

The typical soil profile is generally characteristic of the surrounding areas including the Fimiston II TSF and may be described as follows:

a) Topsoil horizon comprising red brown sandy or gravelly silt up to 2 m thick, overlying

b) Hard, red brown gravelly clay and clayey gravel up to 12 m thick, overlying

c) Hard pale grey-green clay with red-brown clay laminations and mottles.

Superficial materials are generally loose and shallow to around 300 mm depth, becoming dense to very dense or very stiff to hard. Calcrete typically occurs in the topsoil unit with well developed ferricrete horizons occurring in the underlying clay.

Underlying bedrock horizons consist typically of banded meta-sedimentary rock or massive igneous rock, extensively weathered to depth and lateritised.

For the purpose of assigning strength parameters to the foundation materials, reference has been made to preceeding stability assessments and geotechnical investigations in the general vicinity of the Fimiston I TSF. The strength parameters adopted for modelling purposes are as follows:

	Bulk Density (kPa)	Friction Angle (ϕ')	Cohesion (kPa)
Upper Foundation Clays	22	29°	25
Base Foundation Clays	22	30°	40

The concensus of the reports referenced is that the values are conservative.

3.3 Site Hydrology and Hydrogeology

3.3.1 Surface Water Characteristics

The Fimiston I Tailings Storage Facility (TSF) is located in a catchment of Hannan Lake, which is a saline playa lake located about 10 km south of Kalgoorlie. This catchment is about 18 km long and between 8 km and 13 km wide. Surface gradients range between 3 m/km parallel to the central floodway and greater than 10 m/km across the catchment.

The Fimiston I TSF is on the western side of the catchment, and about 1 km west of the central drainage channel of the floodway. The difference in elevation between this channel and the toe of the eastern wall of the TSF is about 10 m.

Significant amounts of surface water flow through the central floodway of the catchment only after heavy rainfall events. Heavy rains associated with tropical depressions in 1992, 1995, and 1999 caused extensive flooding in the Kalgoorlie area, and on those occasions floodwaters to the east of the Fimiston I TSF spread over about 0.5 km.

In February 1995, rainfall of 154 mm was recorded within a 72-hour period, exceeding the 1:50-year 72-hour event of 144 mm (1:100-year 72-hour event is 174 mm). On 14 January 2000, a rainfall of 50 mm was recorded in a 1-hour period, exceeding the 1:100-year 1-hour event of 43.1 mm.

Flooding in the catchment has not caused water to pond around the toe of the Fimiston I TSF walls, and this scenario is not expected to occur. A system of diversion drains ensures that significant amounts of water do not pool or flow near the toe of the TSF.

3.3.2 Groundwater Characteristics

The area around the Fimiston I TSF is underlain by sedimentary deposits and variably weathered bedrock. The sedimentary deposits are widespread, and correlate with similar deposits around Hannan Lake and elsewhere in the Eastern Goldfields. These deposits pinch out to the east and west towards bedrock ridges along the flanks of the catchment.

The maximum thickness of the sedimentary deposits to the east of the Fimiston I TSF is about 30 m. These deposits typically consist of red-brown clays and gravels, and blue-grey clays and clayey gravels which are partly lateritised. The weathered bedrock beneath the central floodway is mainly pallid or mottled clay. Relatively fresh bedrock occurs at shallow depths beneath the western half of the Fimiston I TSF.

The most transmissive parts of the shallow stratigraphic sequence near the Fimiston I TSF are gravels between about 5 m and 15 m below the surface, and ferricrete horizons within lateritised blue-grey clays between about 10 m to 25 m beneath the surface. The underlying weathered bedrock generally has a very low transmissivity and is not an aquifer.

The shallow groundwater system is recharged naturally after significant rainfall events that cause surface water to accumulate and flow down the floodway. Downward seepage from KCGM's Fimiston I TSF infiltrates into the subsurface formations, and also recharges the shallow groundwater system.

Natural groundwater in the catchment is saline, with salinities (total dissolved salts) concentrations in the range of 20,000 mg/L to 50,000 mg/L. This groundwater is very acidic, with pH generally between 2 and 4.

3.4 Seepage Assessment – Current Setting

3.4.1 Groundwater Production, and Groundwater Levels and Salinities

Tailings disposal at the Fimiston I TSF has caused groundwater levels to rise in the vicinity of this TSF and has influenced the quality of groundwater near the TSF. KCGM has installed four groundwater production bores near the eastern wall of the TSF and a trench along the eastern and northern sides of the TSF (Figure 6). Small amounts of surface water runoff accumulate in the trench after heavy rain.

During 2002, the four production bores near the eastern wall of the Fimiston I TSF produced over 174 ML of groundwater, and the total water production from the Fimiston I Trench was nearly 56 ML. Assuming that 80% of the water produced from the trench during 2002 was groundwater, the estimated total groundwater production from facilities near the Fimiston I TSF during 2002 is 219 ML. This volume is equivalent to an average production rate of 600 m^3/day.

KCGM maintains four groundwater monitoring bores near the Fimiston I TSF and another monitor bore is located about 500 m north east of the TSF (Figure 6). The locations of these monitoring bores and the production bores are listed in Table 7, and groundwater levels measured in the monitor bores in December 2002 are listed in Table 8.

TABLE 7 : GROUNDWATER PRODUCTION AND MONITORING BORE LOCATIONS

Bore	Type[1]	Coordinates (AMG84)		Ground Level (mAHD)	Cased Depth (m)
		Easting	Northing		
PB F66	P	357,924	6,597,665	358.8	22.5
PB F67	P	357,926	6,597,505	359.8	22.5
PB F68	P	357,927	6,597,357	359.5	21.0
PB F96	P	357,818	6,597,744	358.0	23.5
MB F5	M	358,055	6,597,441	356.5	25.0
MB F10	M	357,581	6,597,979	359.6	18.0
MB F11	M	357,251	6,597,988	363.4	7.5
MB F12	M	356,835	6,597,998	367.1	20.5
MB F67	M	358,318	6,597,951	352.6	23.7

Note: [1] P = Production bore
M = Monitoring bore

TABLE 8 : GROUNDWATER LEVELS IN MONITORING BORES, DECEMBER 2002

Bore	Date Measured	SWL (mBNS) 1	GWL (mAHD) 2
MB F5	5-Dec-2002	9.76	346.74
MB F10	5-Dec-2002	3.95	355.65
MB F11	5-Dec-2002	3.98	359.39
MB F12	5-Dec-2002	6.76	360.34
MB F67	7-Dec-2002	9.34	343.26

Note: Standing Water Level in metres below natural surface
Groundwater Level in metres AHD

Contours of the December 2002 groundwater levels and depths to the water table near the Fimiston I TSF are illustrated in Figure 6. This plan also indicates locations of groundwater production and monitoring facilities at the TSF, including the production bores, the Fimiston I Trench, groundwater monitor bores, and standpipe piezometers. The contours in Figure 6 are based only on groundwater levels from monitoring bores, and are constrained by groundwater levels in other monitoring bores which are located to the north, east and south of the plan limits. The cones of depression in the water table around each of the production bores are not depicted by the contours.

The December 2002 groundwater level distribution indicates groundwater flows to the east and north, away from the TSF. This distribution is consistent with a conceptual model of seepage from the TSF infiltrating into the shallow subsurface formations and migrating laterally away from the TSF. The groundwater level distribution also indicates natural groundwater recharge occurs to the north and west of the Fimiston I TSF towards the western flank of the catchment. The rising topography and shallowing bedrock to the west cause the main component of groundwater flow in this area to be easterly.

The water table around most of the eastern and northern sides of the Fimiston I TSF was at least 6 m below natural surface in December 2002. Shallower water tables at depths of around 4 m occurred along part of the northern side of the TSF at this time.

Groundwater levels in monitoring bores around the East Paddock of the Fimiston I TSF declined by approximately 0.5 m during 2002, and remained steady elsewhere near the TSF. This suggests that an approximately steady state groundwater flow system exists in the vicinity of the Fimiston I TSF. Little variation in this system is expected as long as the current tailings disposal regime continues, and groundwater production from the bores and trench is maintained at roughly the rate achieved during 2002.

The standpipe piezometers are located on the walls of the Fimiston I TSF (Figure 9), and all are cased nearly to the base of the tailings pile. These piezometers were installed during 2002, and have been dry to the bottom of the casing when groundwater level measurements have been attempted. These results indicate the tailings pile is unsaturated at these locations (ie, the groundwater pressure head is less than atmospheric pressure). Note that a seepage face has not been observed at the toe of the TSF walls, and this is consistent with the dry standpipe piezometers.

The process water used in the Fimiston Mill is hypersaline, with total dissolved salts concentrations of up to 150,000 mg/L. Seepage from the Fimiston I TSF has caused groundwater salinities to increase in the underlying formations, and samples from the monitoring and production bores around the TSF had salinities in the range 70,000 mg/L to 140,000 mg/L in late 2002. Time series of groundwater salinity data indicate very slight increasing trends, and this is consistent with more saline seepage from the TSF mixing with less saline natural groundwater in the formations.

The results of hydrochemical analyses of samples collected from the production and monitoring bores near the Fimiston I TSF in late 2002 are listed in Table 9. Cyanide concentrations in the groundwater samples are at least two orders of magnitude less than the cyanide concentrations in the slurry discharged to the TSF. Cyanide concentrations in groundwater samples tend to decrease rapidly away from the TSF.

TABLE 9 : RESULTS OF HYDROCHEMICAL ANALYSES OF PRODUCTION AND MONITORING BORES

Bore	Date Sampled	pH	Salinity (mg/L)	CN (total) (mg/L) [1]	CN (free) (mg/L) [2]	CN (WAD) (mg/L) [3]
PB F66	Oct 2002	3.0	120,000	0.57	0.01	0.16
PB F67	Oct 2002	3.0	130,000	1.00	0.01	0.21
PB F68	Oct 2002	3.1	140,000	0.98	0.01	0.22
PB F96	Oct 2002	2.9	120,000	0.87	0.01	0.25
MB F5	Sept 2002	3.1	120,000	0.92	0.14	0.20
MB F10	Sept 2002	3.6	130,000	0.39	0.15	0.15

3.4.2 Estimated Rate of Seepage from the TSF

In an established tailings storage facility like the Fimiston I TSF, the rate of downward seepage from the tailings pile is mainly dependent upon by the hydraulic conductivities of the tailings and the underlying natural formations, and the size of the supernatant pond of water on top of the TSF.

Testing of tailings materials from the Fimiston I TSF by Golder Associates Pty Ltd indicates hydraulic conductivities in the range 10^{-8} m/sec to 10^{-7} m/sec. The distribution of groundwater levels and the performance of production bores near the Fimiston I TSF indicate the natural formations underlying the TSF have hydraulic conductivities of order 10^{-5} m/sec.

As the natural formations have hydraulic conductivities at least two orders of magnitude greater than the tailings, the position of the phreatic surface within the tailings is expected to be close to the central decant pool on top of the TSF. Under these conditions, the rate of downward seepage through the tailings pile is a function of the area of the pool of water on top of the TSF and the hydraulic conductivity of the tailings.

Under normal operating conditions, the surface area of the pool of water on top of the Fimiston I TSF is maintained at about 10% of the surface area of the TSF, ie about 6 ha. This provides storage capacity for water accumulating after extreme rainfall events, and also limits the lateral extent of the phreatic surface within the tailings pile.

Given the pond area of 6 ha and an assumed nominal hydraulic conductivity of the tailings of 10^{-7} m/sec, the estimated rate of downward seepage from the tailings into the underlying natural formations is 500 m^3/day. Note that in the absence of more detailed testing there is some uncertainty associated with this estimate; however it is expected to be of the correct order of magnitude.

The estimated rate of seepage from the Fimiston I TSF is slightly less than the average rate of groundwater production achieved during 2002 by the four production bores and the trench at the TSF. This suggests that there is a reasonable balance between the seepage rate from the TSF and the current rate of groundwater production in the vicinity of the TSF.

4.0 DESIGN ASPECTS OF FIMISTON I TSF UPGRADE

4.1 General Description

The proposed Fimiston I upgrade will include the raising of the perimeter embankment encompassing the original Croesus North and South, Fimiston I East and Fimiston I West TSF cells, currently in the final stages of amalgamation. The perimeter embankment will be raised in an upward direction in vertical height increments of between 1 and 2 m using tailings excavated from the adjacent beach.

The operation of raising the embankment will be an on-going process tied in to the deposition and drying schedules for various sections of the perimeter embankment. In effect, there will be little change from the current methodology employed for constructing embankment raises.

The proposed design allows for construction of a step-in at a maximum height of 10 m above the previously constructed bench on the outer slope of the TSF. The actual elevation of the bench will be determined by the need to establish gradients for run-off captured on the bench to flow towards the rockfill drop structures. These drop structures will be extended to meet the newly constructed bench. As the maximum vertical interval between benches is 10 m, there is provision for construction of only one further intermediate bench below the final maximum crest height of 40 m.

A layout of the existing TSF, surveyed in November 2002, is presented as Figure 3. The proposed final layout of the combined Fimiston I TSF, at the maximum height of 40 m (RL396.7), and typical cross-section of the outer embankment are shown on Figure 7.

4.2 Design Details

The proposed embankment raise increments will be constructed to a similar geometry to that currently employed for construction of the raises. Based on an assessment of a limited number of surveyed cross-sections of the external slopes, the existing average outer slopes are as follows:

- Average outer slope between benches: 1V : 2.7H
- Average overall slope (including benches): 1V : 3.5H

The proposed geometry for the remaining lifts will be nominally as follows:

- External batters: 1V : 4H (14º)
- Internal batters of increments: 1V : 1.5H approx.
- Crest width: 5.0 m (nominal)
- Bench width: 5.0 m (minimum)

The outer slope design needs to maintain stability in the short term as the TSF will ultimately be encapsulated within the waste rock dump that is currently abutting the southern and south eastern margins of the TSF.

The height of each embankment lift increment will be limited to a vertical height of 1 to 2 m, dependant upon beach drying and consolidation and management requirements.

4.3 Construction Considerations

The current method of incremental upstream embankment raising will continue to be employed. The method utilizes tailings excavated from within the storage as fill for construction of the embankment lifts. Excavation is carried out using a long reach excavator that tracks along the beach immediately upstream of the raise footprint.

The excavated tailings are placed into the formation in layers not exceeding 500 mm thick. Compaction is provided by a padfoot roller. The target level for compaction of the tailings fill is a compaction ratio of 95% relative to the Standard Maximum Dry Density (SMDD) of the tailings determined in accordance with the Standard method of compaction, AS 1289.5.1.1. The target moisture content of the tailings fill is ± 2% of the Optimum Moisture Content (OMC) determined on the tailings fill (AS 1289.5.1.1).

5.0 DESIGN ANALYSES

5.1 Stability Analyses

5.1.1 General

Effective stress stability analyses were conducted using the computer software package SLOPE/W for each of the identified representative sections through the Fimiston I TSF. The sections were analysed using the Morgenstern-Price method of analysis under static and pseudo-static (earthquake) load conditions (using an acceleration coefficient of 0.07g).

5.1.2 Methodology

Four sections were taken through the Fimiston I embankment, three within the East Cell and one within the West Cell. The locations of the sections are indicated in Figure 7. The phreatic surface for each of the critical sections was inferred from readings taken from eight standpipe piezometers located in the Fimiston I embankment (SP-F1-10 to SP-F1-17).

In accordance with ICOLD (1989) and ANCOLD (1999), the facility should be assessed for an Operating Base Earthquake (OBE) and consideration given to the effects of a Maximum Credible Earthquake (MCE[6]). Under an MCE event, it is allowable that the TSF may be badly damaged but the facility should maintain its integrity and cannot allow the release of impounded tailings and / or water, that is to say that the factor of safety would be in the order of unity. ANCOLD (1999) suggests that an MCE with a recurrence interval of 1:1,000 years should be used for a "high hazard" facility (equivalent to a DMPR Category 1 TSF).

There is limited information on seismic activity in the area on which to base the OBE and MCE events. However, information obtained from AS 1170.4 suggests that an OBE ground acceleration coefficient of 0.07g should be applied to the area. There is no information available for the MCE case. A peak ground acceleration of 0.175g for the MCE case has therefore been selected, which is based upon a general guide of adopting a value of about 2.5 times the acceleration for the OBE.

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[6] The MCE is defined as the hypothetical earthquake that could be expected from the regional and local potential sources of seismic events that would produce the severest vibratory ground motion.

5.1.3 Material Parameters

The material parameters adopted for the analysis are consistent with the most recent stability analyses of the TSFs (Golder Associates, 2002) and reflect the current understanding of the material properties at the Fimiston I TSF. A lower shear strength value was assigned to the tailings borrow area to reflect the potential of the borrow area to fill with finer grained tailings. The adopted parameters are summarised in Table 10.

TABLE 10 : MATERIAL PARAMETERS FOR SLOPE STABILITY ANALYSES

Material	Unit Weight (γ_m) (kN/m^3)	Friction Angle (ϕ')°	Cohesion (c') (kPa)
Tailings	16	35	0
Tailings Borrow Area	16	30	0
Embankment Raises	19	35	7
Starter Embankment	19	30	17
Upper Foundation Clays	22	29	25
Base Foundation Clays	22	30	40

5.1.4 Results

The results of the analyses are summarised in Table 11. Critical slip surfaces for each of the cross sections considered are presented in Figures 8 and 9.

TABLE 11: RESULTS OF SLOPE STABILITY ANALYSES

Tailings Storage Facility	Minimum Factor of Safety		
	Static Loading	Pseudo-Static Loading	
		OBE (0.07g)	MCE (0.175g)
Section 1 – East Wall	2.04	1.65	1.27
Section 2 – North East Wall	2.02	1.65	1.28
Section 3 – North Wall	1.94	1.61	1.28
Section 4 – North Wall (West Cell)	2.01	1.63	1.26

The following minimum factors of safety (FoS), based on requirements set down by ANCOLD (ANCOLD, 1999) are considered appropriate for the Fimiston I TSF:

- steady state static loading conditions, FoS = 1.5

- earthquake or pseudo-static (OBE) conditions, FoS = 1.2

- earthquake or pseudo-static (MCE) conditions, FoS = 1.0

These minimum values are also consistent with other published values for earth dams. It is evident, therefore, that the TSF satisfies the minimum recommended factors of safety under steady state static (no seismic coefficient) and pseudo-static (OBE and MCE) loading.

5.2 Settlement

A one-dimensional consolidation test was conducted on a tube sample collected from the tailings beach of the TSF in March 2003. The test results (Appendix C) were entered into a consolidation spreadsheet to assess the total additional settlement that might be expected from an increase of 10 m to the current licensed height. The calculations assumed a one-dimensional column of tailings deposited instantaneously and used iterative calculations to approach a final total settlement. A total additional settlement of 0.42 m is expected when the facility is raised from 30 m to a maximum height of 40 m.

Given the relatively long period for construction, the low position of the phreatic surface and the relatively high values for the coefficient of consolidation (c_v) it is expected that much of the total settlement will be taken up during the construction and deposition within each raise. The resulting observed long-term settlement is expected to be negligible on the periphery of the TSF.

5.3 Seepage Assessment – Proposed TSF Height Increase

The development proposal is for the existing cells of the TSF to be amalgamated into a single tailings disposal cell, and the height of the TSF to be increased by 10 m above the present maximum design height of 30 m. The average rate of tailings deposition and the physical characteristics of the tailings are not expected to change as the TSF is further developed.

As there will be no change in the physical characteristics of the tailings, the hydraulic conductivity of the tailings pile will not change substantially. Under the development proposal, the surface area of the pond on top of the TSF during normal operations will not exceed the target maximum pond size of around 15 Ha, similar to the maximum target area of the pond from current operations. If these conditions do not change, the rate of downward seepage from the TSF into the underlying natural formations will not change from the present rate, ie the seepage rate will be around 500 m^3/day.

As discussed in Section 3.4.1, KCGM has established groundwater production facilities at the Fimiston I TSF to control the mounding of the water table caused by operation of this TSF and to intercept some of the seepage from the TSF. These bores are part of KCGM's Eastern Borefield. This borefield is licensed by the Water and Rivers Commission, and KCGM conducts a monitoring and reporting program in accordance with the operating strategy for this licence. As part of this operating strategy, KCGM installs additional production bores in the borefield on an as-needed basis where monitoring indicates further drawdown of the water table is required. This operating strategy would be followed by KCGM during the operating of the Fimiston I TSF.

5.4 Water Management and Freeboard

The final amalgamation of the Fimiston I cells will result in a supernatant pond located near the centre of the integrated TSF surrounding the single decant. The active area of tailings discharge will be progressively cycled around the storage to for the purpose of maintaining the pond at the centre of the TSF. Management of the pond will seek to maintain the areal extent of the pond within the current target limit of 15% (about 15 Ha). This will be achieved by controlling the flow of return water back to the plant and maximizing off takes following periods of high rainfall on the TSF.

The supernatant water pond will be centred around what is currently the Fimiston I West decant. Access to the decant will be via a new decant causeway extending out from the northern perimeter embankment (Figure 7). The decant will be managed in line with current operational procedures. Wing walls of appropriate length and alignment will be constructed at the decant end of the causeway to extend the supernatant water flow path to the decant as required. This will further assist in controlling pond location.

The DoIR requires a total freeboard of 500 mm above the pond level following the 1:100-year 72-hour rainfall event, assuming no decant takes place during this period. In addition, the DoIR requires an operational (beach) freeboard (highest point of solids/water in the basin to the adjacent perimeter crest elevation) of at least 300 mm (Figure 10). The current proposals assume that these minimum freeboard requirements will be maintained throughout the operational phase of the TSF.

6.0 OPERATING PROCEDURES

The initial objectives will be to achieve the final integration of Fimiston I East with Croesus/Fimiston I West. This will require that deposition into Fimiston I East takes place at a greater rate per unit area than into the remainder of Fimiston I until the perimeter embankment attains a similar crest elevation to the perimeter embankments of Fimiston I West. This final integration is expected to occur within a 12-month period, during which time efforts will be focussed on the continued improvement of the beach profile as integration proceeds.

Once integration has been achieved, the proposed operating procedures currently in place will be continued. The procedures for tailings deposition are as follows:

- tailings slurry is pumped from the mill to Fimiston I via a 450 mm HDPE PE100 delivery pipeline,

- a 400 mm HDPE pipeline, located around the perimeter of the combined TSF distributes the tailings to the active area of tailings discharge,

- tailings are discharged into the storage from multiple spigots tapped into the distribution pipeline on the perimeter of the TSF,

- the area of active discharge is systematically rotated around the TSF by progressively opening and closing spigots as the deposition points are cycled around the TSF for the purpose of maintaining a uniform beach and the supernatant water pond around the decant,

- a tailings layer thickness of approximately 200 mm will be deposited during each discharge rotation around the TSF and

- return water flow into the decant will be regulated through the placement or removal of collars around the central slotted riser in the centre of the decant tower.

In summary, similar practices to those that have been developed over the years to manage the Fimiston I and II storage cells will be applied to the integrated Fimiston I TSF. The storage responses with respect to tailings deposition, beach formation and water management are expected to differ little from current storage responses.

7.0 MONITORING REQUIREMENTS

7.1 Groundwater Monitoring

KCGM monitors groundwater in the vicinity of the Fimiston I TSF in accordance with requirements in the Department of Environment, Water and Catchment Protection (DEWCP) licence for operation of the Fimiston Mill and requirements in the Water and Rivers Commission (WRC) licence for operation of the Eastern Borefield[7]. The groundwater monitoring program has been developed in consultation with these government departments, and provides KCGM with sufficient information for managing groundwater issues arising from the operation of their tailings storage facilities located to the east of the Fimiston Mill. KCGM reports on the results of the groundwater monitoring program annually.

The groundwater monitoring program requires the following information to the collected and recorded by KCGM:

- record on a monthly basis the cumulative volumes of groundwater pumped by each production bore, and the Fimiston I Trench

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[7] The four groundwater production bores near the eastern wall of the Fimiston I TSF are part of KCGM's Eastern Borefield.

- collect samples every month from all active groundwater production facilities and analyse these samples in the field for pH and electrical conductivity (EC)

- collect samples from the production bores and trenches annually, and submit these samples for laboratory analysis of pH, EC, total dissolved salts (TDS) concentration, and cyanide concentrations (total, free, and WAD)

- measure and record groundwater levels in the monitor bores on a quarterly basis

- collect samples from the monitor bores every six months and analyse these samples in the field for pH and EC

- collect samples from the monitor bores annually, and submit these samples for laboratory analysis of pH, EC, TDS, and cyanide concentrations (total, free, and WAD)

- collect samples from a group of ten production bores every three years, and submit these samples to a laboratory for major component analysis

There is no particular need to adjust this monitoring program if the proposed raising of the Fimiston I TSF proceeds. The monitoring program is reviewed annually when the data from the program are also reviewed, and any adjustments to the program are made at that time if necessary.

7.2 Freeboard

A programme to monitor freeboard on a fortnightly basis has been implemented and will be continued to ensure that available freeboard on the storage complies with the DoIR minimum requirements outlined in Section 5.4 and illustrated in Figure 10.

7.3 Inspections

Apart from the water monitoring programme detailed in Section 7.1, regular inspections of the TSF will be carried out in accordance with current schedules. These include the following:

Short Term Monitoring

- pipeline integrity checks (3-hourly)

- visual check of tailings level versus embankment crest (3-hourly)

- spigot discharge location and operation (3-hourly)

- flow into decant and fines entrainment (3-hourly)

- location of decant pond (daily)

Compliance Monitoring

- embankment integrity (3-hourly)
- seepage from embankments (3-hourly)
- condition of access ramps (daily)
- piezometer pore pressures (monthly)
- decant water analysis (monthly)
- survey pins (quarterly)
- operational review by qualified engineer (annually)

Long Term Performance Monitoring

- tailings solids to TSF in tonnes (daily)
- water to TSF in tones or m^3 (daily)
- average tailings flow in m3/s (daily)
- freeboard monitoring survey
    - regular (monthly)
    - comprehensive (biannually)
- water return to plant (alternate days)
- silt removal from return water pond (biannually or more frequently if required)
- daily inspections of the TSF for fauna or flora mortality, signs of seepage, dusting, erosion and pipe leakage

The inspections should be documented and faulty equipment repaired or replaced. The annual operational review of the TSF should include a review of the accumulated data and provide an annual assessment of TSF performance.

8.0 EMERGENCY ACTION PLAN

8.1 General

KCGM has an Emergency Procedures Manual for the Fimiston Mill operations that include tailings disposal. The manual outlines the procedural responses in the event of a systems failure. The salient aspects of the manual are summarized within the following sections.

The DoIR Guidelines on the Development of an Operating Manual for Tailings Storage defines the following as reportable incidents:

- faunal deaths on, or in the vicinity of the TSF
- uncontrolled release of tailings and/or liquor (including pipe breaks, overtopping or similar)
- major seepage occurrence (e.g. discernible impact on vegetation, soil contamination)
- defects in the structural integrity of the TSF (e.g. cracking, slumping, significant wall erosion, breakout, decant collapse).

8.2 Pipeline Breakage or Spillage

The tailings delivery pipeline is contained either between bunds or within a trench. Scour pits have been established at critical locations in the event that it necessary to drain down the pipeline.

Embankments are designed with a safety bund on the downstream crest margin and a 2% fall towards the upstream crest margin so that spilled liquor will be contained and flow into the storage.

Pipelines are equipped with leak detection equipment that will signal a line failure to the operational personnel at the Fimiston Mill. The leak detection system, coupled with regular visual inspections of the slurry and return water pipelines provides early detection of a pipeline failure and allows a prompt response. In the event of a failure being detected in the delivery pipeline between the Fimiston Mill and the TSF, the following actions should be taken:

- Slurry should be redirected to an alternative pipeline where possible and the failed pipeline should be shut down until the nature of the failure can be determined and remedial work carried out on the pipeline.

- Where containment is necessary, immediate steps should be taken to dispatch the necessary earthmoving equipment to the site in order to contain the spill and minimize lateral damage.

- Spillage should be cleaned up and contaminated material transported to and disposed of in the tailings storage.

Where a failure occurs in the tailings distribution pipeline on the embankment crest, the following actions will be carried out:

- Spigots will be opened on the manifold side of the failure and the section of pipeline where the failure has occurred will be isolated.

- The cause of the failure will be determined and remedial steps taken to effect repairs to the failed section of pipeline.

- Any spillage that has occurred will be cleaned up.

- Where spillage has reached the downstream embankment, the incident will be notified to the regulatory authorities. If spillage is minor and contained within the confines of the TSF (upstream from the safety bund) the failure will be logged in the incident report book at the mill.

8.3 Embankment Erosion, Sloughing and Settlement

Should visual inspection reveal local embankment erosion, sloughing and/or settlement, the following actions should be carried out, preferably by a qualified Engineer:

- The short term risk should be assessed immediately and appropriate measures adopted to address the problem.

- Long term risks should have short term remediation designs implemented immediately, while longer term solutions and actions designed.

- The longer term actions once implemented should be monitored to limit further risk.

8.4 Groundwater and Embankment Seepage

The existing TSF incorporates a low permeability cut-off key, an external seepage interception trench and piezometric arrays to monitor any rise in the phreatic surface within the tailings storage embankment and at the toe. As discussed in Sections 3.4.1 and 5.3, KCGM has established an effective groundwater production bore system to control the mounding of water caused by operation of the TSF. In order to prevent lateral impacts from rising water levels, the following actions should be followed:

- The existing monitoring system should be maintained and observed regularly for any rise in the groundwater levels.

- If monitoring identifies a rising trend in the water levels, a threat of seepage breakout beyond the toe of the TSF or potential lateral impacts on flora or fauna, the current extraction schedule should be reviewed and revised to control groundwater levels.

- If impacts are observed, a clean-up procedure should be implemented to minimize damage in the vicinity of the TSF.

8.5 Large Scale Embankment Failure

If a large scale embankment failure were to occur, the following course of action should be followed:

- The likelihood of a release of tailings or a reduction in freeboard would be assessed and, if either is considered likely, deposition should be stopped or redirected to an alternative TSF.

- The free water on the TSF should be drawn down as rapidly as possible.

- Remedial action such as buttressing of the slope should be implemented to stabilize the slope and, once stabilized, any damage to the crest would be repaired.

- Any tailings released from the TSF should be recovered and the area cleaned.

8.6 Dam Break

A risk-based dam break study of the Croesus/Fimiston I TSF at 30 m height was carried out by Golder Associates during 1998 (Golder Associates, 1998). This study presented a semi-quantitative analysis of the likelihood of occurrence of a flow failure of the TSF based around the development of a fault/event tree, with probabilities assigned on the basis of professional judgement and an in depth knowledge of the KCGM tailings disposal operations.

The summarised results of the semi-quantitative assessment are reproduced in Table 12.

TABLE 12 : RESULTS SUMMARY OF SEMI-QUANTITATIVE RISK ASSESSMENT

Event	Annual Probability Of Occurrence
Due to failure under static conditions	6.29E-5 (1 in 14,500)
Due to failure under dynamic conditions	1.10E-5 (1 in 91,000)
Overall probability of flow failure	8.03E-5 (1 in 12,500)
Probability of loss of life/serious injury	4.32E-6 (1 in 231,000)

In addition, an assessment of the extent of probable flow was subjectively developed based on a method proposed by Blight *et al* (1981) and subsequently applied to risk-based modelling of flow failures, eg Williams *et al* (1990). A method suggested by Vick (1991) was considered to provide a comparative cross-check and was used to estimate the possible runout distance of a flow failure. The assessment indicated that the "zone of influence" into which tailings or liquid from a dam break could flow would extend to the north east of the TSF on a front up to 900 m wide. This zone would traverse the Transcontinental Railway Reserve and Bulong Road, but would not include any areas of habitation, therefore limiting consideration of loss of life or serious injury to personnel working on the TSF, people travelling along Bulong Road and persons travelling within the railway corridor.

The study concluded that the level of risk associated with loss of life or serious injury arising from a flow failure was acceptably low and that scope for improving the risk existed through managing pond formation and position. It should be noted that final integration of the Fimiston cells into a single cell will provide a means for further reducing the total supernatant pond area and will position the single pond at the centre of the facility, thereby contributing to risk reduction.

The study was carried out for a maximum storage height of 30 m. The current proposals provide for a maximum embankment height of 40 m and a 30% increase in stored tailings. It should be anticipated that while released tailings would follow a generally similar flow path, to the north and east of the TSF, the distance and width of flow may increase. The extent to which this would occur has not been assessed for the purpose of this report. The fault/event tree prepared as part of the earlier dam break study has been examined. Because the likelihood of the factor of safety against embankment failure falling below 1 is only marginally greater than the originally assigned risk, the overall probability of tailings being released will not be significantly effected by increasing the height of the TSF. Similarly, the probability of unremediated erosion and piping along the decant pipeline will not be significantly increased by increasing the height. The potential maximum likely extent of flow in the event of a failure is depicted on Figure 11.

8.7 Reportable Incidents

The incidents referred to above are classed as reportable incidents by the DoIR. Should a reportable incident occur, the relevant government authorities should be notified immediately and the 'Incident Reporting Form' contained in Appendix IV of the DoIR *Guidelines on the Development of an Operating Manual for Tailings Storage* should be completed. Alternatively, a "site incident report" containing relevant details of the incident should be completed and submitted to the authorities.

9.0 DECOMMISSIONING AND REHABILITATION

The overall slopes formed by the outer wall lifts are generally at a batter angle of 17° to 20°, in compliance with conditions of the Notice of Intent and future raises will have external slopes of 14°. The decommissioning proposals anticipate that the waste rock dump located on the southern and south eastern side of the Fimiston TSF will ultimately be extended over the top of the TSF, effectively encapsulating the facility.

Rehabilitation procedures for decommissioning of waste dumps and tailings storages are detailed in the Environmental Guidelines prepared by the KCGM Environmental Section. Introduction of vegetation to the upper surface of the encapsulated facility should be in line with the KCGM guidelines and should reflect commitments current at the time of decommissioning.

10.0 IMPORTANT INFORMATION

Your attention is drawn to the document - "Important Information About Your Geotechnical Engineering Report", which is included in Appendix D of this report. This document has been prepared by the ASFE *(Professional Firms Practicing in the Geosciences)*, of which Golder Associates is a member. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be, and to present you with recommendations on how to minimise the risks associated with the groundworks for this project. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

GOLDER ASSOCIATES PTY LTD

Roger Gavshon Senior Tailings Engineer	David Williams Manager, Mine Waste Services

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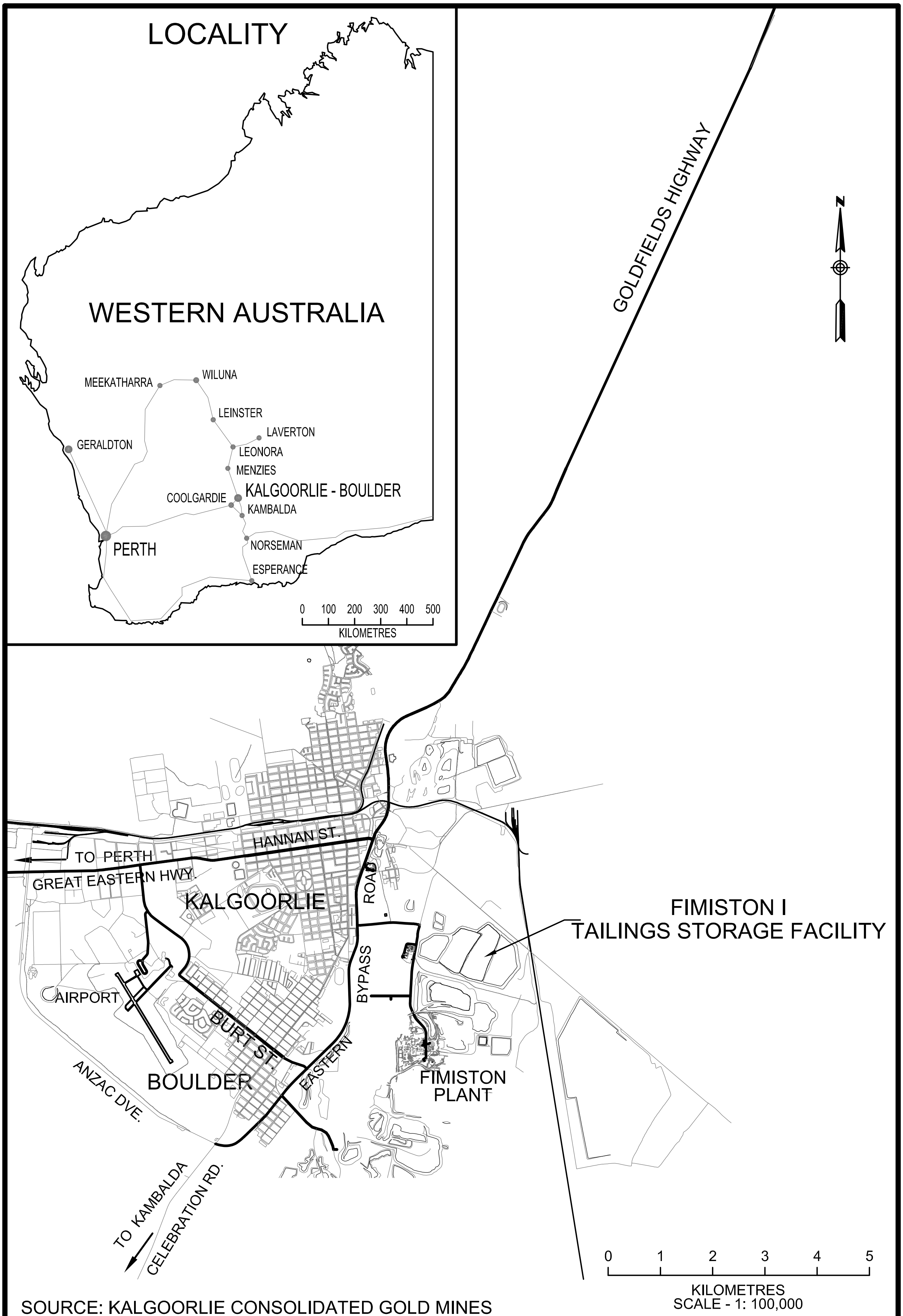
FIGURES



SOURCE: KALGOORLIE CONSOLIDATED GOLD MINES

Golder Associates

CLIENT	KCGM	PROJECT	Fimiston I - Addendum to NOI
DRAWN TJP	DATE Apr. 2003	TITLE	PROJECT LOCATION PLAN
CHECKED	DATE Apr. 2003		
SCALE As Shown	A4	PROJECT No 03641063	FIGURE 1

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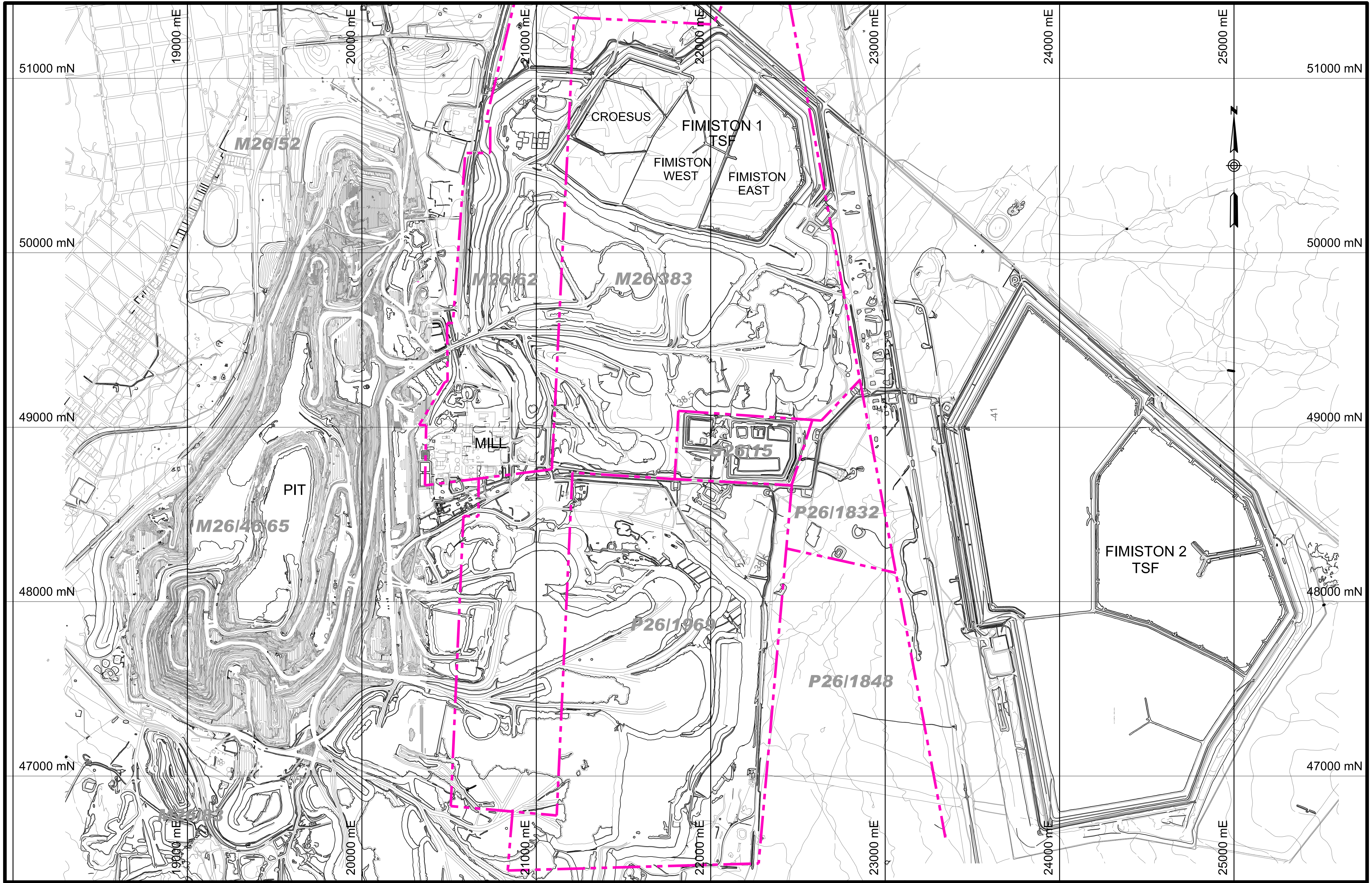
DATE:Apr 03 PLOT SCALE:1:1



LEGEND:

— · —	APPROXIMATE LEASE BOUNDARIES
P26/1969	LEASE NUMBER

1:20000
400 200 0 400 800 m

Golder Associates

CLIENT	KCGM	PROJECT	FIMISTON 1 - ADDENDUM TO NOI
DRAWN	TJP	DATE	Apr 03
CHECKED		DATE	Apr. 2003
TITLE	SITE PLAN AND LEASE BOUNDARIES		
SCALE	1:20,000	A3	
PROJECT No	03641063	FIGURE 2	

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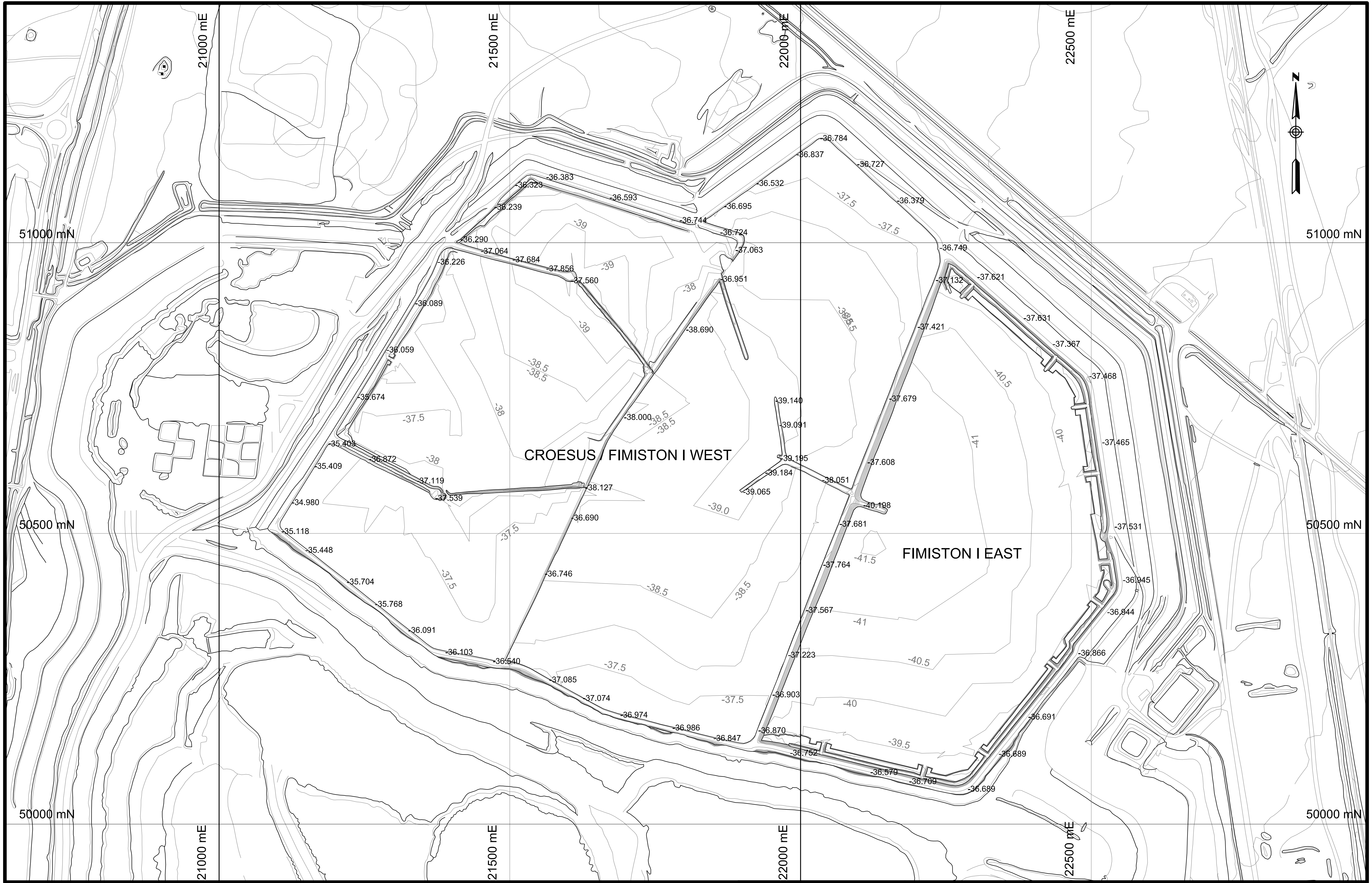

CLIENT KCGM		PROJECT FIMISTON 1 - ADDENDUM TO NOI	
DRAWN TJP	DATE Apr 03	TITLE EXISTING FIMISTON 1 LAYOUT	
CHECKED	DATE Apr. 2003		
SCALE 1:600	A3	PROJECT No 03641063	FIGURE 3

1:600 3 0 3 6 m

Golder Associates

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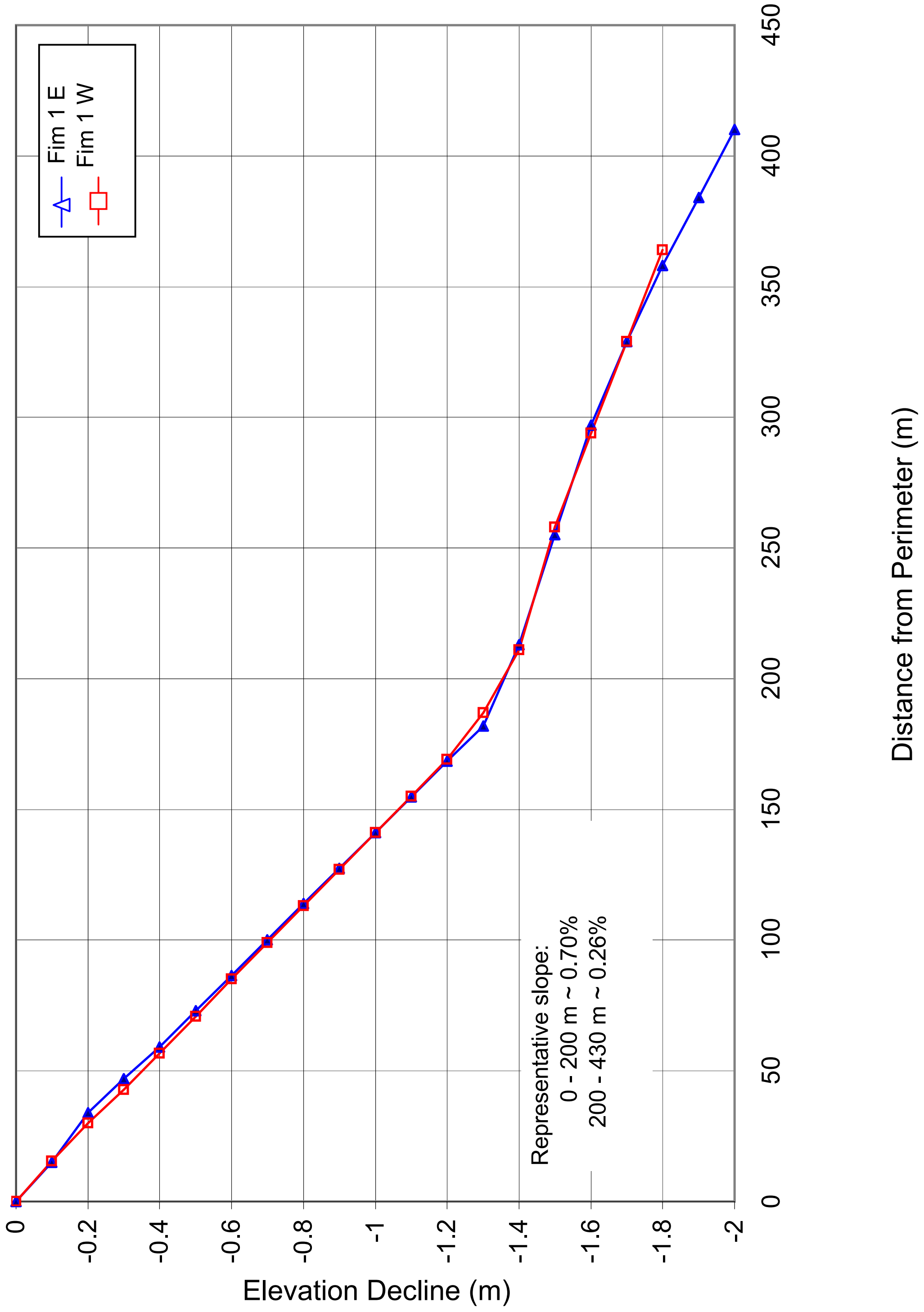


Golder Associates

CLIENT KCGM

PROJECT Fimiston I - Addendum to NOI

DRAWN TJP **DATE** Apr 03

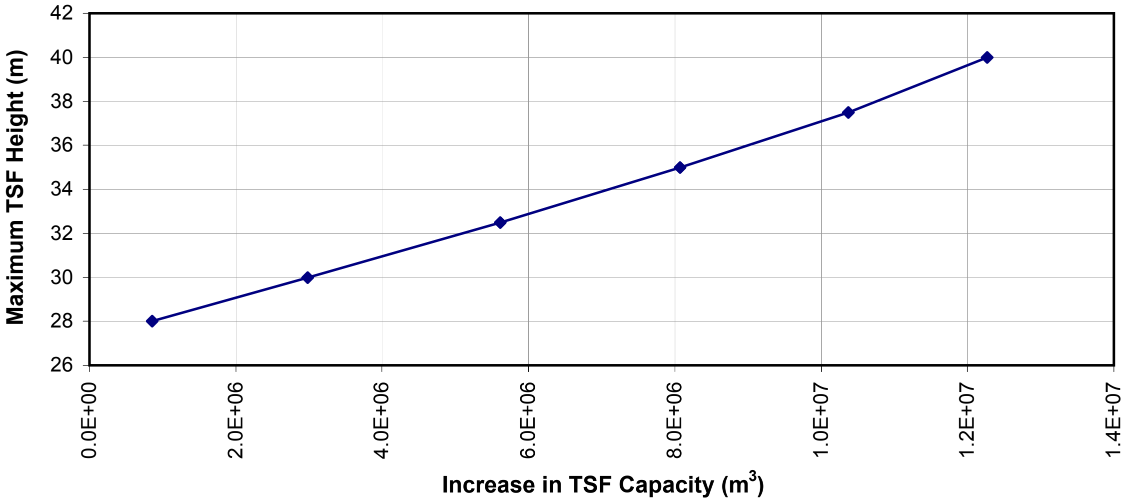
CHECK **DATE** Apr 03

SCALE NTS **A4**

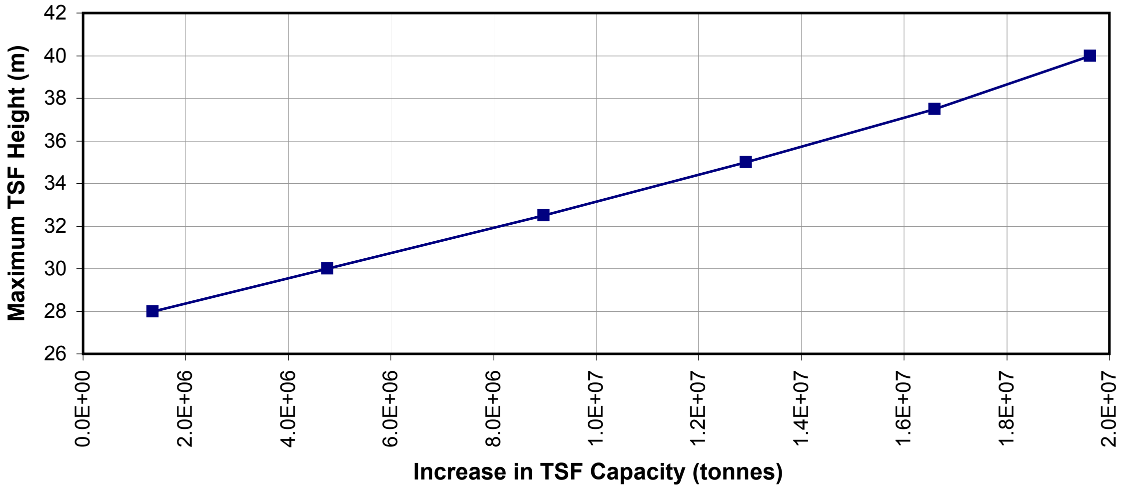
REPRESENTATIVE BEACH SLOPES
FIMISTON I

PROJECT I **03641063** **FIGURE 4**

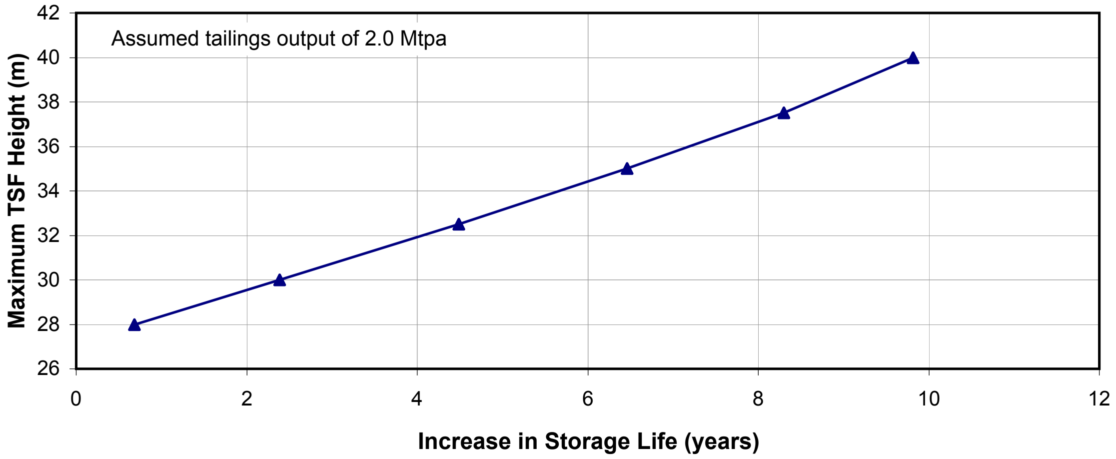
INCREASED STORAGE VOLUME



INCREASED STORAGE TONNAGE



INCREASED STORAGE LIFE


Assumed tailings output of 2.0 Mtpa

Golder Associates

CLIENT	KCGM			PROJECT	Fimiston I - Addendum to NOI	
DRAWN	TJP	DATE	Apr 03	**HEIGHT Vs TIME Vs CAPACITY RELATIONSHIPS**		
CHECK		DATE	Apr 03			
SCALE	NTS	**A4**		PROJECT I	**03641063**	**FIGURE 5**

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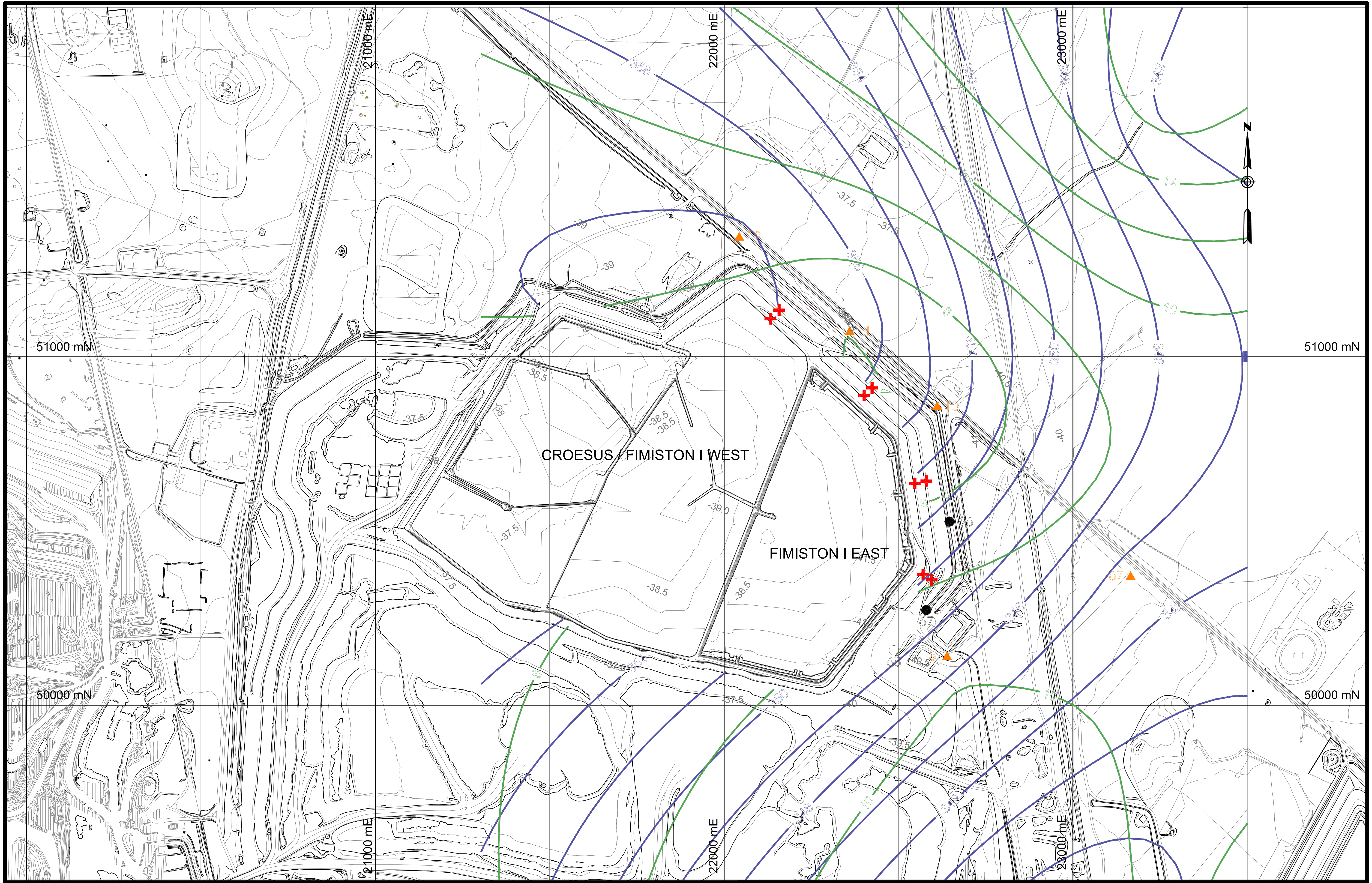

LEGEND:

—	GROUNDWATER LEVELS (mAHD)
—	WATER TABLE DEPTHS (m BELOW NATURAL SURFACE)
— —	FIMISTON I TRENCH
✚	STANDPIPE PIEZOMETERS
▲	MONITORING BORE - "MB F" SERIES
●	PRODUCTION BORE - "PB F" SERIES

Golder Associates

CLIENT KCGM		PROJECT FIMISTON 1 - ADDENDUM TO NOI	
DRAWN TJP	DATE Apr 03	TITLE CONTOUR PLAN OF DECEMBER 2002 GROUNDWATER LEVELS AND DEPTHS TO WATER TABLE	
CHECKED	DATE Apr. 2003		
SCALE 1:1000	A3	PROJECT No 03641063	FIGURE 6

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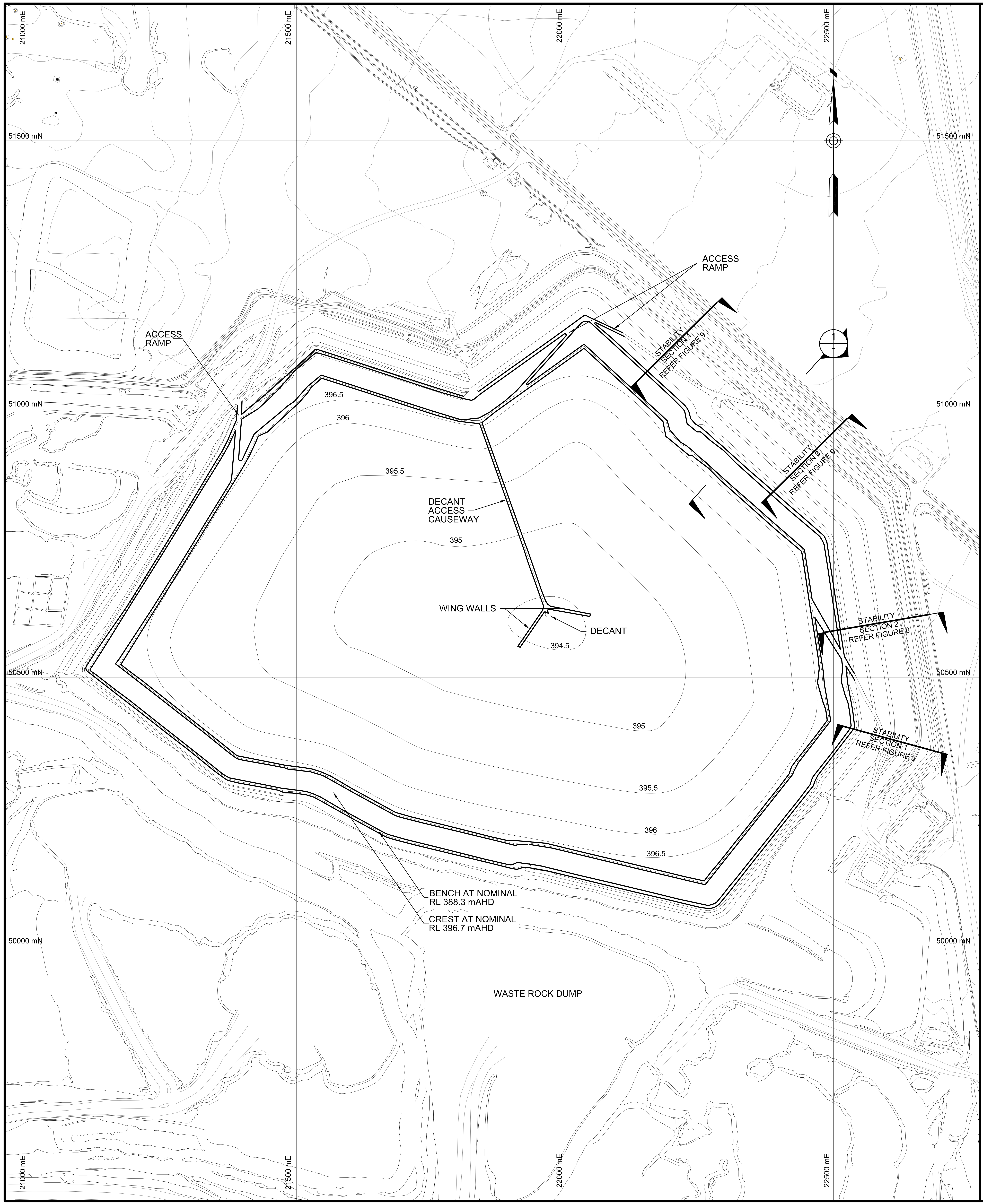
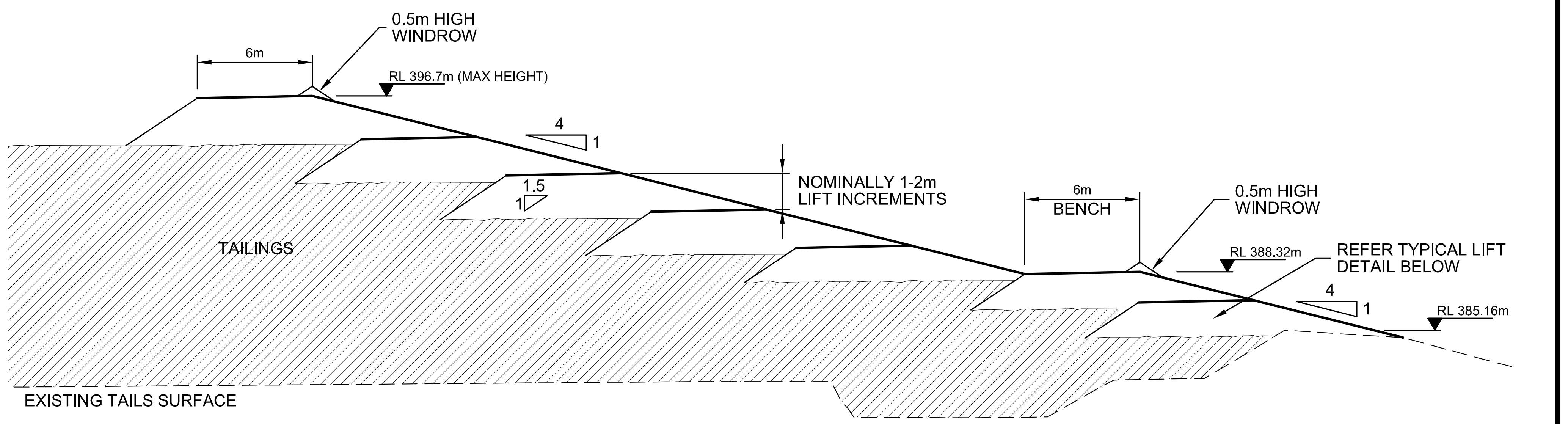
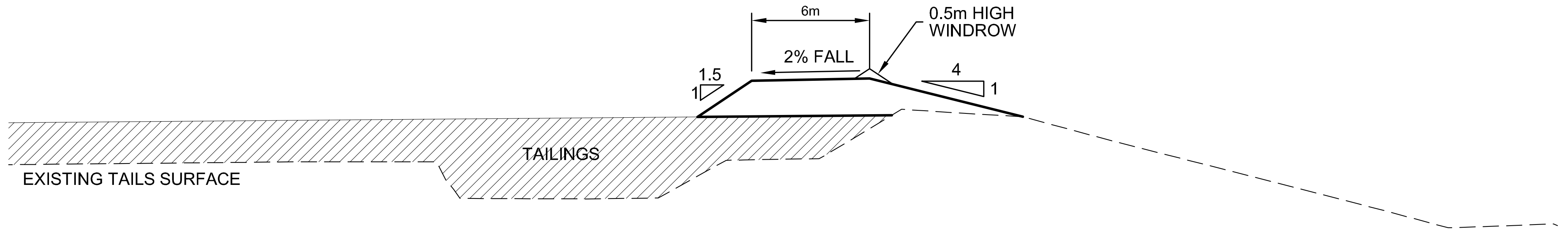




SECTION 1
-
SCALE 1:250



TYPICAL LIFT SECTION
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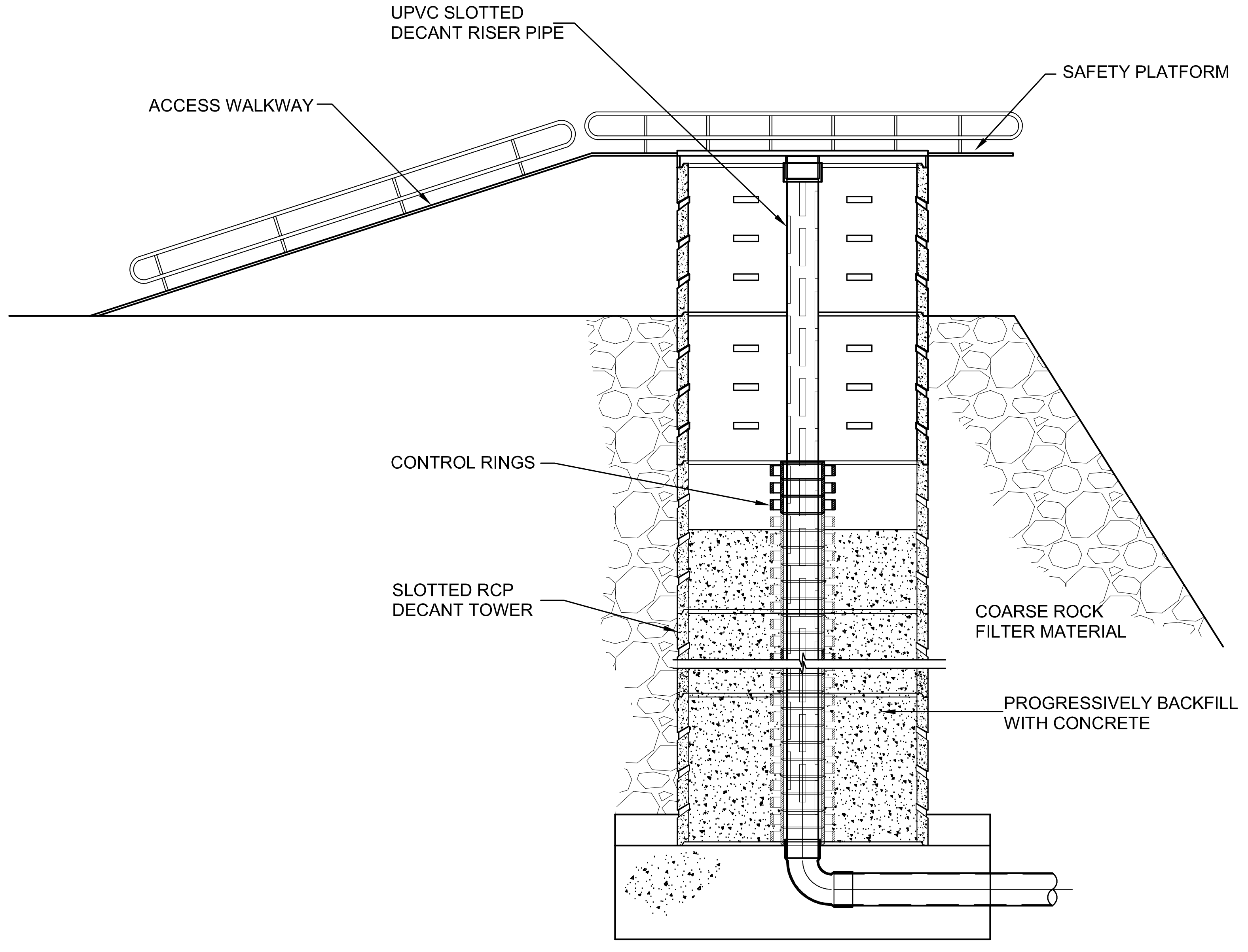

DECANT TOWER SECTION
SCALE 1:40

Golder Associates

CLIENT KCGM
DRAWN TJP
DATE Apr 03
CHECKED
DATE Apr. 2003
SCALE 1:400
A1
PROJECT FIMISTON 1 - ADDENDUM TO NOI
TITLE PROPOSED EMBANKMENT RAISE TO RL 396.7 mAHD (-25.0 mMCD)
PROJECT No 03641063
FIGURE 7

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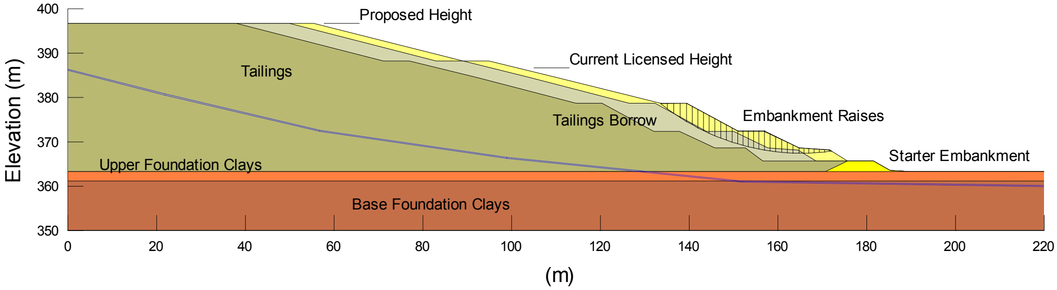
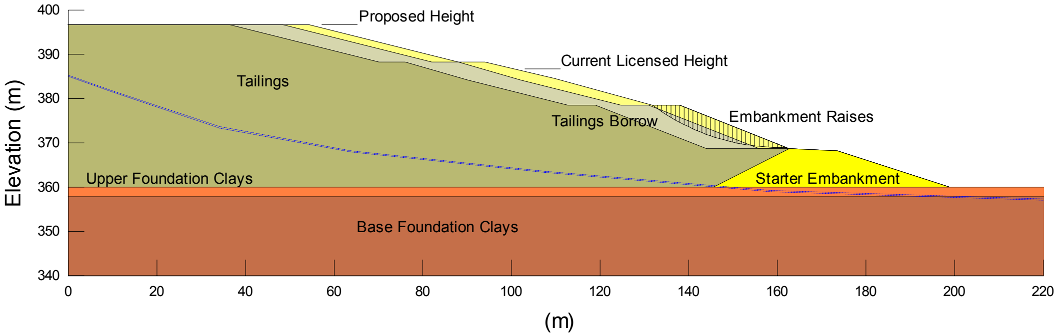
DATE:Apr 03 PLOT SCALE:1:1

Eastern Wall.slz
Analysis Method: Morgenstern-Price



Section 1 - East Wall

North East Wall.slz
Analysis Method: Morgenstern-Price



Section 2 - North East Wall

Section	Minimum Factor of Safety		
	Static Loading	Pseudo-Static Loading	
		OBE (0.07g)	MCE (0.175g)
Section 1 – East Wall	2.04	1.65	1.27
Section 2 – North East Wall	2.02	1.65	1.28

Golder Associates

CLIENT KCGM Pty Ltd
PROJECT NOI ADDENDUM RAISE OF FIMISTON 1
DRAWN DRA
DATE Apr 03
CHECKED
DATE Apr 03
TITLE **CRITICAL SLIP SURFACE GEOMETRY SECTION 1 & 2**
SCALE Not To Scale
A4
PROJECT No **03641063**
FIGURE No. **FIGURE 8**

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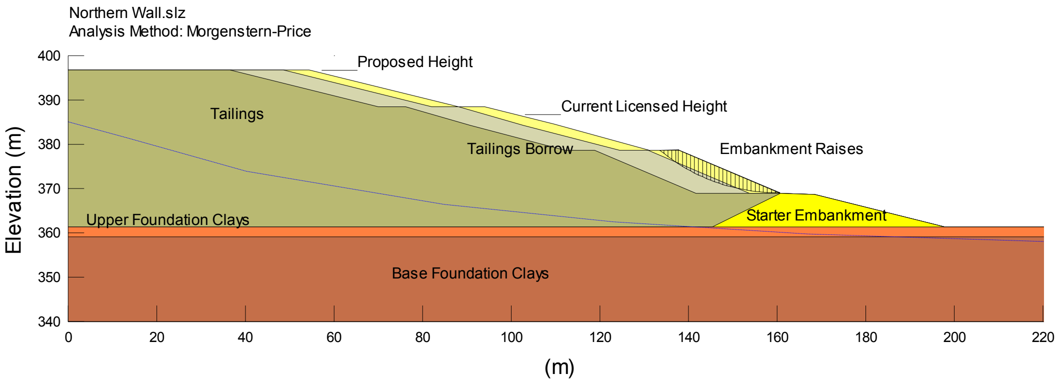
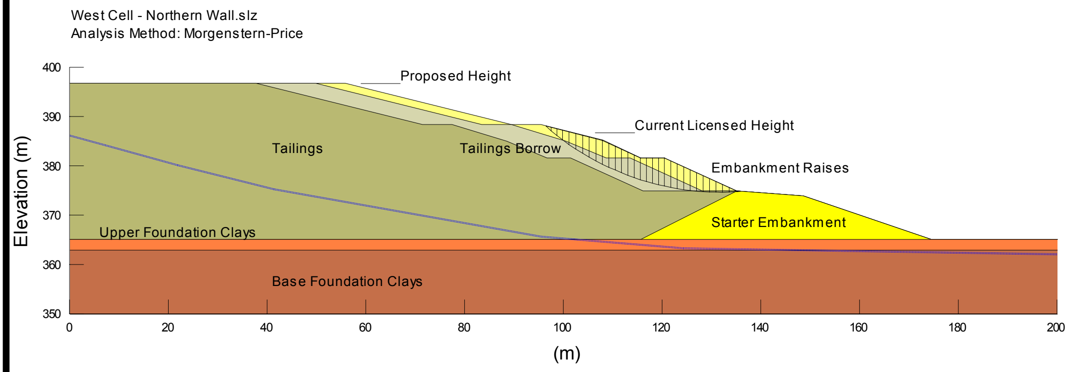


Section 3 - North Wall



Section 4 - North Wall (West Cell)

Section	Minimum Factor of Safety		
	Static Loading	Pseudo-Static Loading	
		OBE (0.07g)	MCE (0.175g)
Section 3 – North Wall	1.94	1.61	1.28
Section 4 – North Wall (West Cell)	2.01	1.63	1.26

Golder Associates

CLIENT	KCGM Pty Ltd	PROJECT	NOI ADDENDUM RAISE OF FIMISTON 1
DRAWN DRA	DATE Apr 03	TITLE	**CRITICAL SLIP SURFACE GEOMETRY SECTION 3 & 4**
CHECKED	DATE Apr 03		
SCALE Not To Scale	A4	PROJECT No **03641063**	FIGURE No. **FIGURE 9**

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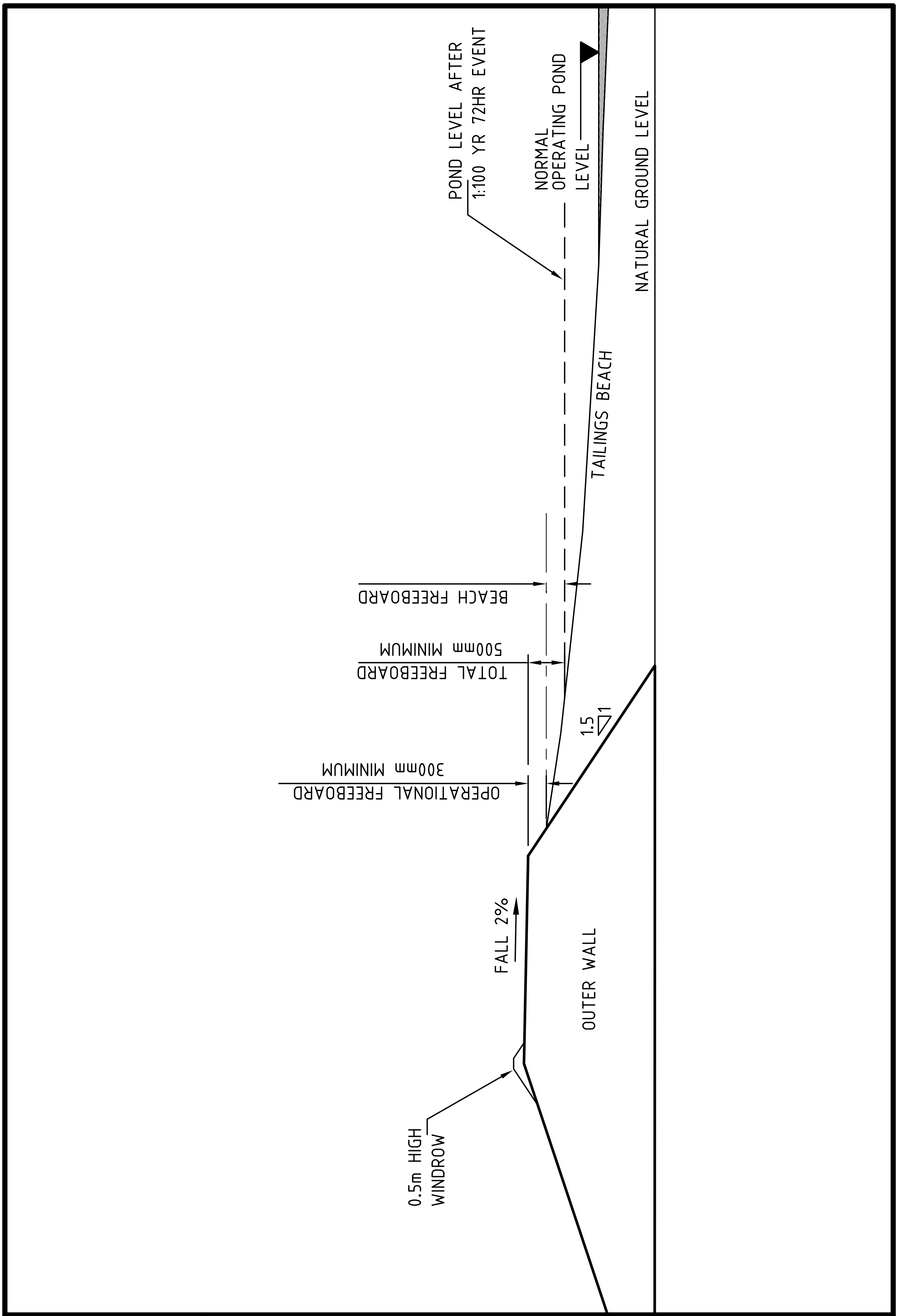

Golder Associates

CLIENT KCGM

PROJECT FIMISTON 1 - ADDENDUM TO NOI

DRAWN TJP

DATE Apr 2003

TITLE FREEBOARD REQUIREMENTS

CHECKED

DATE Apr. 2003

SCALE 1:40

A4

PROJECT No 03641063

FIGURE 10

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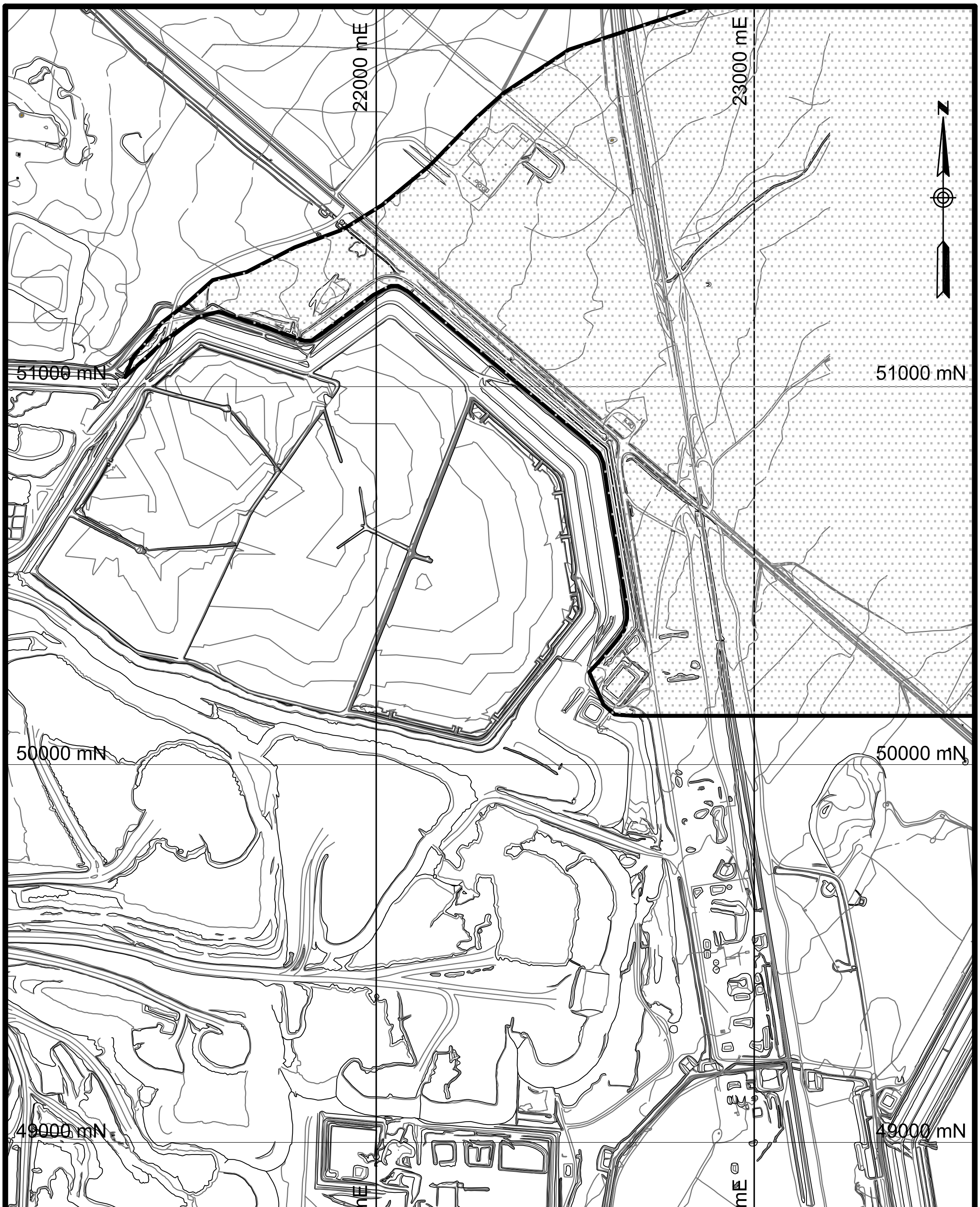

LEGEND

▨ - "ZONE OF INFLUENCE"
POTENTIAL OF FLOW EMANATING
FROM THE TSF

Golder Associates

CLIENT	KCGM		PROJECT	FIMISTON 1 - ADDENDUM TO NOI
DRAWN	TJP	DATE Apr. 2003	TITLE	MAXIMUM LIKELY EXTENT OF FLOW FIMISTON 1
CHECKED		DATE Apr. 2003		
SCALE	SCALE 1:15,000	A4	PROJECT No 03641063	FIGURE 11

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DATE:Apr 03 PLOT SCALE:1:1

APPENDIX A

TAILINGS STORAGE DATA SHEETS

TAILINGS STORAGE DATA SHEET

Please complete a separate sheet for each tailings storage facility (TSF)

1. PROJECT DATA			
1.1 PROJECT NAME: *Kalgoorlie Consolidated Gold Mines*			1.2 Date: *April 2003*
1.3 TSF Name: *Fimiston I*		1.4 Commodity: *GOLD*	
1.5 Name of data provider:* *Trevor Tyson (Civil Engineer, Tailings Dams)*			Phone:* *(08) 9022 1719*
1.6 TSF centre co-ordinates (AMG) *6,597,385 m North* *357,150 m East*			
1.7: Lease numbers: *M26/383*			
2. TSF DATA			
2.1 TSF Status: Proposed ☐ Active ✔ Disused ☐ Rehabilitated ☐			
2.2 Type of TSF:[1] *Paddock*		2.2.1 Number of cells:[2] *1 (combined Fim I West, East & Croesus)*	
2.3 Hazard rating:[3] *Significant*		2.4 TSF category:[4] *1*	
2.5 Catchment area:[5] *108 ha*		2.6 Nearest watercourse: *None nearby*	
2.7 Date deposition started (mm/yy) pre *1988*		*2.7.1* Date deposition completed (mm/yy) *2012 (est)*	
2.8 Tailings discharge method:[6] *Multiple Spigot*		2.8.1 Water recovery method:[7] *Gravity Decant*	
2.9 Bottom of facility sealed or lined? *No*		2.9.1 Type of seal or liner: [8] *N/A*	
2.10 Depth to original groundwater level: *Unknown*		2.10.1 Original groundwater TDS: *approx 50,000*	
2.11 Ore process: [9] *CIL*		2.12 Material storage rate: [10] *nom 2,000,000 tpa*	
2.13 Impoundment volume (present) *30 x* 10^6 m^3		2.13.1 Expected maximum *42 x* 10^6 m^3	
2.14 Mass of solids stored (present) *45 x* 10^6 *tonnes*		2.14.1 Expected maximum *63 x* 10^6 *tonnes*	
3 ABOVE GROUND FACILITIES			
3.1 Foundation soils *clayey sand/sandy clay*		3.1.1 Foundation rocks	
3.2 Starter bund construction materials: [11] *Surficial soils within perimeter walls*		3.2.1 Wall lifting by: Upstream ✔ Downstream ☐ Centreline ☐	
3.3 Wall construction by: *Rock 'n Tails Pty Ltd*		3.3.1 Wall lifting material: [12] *Tailings (planned)* mechanically ✔ hydraulically ☐	
3.4 Present maximum wall height agl: [13] *28 m*		3.4.1 Expected maximum *40 m*	
3.5 Crest length (present) *(all embankments)* *5,030 m*		3.5.1 Expected maximum *5,030 m*	
3.6 Impoundment area (present) *108 ha*		3.6.1 Expected maximum *108 ha*	
BELOW GROUND/IN-PIT FACILITIES			
~~4.1 Initial pit depth (maximum) m~~		~~4.2 Area of pit base Ha~~	
~~4.3 Thickness of tailings (present) m~~		~~4.3.1 Expected maximum m~~	
~~4.4 Current surface area of tailings Ha~~		~~4.4.1 Final surface area of tailings Ha~~	
5 PROPERTIES OF TAILINGS			
5.1 TDS *70-190,000 mg/L*	5.2 *pH 7.7*	5.3 Solids content 55 - *56 %*	5.4 Deposited density *1.2 – 1.6 t/*m^3
5.5 Potentially hazardous substances: [14] *Cyanide*		5.6 WAD CN *2-10 mg/L*	5.7 Total CN *20-60 mg/L*
		5.8 Any other NPI listed substances in the TSF?[18] *No*	

***Not to be recorded in the database; for 1, 2, 3 etc see explanatory notes on the next page**

EXPLANATORY NOTES
FOR COMPLETING
TAILINGS STORAGE DATA SHEET

The following notes are provided to assist the proponent to complete the tailings storage data sheet.

1. Paddock (ring-dyke), cross valley, side-hill, in-pit, depression, waste fill etc.
2. Number of cells operated using the same decant arrangement.
3. See Table 1 in the Guidelines.
4. See Figure 1 in the Guidelines.
5. Internal for paddock (ring-dyke) type, internal plus external catchment for other facilities.
6. End of pipe (fixed), end of pipe (movable), single spigot, multi-spigots, cyclone, CTD (central thickened discharge) etc.
7. Gravity feed decant, pumped central decant, floating pump, wall/side mounted pump etc.
8. Clay, synthetic etc.
9. See list below for ore process method.
10. Tonnes of solids per year.
11. Record only the main material(s) used for construction eg: sand, silt, gravel, laterite, fresh rock, weathered rock, tailings, clayey sand, clayey gravel, sandy clay, silty clay, gravelly clay, etc or any combination of these materials.
12. Any one or combination of the materials listed under item 11 above.
13. Maximum wall height above ground level (not AHD or RL).
14. Arsenic, Asbestos, Caustic soda, Copper sulphide, Cyanide, Iron sulphide, Lead, Mercury, Nickel sulphide, Sulphuric acid, Xanthates etc.
15. NPI – National Pollution Inventory. Contact Dept of Environmental Protection for information on NPI listed substances.

ORE PROCESS METHODS

The ore process methods may be recorded as follows:

Acid leaching (Atmospheric)
Acid leaching (Pressure)
Alkali leaching (Atmospheric)
Alkali leaching (Pressure)
Bayer process
Becher process
BIOX
Crushing and screening
CIL/CIP
Flotation
Gravity separation
Heap leaching
Magnetic separation
Ore sorters
Pyromet
SX/EW (Solvent extraction/Electro winning)
Vat leaching
Washing and screening

APPENDIX B

TENEMENT CONDITIONS
RELATING TO M26/383

TENEMENT CONDITIONS RELATING TO M26/383

Endorsements

1. The land the subject of this lease does not include land the subject of Prospecting Licence 26/1696. 17/07/1992

2. The land the subject of this lease does not include any private land except that below 30 metres from the natural surface of the land. 17/07/1992

Conditions

1. Survey. 17/07/1992

2. Compliance with the provisions of the Aboriginal Heritage Act, 1972 to ensure that no action is taken which would interfere with or damage any Aboriginal site. 17/07/1992

3. All surface holes drilled for the purpose of exploration are to be capped, filled or otherwise made safe after completion. 17/07/1992

4. All costeans and other disturbances to the surface of the land made as a result of exploration, including drill pads, grid lines and access tracks, being backfilled and rehabilitation to the satisfaction of the District Mining Engineer. Backfilling and rehabilitation being required no later than 6 months after excavation unless otherwise approved in writing by the District Mining Engineer. 17/07/1992

5. All waste materials, rubbish, plastic sample bags, abandoned equipment and temporary buildings being removed from the mining tenement prior to or at the termination of exploration program. 17/07/1992

6. Unless the written approval of the District Mining Engineer, Department of Mines, is first obtained, the use of scrapers, graders, bulldozers, backhoes or other mechanised equipment for surface disturbance or the excavation of costeans is prohibited. Following approval, all topsoil being removed ahead of mining operations and separately stockpiled for replacement after backfilling and/or completion of operations. 17/07/1992

7. The lessee within three months of grant submitting a plan of the ongoing mining operations and measures to safeguard the environment to the State Mining Engineer for his assessment and written approval. 17/07/1992 09/01/1993

8. Mining on any road, road verge or road reserve being confined to below a depth of 15 metres from the natural surface. 17/07/1992

9. The rights of ingress to and egress from Miscellaneous Licence 26/38, 26/91, 26/144 and 26/172 being at all times preserved to the licensee and no interference with the purpose or installations connected to Miscellaneous Licences 26/38, 26/91, 26/144 and 26/172. 17/07/1992

10. No interference with the powerline and transmission line or the installations in connection therewith, and the rights of ingress to and egress from the facility being at all times preserved to the owners thereof. 17/07/1992

11. The construction and operation of the project and measures to protect the environment being carried out generally in accordance with the proposals outlined in the following documents: 17/07/1992

- Notice of Intent for an extension to the tailings storage at North Kalgurli Mine dated September 1987, letter dated 3 May 1991 and retained on Mines Department File No. 1198/91.

- Letter from North Kalgurli Mines Limited dated 11 April 1988 and filed at pages 162 and 163 of Mines File 17221/83, in particular points 2(a), (b) and 2(c).

- Notice of Intent, Fimiston Project - Phase II, Proposed Ore Processing Plant Expansion, dated September 1990 and retained on Mines File 920/89.

- Mt Percy Mine Tailings Storage Extension Works Approval Documentation dated November 1988, from Australian Groundwater Consultants.

- Fimiston to Mt Percy Process Water Transfer Pipeline Drainage and Spillage Containment dated 6 August 1991, the associated letter dated 13 August 1991 and both retained on Mines Department File No. 87/88.

- "Notice of Intent - Sitewide Water Supply Rationalisation" dated September 1991 and retained on Mines Department File No. 1273/91; and

- "Addendum to Notice of Intent - Sitewater Water Supply Rationalisation" dated 16 March 1992 and retained on Mines Department File No. 2001/92

- "Consultative Environmental Review Mine and Waste Dumps- Fimiston" Kalgoorlie Consolidated Gold Mines Pty Ltd dated August 1990 and retained on Department of Minerals and Energy File No. 1198/91; and

- Letters dated 18 November 1992 and 3 February 1993 both titled "Consultative Environment Review- Request for Amendment" signed by A O'Neil Manager- Mining (KCGM) and retained on Department of Minerals and Energy File No. 2058/93.

- "Rationalisation Fimiston I and Croesus Tailings Dams Kalgoorlie Consolidated Gold Mines, Kalgoorlie WA" dated April 1993 and retained on Department of Minerals and Energy File No. 2058/93.

- "Environmental Guidelines, Tailings Dams - Preparation for Revegetation, Kalgoorlie Consolidated Gold Mines Environmental Section" May 1991, and retained on Department of Minerals and Energy File No.2058/93.

- "Letter of Intent - Fimiston Stage 1 Tailings Dam Seepage Control Trench", dated 7 February 1994 and signed by Peter Rowe, received at the Kalgoorlie Inspectorate on 14 February 1994 and retained on Department of Minerals and Energy File No. 2212/93.

- Notice of Intent - Fimiston Expansion 1994/95" dated 11 August 1994 and "Letter of Intent - Tenement Mining Lease 26/383" dated 25 August 1994 and retained on Department of Minerals and Energy File No. 2068/94.

- "Notice of Intent - Mt Charlotte to Fimiston Overland Conveyor" dated 2 December 1994 and retained on Department of Minerals and Energy File No. 2010/95.

- "Addendum to Rationalisation Fimiston I and Croesus Tailings Storages" dated 8 August 1995 and retained on Department of Minerals and Energy File No. 2009/96.

- "Request for Amendment - Fimiston Waste Dump Boundaries" dated 5 March 1996, signed by Mr A King - Manager Mining, KCGM; and retained on Department of Minerals and Energy File No. 2156/96.

- "Notice of Intention to Clear Land on M26/383 for Powerline Maintenance and Access Road" dated 13 June 1996, signed by Mr Brett Anderson - KCMG Land Administration Officer; and retained on Department of Minerals and Energy File No. 2009/96

- "Retreatment of Croesus, Mt Trafalgar and Old Croesus Tailings Dumps - Notice of Intent" dated 3 July 1998;

- "Retreatment of Croesus and Mt Trafalgar Tailings dumps - Plan of Operations" dated July 1998; and

- Letters dated 7 July 1998 and 1 September 1998 signed by Resident Manager - Mr Phil Evers; and all retained on Department of Minerals and Energy File No. 2041/98.

- "Minor Changes to Waste Rock Dump Footprint Fimiston 1 and Topsoil Stripping Fimiston 1 - North East Waste Rock Dump - M26/383, G26/79 and G26/15 (NOI 3681) dated 20 December 2001 signed by Mr Jim Bawden, Manager - Community Safety and Environment and 15 March 2001 signed by Mr Neil Rankine, Land Administrator, Kalgoorlie Consolidated Gold Mines and retained on Department of Minerals and Energy File No. 4355/00;

Where a difference exists between the above documents and the following conditions, then the following conditions shall prevail. 17/07/1992

12. The development and operation of the project being carried out in such a manner so as to create the minimum practicable disturbance to the existing vegetation and natural landform. 17/07/1992

13. All topsoil being removed ahead of all mining operations from sites such as pit areas, waste disposal areas, ore stockpile areas, pipeline, haul roads and new access roads and being stockpiled for later respreading or immediately respread as rehabilitation progresses. 17/07/1992

14. At the completion of operations, all buildings and structures being removed from site or demolished and buried to the satisfaction of the State Mining Engineer. 17/07/1992

15. At the completion of operations, or progressively where possible, all access roads and other disturbed areas being covered with topsoil, deep ripped and revegetated with local native grasses, shrubs and trees to the satisfaction of the State Mining Engineer. 17/07/1992

16. The lessee submitting to the State Mining Engineer in July of each year, a brief annual report outlining the operations and rehabilitation work undertaken in the previous 12 months and the proposed operations and rehabilitation programmes for the next 12 months. 17/07/1992 09/08/1996 The lessee submitting to the State Mining Engineer in September of each year, a brief annual report outlining the operations and rehabilitation work undertaken in the previous 12 months and the proposed operations and rehabilitation programmes for the next 12 months. 09/08/1996 25/02/2002 The lessee submitting to the State Mining Engineer, a brief annual report outlining the project operations, minesite environmental management and rehabilitation work undertaken in the previous 12 months and the proposed operations, environmental management plans and rehabilitation programs for the next 12 months. This report to be submitted each year in March: 26/02/2002

17. Upon cessation of any open pit mining operations all pits being securely fenced, the walls battered and ground near the periphery of such pits being rehabilitated to the satisfaction of the State Mining Engineer. 17/07/1992

18. All ore stockpile areas and roads constructed in the course of mining being left level and rehabilitated with trees or natural scrub to the satisfaction of the State Mining Engineer. 17/07/1992

19. Upon completion of waste dumps the material being either:- 17/07/1992

- backfilled into the excavated pits; or
- contained with trees and natural scrub being planted over the entire surface of each such dump to the satisfaction of the State Mining Engineer.

20. The relocation and re-instatement of the dust abatement fence, as discussed between the lessees and the Shire of Boulder and adequate dust control measures being utilised at all times. 17/07/1992

21. The lessee using adequate dust suppression control methods and practices. 17/07/1992

22. The construction and operation of the tailings dam being such as to maximise settled tailings density minimise water seepage and to collect any such seepage and return it to the tailings dam process plant circuit. 17/07/1992

23. The walls of the tailings dam being constructed from or having a substantial outer covering of competent waste rock which will prevent long term erosion and when completed the outslopes being contoured such that the maximum angle to the horizontal is 20 degrees. 17/07/1992

24. The outslopes of the tailings dam being progressively covered with topsoil and revegetated with local native grasses, shrubs and trees to the satisfaction of the Regional Mining Engineer or his nominee. 17/07/1992

25. At the completion of operations and when the tailings have dried sufficiently, the surface of the tailings dam being covered with 0.5 metres of waste rock, covered with topsoil and revegetated with local native grasses, shrubs and trees. 17/07/1992

26. All rubbish and scrap being progressively disposed of in a suitable manner. 17/07/1992

27. The tailings pipeline and return water pipeline being placed in secure bunded corridor or trench to contain any effluent in the event of pipe failure. 17/07/1992

28. Any leaks or spillage associated with the operations of the tailings dam or associated pipelines being notified immediately to the District Mining Engineer. 17/07/1992

29. Any faunal deaths associated with the operation of the tailings dam or associated pipelines being notified immediately to the District Mining Engineer. 17/07/1992

30. Any alteration or expansion of operations within the lease boundaries beyond that outlined in the above documents not commencing until a plan of operations and a program to safeguard the environment are submitted to the State Mining Engineer for his assessment and until his written approval to proceed has been obtained. 17/07/1992

31. The lessee providing an Unconditional Performance Bond (guaranteed by a Bank or other financial institution) in favour of the Minister for Mines in the sum of $1,025,000 for due compliance with the environmental conditions on its mining tenements. 17/07/1992 14/02/2001 The lessee arranging lodgement of an Unconditional Performance Bond executed by a Bank or other approved financial institution in favour of the Minister for Mines in the sum of $3,908,400 for due compliance with the environmental conditions of the lease. 15/02/2001 Consent to Mine on Parklands Townsite and Brown Hill Suburban Areas granted by Minister for Mines subject to:

32. Access to the surface of land within Parkeston and Brown Hill Suburban Area for mining purposes being subject to the approval of the local Authority or relevant reserve vestees, and mining activities within the first 100 metres below the surface of the land being limited to such exploration activities as may be approved by the State Mining Engineer. 17/07/1992 Consent to Mine on Parklands Reserve 35662 and Sanitary Reserve 10081 granted by Minister for Mines subject to.

33. The construction of the new decant footings and the installations of the decant outfall through the storage walls shall be supervised by an engineering/geotechnical specialist. 17/07/1992

34. Within one month of the completion of construction of the decant structures, the lessee submitting to the Department of Minerals and Energy, as built drawings and a brief construction report by an engineering/geotechnical specialist. 17/07/1992

35. An annual inspection report being provided to the Department of Minerals and Energy by a geotechnical/engineering specialist to review the performance of the tailings structure, validate the engineering design and review the results of environmental monitoring. A recent survey drawing of the storage should be included. 17/07/1992

36. At decommissioning of the tailings dam and prior to rehabilitation, the lessee submitting a review by an engineering/geotechnical specialist of: 17/07/1992

- the status of the structure;
- its contained tailings;
- the results of environmental monitoring;
- any ongoing remedial works required.

to the State Mining Engineer for his assessment and written approval.

37. Any leak or spillage associated with the operation of tailings pipeline, saline water pipeline, pumping stations or tailings trenches being immediately reported to the inspectorate Environmental and Rehabilitation Officer of the Department of Minerals and Energy. This report being accompanied by a program for corrective measure. 06/11/1998

APPENDIX C

TAILINGS TESTWORK
LABORATORY TEST CERTIFICATES

Golder Associates
Perth Laboratory
182 Lord Street
East Perth 6000
Phone (08) 9427 7600

TEST REPORT No. 46/03

Consolidation Test Summary

Client: KCGM
Project: Fimiston 1 TSF
Location: Kalgoorlie

Job No: 03641063
Lab No: #8001
Date Tested: 28-30/3/03

Sample Location: Tube A

Material Description: Beached Tailings

Results Summary

Effective Pressure (kPa)	Percent Settlement (%)	Void Ratio (e)	Coefficient of Volume Compressibility mv (m^2 / MN)	Coefficient of Consolidation Cv (m^2 / year)	Compression Index (Cc)	Permeability k (m sec^{-1})
3	0.0	0.582	-	-	-	-
50	1.0	0.565	0.219	92.9	0.013	6.4×10^{-9}
100	1.6	0.557	0.107	98.0	0.028	3.3×10^{-9}
200	2.4	0.544	0.082	83.6	0.042	2.2×10^{-9}
400	3.4	0.527	0.056	92.2	0.057	1.6×10^{-9}
800	5.1	0.502	0.042	93.5	0.085	1.3×10^{-9}

Assumed Particle Density = 2.79 g/cm^3

Test Conditions	**Initial**	**Final**
Moisture Content (%):	20.1	17.8
Dry Density (t/m^3):	1.76	1.86
Void Ratio (e):	0.58	0.50
% Saturation:	97	99

The test specimen was extruded from a thin walled tube sample

Test Method AS1289
6.6.1 - Consolidation Test

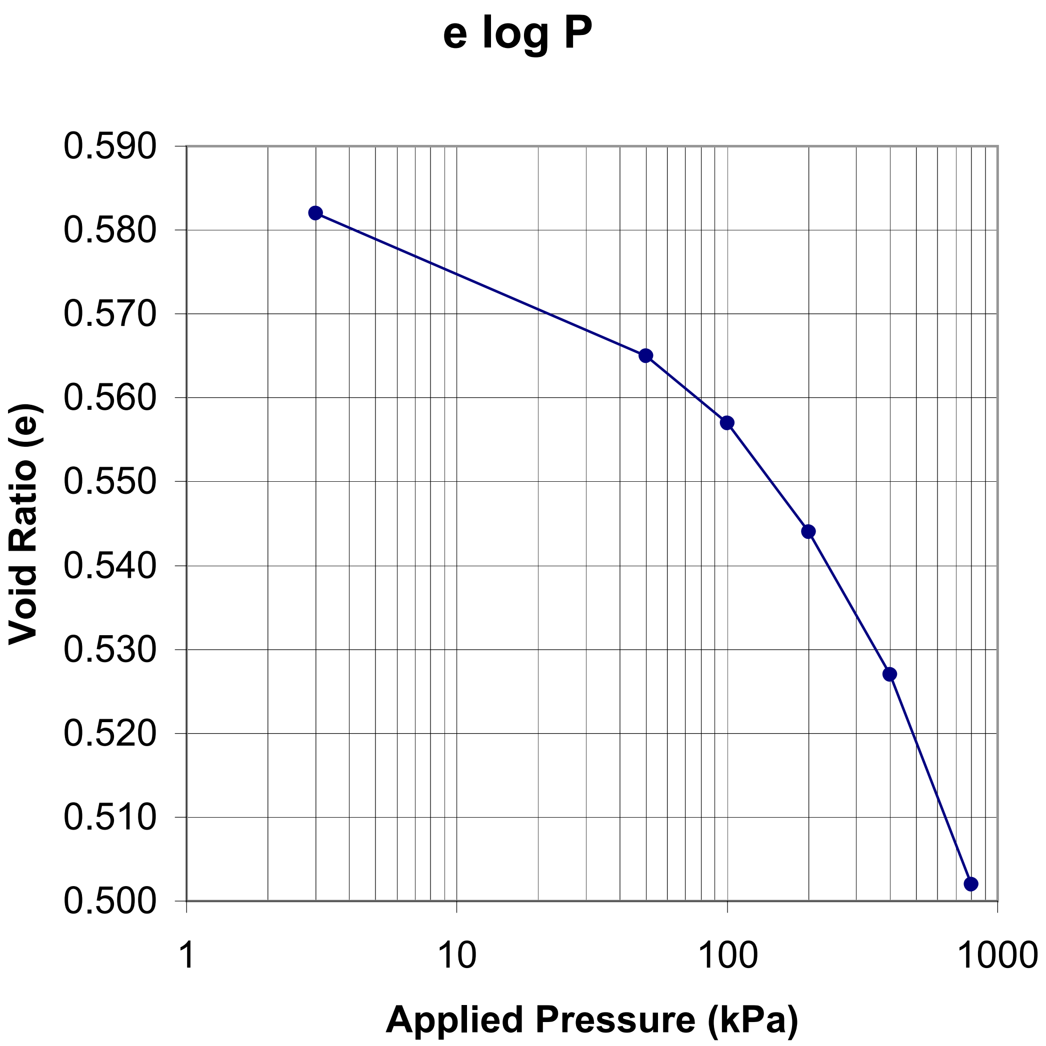
Sampling Procedure: Tested as received

Approved Signatory: **A. Mangano**

Date: April, 2003
(Laboratory Manager)

TEST REPORT No. 46/03

Consolidation Test - e Log P Graph



April, 2003

Golder Associates
Perth Laboratory
182 Lord Street
Perth, 6000
Phone (08) 9427 7600

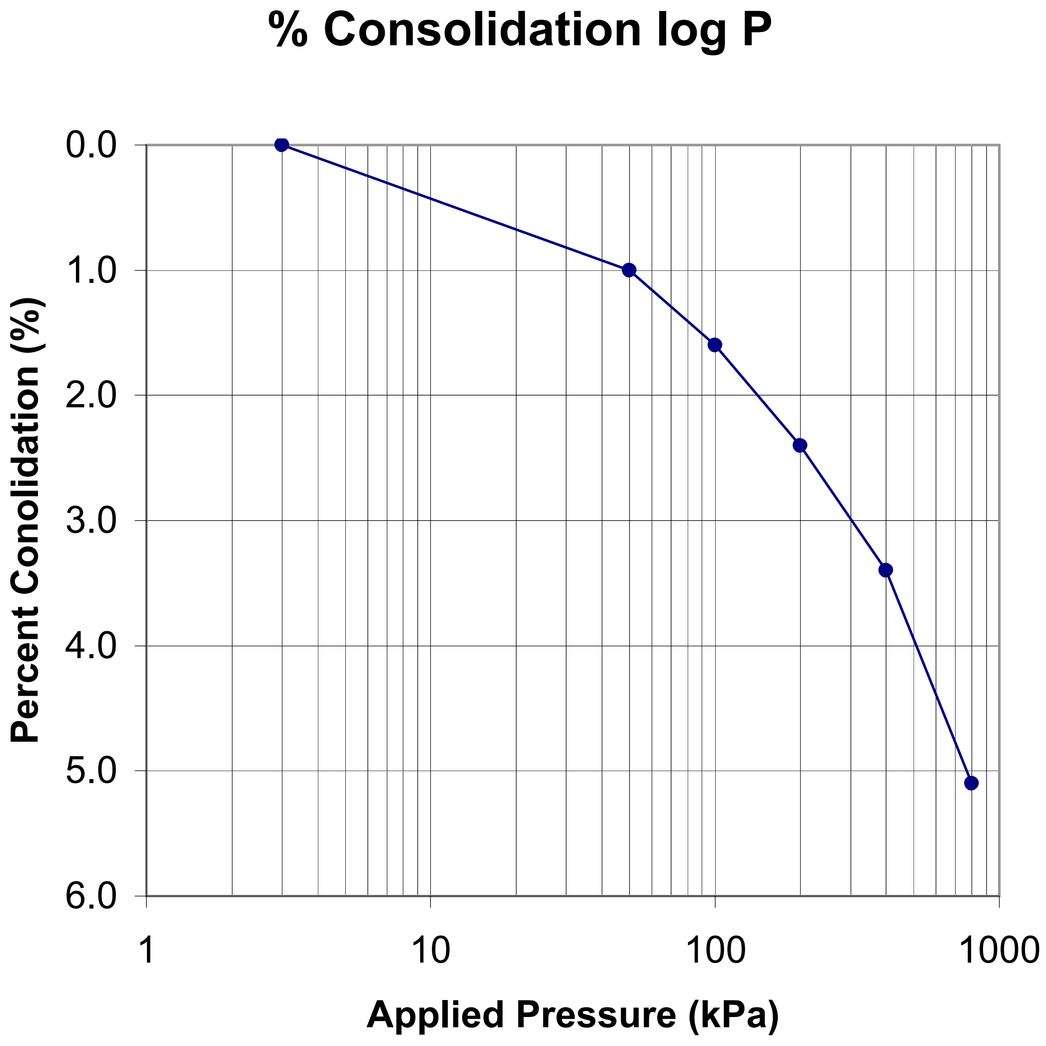
TEST REPORT No. 46/03

Sheet 3 of 4

Consolidation Test - % Consolidation Log P Graph

Client: KCGM
Project: Fimiston 1 TSF
Location: Kalgoorlie

Job No: 03641063
Lab No: #8001
Date Tested: 28-30/3/03



April, 2003

Golder Associates
Perth Laboratory
182 Lord Street
Perth, 6000
Phone (08) 9427 7600

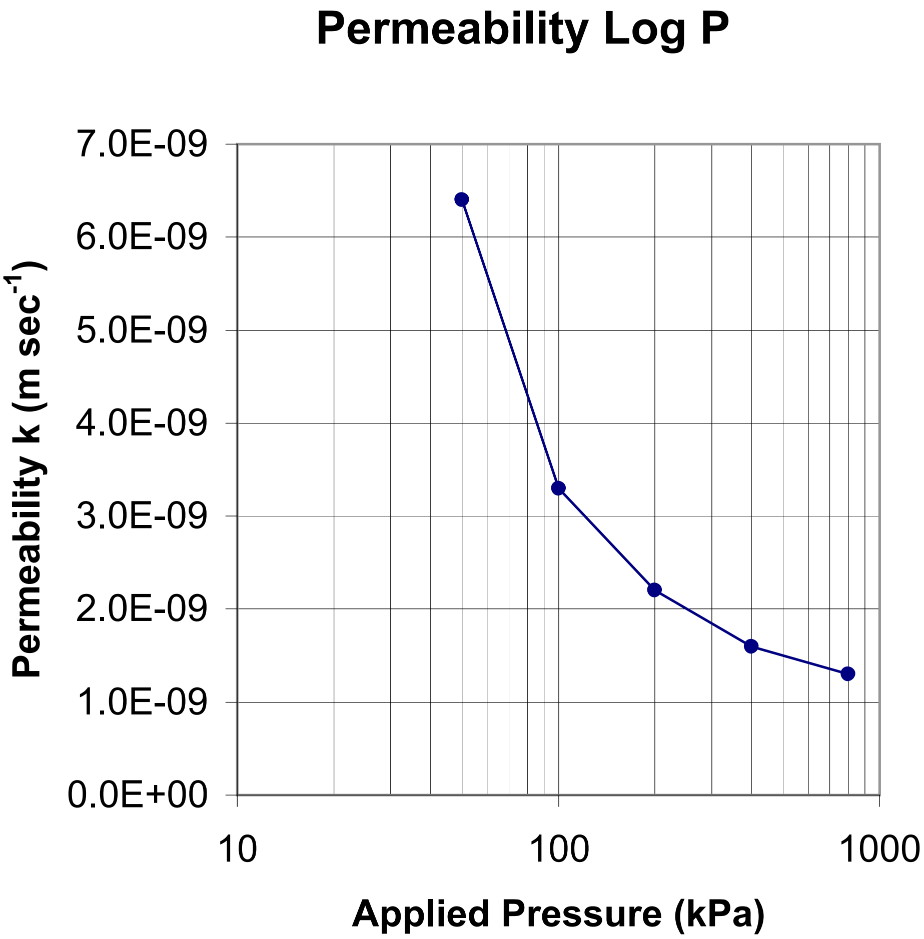
TEST REPORT No. 46/03

Sheet 4 of 4

Consolidation Test - Permeability log P Graph

Client: KCGM
Project: Fimiston 1 TSF
Location: Kalgoorlie

Report No: 03641063
Job No: #8001
Lab No: 28-30/3/03



April, 2003

CSIRO

CSIRO Minerals

Conlon Street, Waterford, WA, Australia
PO Box 90, Bentley, WA 6982
Tel: +61 8 9334 8000
Fax: +61 8 9334 8001
www.minerals.csiro.au

TONY

JOB No
GOLDER ASSOCIATES PTY LTD
REC'D 29 OCT 2002
DATE: BY:

PARTICLE ANALYSIS SERVICE

ANALYSIS REPORT

Analyst:
Phan Tuan Khanh

Report Authorised: P. J Austin
Peter J Austin
Manager

Date: 29·10·02

Report Number: R027270 (12) pages including cover

Analysis Report

CSIRO
Division of Minerals
Particle Analysis Service

Sample Name : 02640 199 - Fimiston I West - Nth Wall # 7547

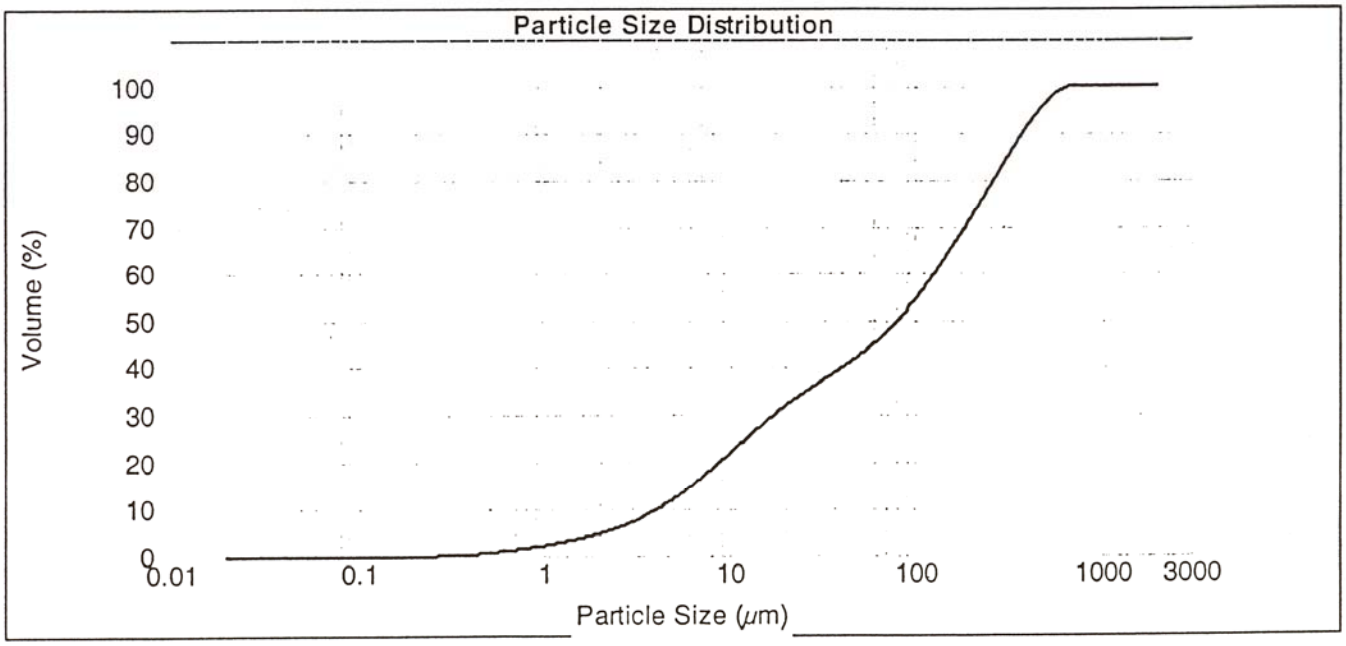
Batch No : R027270

PAS ID No : P39223

Dispersant :	Water	**SOP Name :**	
Additives :	10 millilitres Sodium hexametaphosphate	**Analysis model :**	General purpose
Sonication :	20 minutes in ultrasonic bath	**Result units :**	Volume

---

Concentration :	0.0379 %Vol	**Vol. Weighted Mean D[4,3] :**	138.9... µm	**d(0.1) :**	4.118 µm
Obscuration :	29.34 %	**Surface Weighted Mean D[3,2] :**	9.332 µm	**d(0.5) :**	80.665 µm
Weighted Residual :	1.768 %	**Specific Surface Area :**	0.643 m²/cc	**d(0.8) :**	265.005 µm



Size (µm)	Vol Under %
0.020	0.00
0.022	0.00
0.025	0.00
0.028	0.00
0.032	0.00
0.036	0.00
0.040	0.00
0.045	0.00
0.050	0.00
0.056	0.00
0.063	0.00
0.071	0.00
0.080	0.00
0.089	0.00
0.100	0.00
0.112	0.00
0.126	0.00

Size (µm)	Vol Under %
0.142	0.00
0.159	0.00
0.178	0.00
0.200	0.00
0.224	0.00
0.252	0.00
0.283	0.02
0.317	0.09
0.356	0.18
0.399	0.31
0.448	0.46
0.502	0.64
0.564	0.85
0.632	1.07
0.710	1.32
0.796	1.58
0.893	1.87

Size (µm)	Vol Under %
1.002	2.19
1.125	2.53
1.262	2.91
1.416	3.33
1.589	3.79
1.783	4.30
2.000	4.86
2.244	5.48
2.518	6.16
2.825	6.92
3.170	7.75
3.557	8.68
3.991	9.70
4.477	10.83
5.024	12.07
5.637	13.41
6.325	14.87

Size (µm)	Vol Under %
7.096	16.42
7.962	18.07
8.934	19.79
10.024	21.56
11.247	23.36
12.619	25.15
14.159	26.92
15.887	28.62
17.825	30.25
20.000	31.79
22.440	33.25
25.179	34.62
28.251	35.94
31.698	37.22
35.566	38.49
39.905	39.78
44.774	41.14

Size (µm)	Vol Under %
50.238	42.59
56.368	44.16
63.246	45.87
70.963	47.73
79.621	49.76
89.337	51.95
100.237	54.31
112.468	56.84
126.191	59.52
141.589	62.36
158.866	65.35
178.250	68.49
200.000	71.74
224.404	75.08
251.785	78.48
282.508	81.89
316.979	85.25

Size (µm)	Vol Under %
355.656	88.50
399.052	91.54
447.744	94.29
502.377	96.64
563.677	98.45
632.456	99.63
709.627	100.00
796.214	100.00
893.367	100.00
1002.374	100.00
1124.683	100.00
1261.915	100.00
1415.892	100.00
1588.656	100.00
1782.502	100.00
2000.000	100.00

Analysis Report

CSIRO
Division of Minerals
Particle Analysis Service

Sample Name : 02640 199 - Fimiston II A/B - Cell Wall # 7548

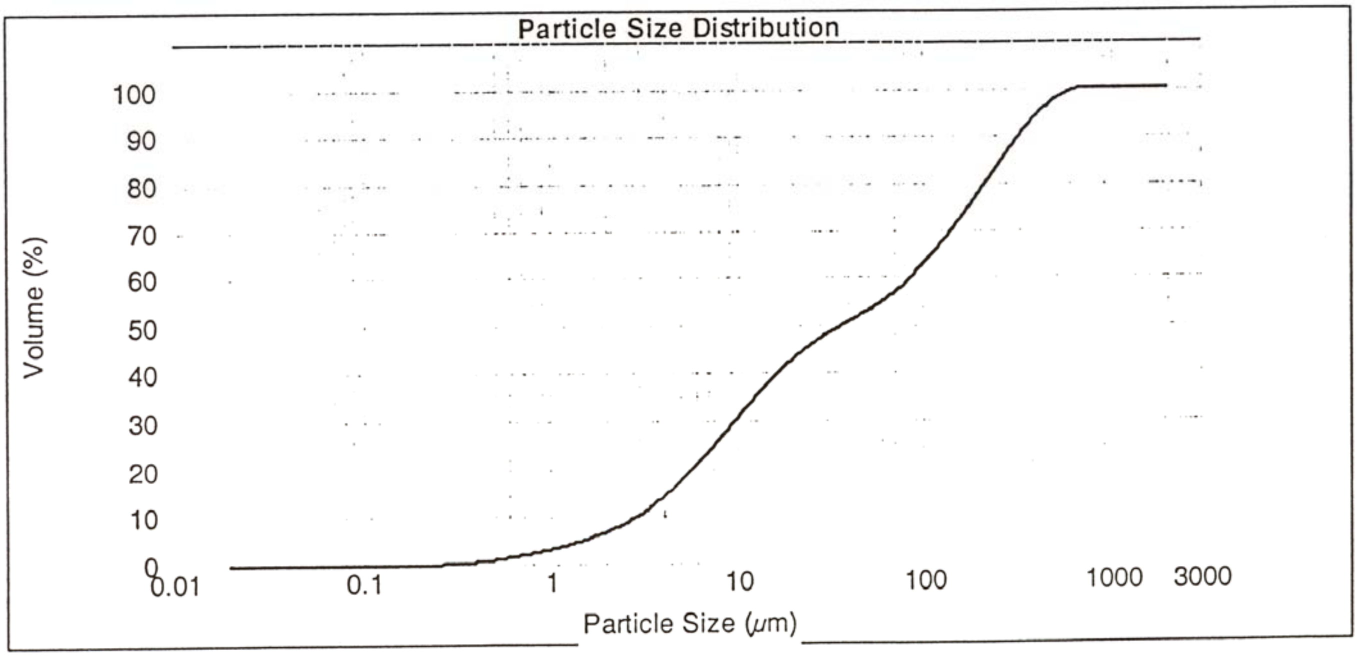
Batch No : R027270

PAS ID No : P39224

Dispersant :	Water	**SOP Name :**	
Additives :	10 millilitres Sodium hexametaphosphate	**Analysis model :**	General purpose
Sonication :	20 minutes in ultrasonic bath	**Result units :**	Volume

---

Concentration :	0.0273 %Vol	**Vol. Weighted Mean D[4,3] :**	111.062 µm	**d(0.1) :**	2.890 µm
Obscuration :	29.04 %	**Surface Weighted Mean D[3,2] :**	6.841 µm	**d(0.5) :**	37.302 µm
Weighted Residual :	2.055 %	**Specific Surface Area :**	0.877 m²/cc	**d(0.8) :**	217.341 µm



Size (µm)	Vol Under %
0.020	0.00
0.022	0.00
0.025	0.00
0.028	0.00
0.032	0.00
0.036	0.00
0.040	0.00
0.045	0.00
0.050	0.00
0.056	0.00
0.063	0.00
0.071	0.00
0.080	0.00
0.089	0.00
0.100	0.00
0.112	0.00
0.126	0.00

Size (µm)	Vol Under %
0.142	0.00
0.159	0.00
0.178	0.00
0.200	0.00
0.224	0.00
0.252	0.00
0.283	0.03
0.317	0.12
0.356	0.26
0.399	0.44
0.448	0.66
0.502	0.91
0.564	1.20
0.632	1.51
0.710	1.86
0.796	2.23
0.893	2.63

Size (µm)	Vol Under %
1.002	3.07
1.125	3.55
1.262	4.07
1.416	4.65
1.589	5.30
1.783	6.01
2.000	6.81
2.244	7.69
2.518	8.67
2.825	9.77
3.170	10.99
3.557	12.33
3.991	13.83
4.477	15.47
5.024	17.25
5.637	19.18
6.325	21.24

Size (µm)	Vol Under %
7.096	23.42
7.962	25.69
8.934	28.03
10.024	30.38
11.247	32.73
12.619	35.02
14.159	37.22
15.887	39.28
17.825	41.19
20.000	42.93
22.440	44.51
25.179	45.94
28.251	47.23
31.698	48.42
35.566	49.55
39.905	50.64
44.774	51.75

Size (µm)	Vol Under %
50.238	52.90
56.368	54.15
63.246	55.50
70.963	57.00
79.621	58.65
89.337	60.47
100.237	62.47
112.468	64.64
126.191	66.98
141.589	69.49
158.866	72.16
178.250	74.96
200.000	77.87
224.404	80.82
251.785	83.79
282.508	86.68
316.979	89.44

Size (µm)	Vol Under %
355.656	91.98
399.052	94.25
447.744	96.18
502.377	97.74
563.677	98.89
632.456	99.71
709.627	100.00
796.214	100.00
893.367	100.00
1002.374	100.00
1124.683	100.00
1261.915	100.00
1415.892	100.00
1588.656	100.00
1782.502	100.00
2000.000	100.00

Malvern Instruments Ltd.
Malvern, UK

Mastersizer 2000 Ver. 5.1
Serial Number : 34264-141

File name: R027270
Record Number: 2
29 Oct 2002 11:37:12

Analysis Report

CSIRO
Division of Minerals
Particle Analysis Service

Sample Name : 02640 199 - Fimiston II A/B - Cell Decant # 7549

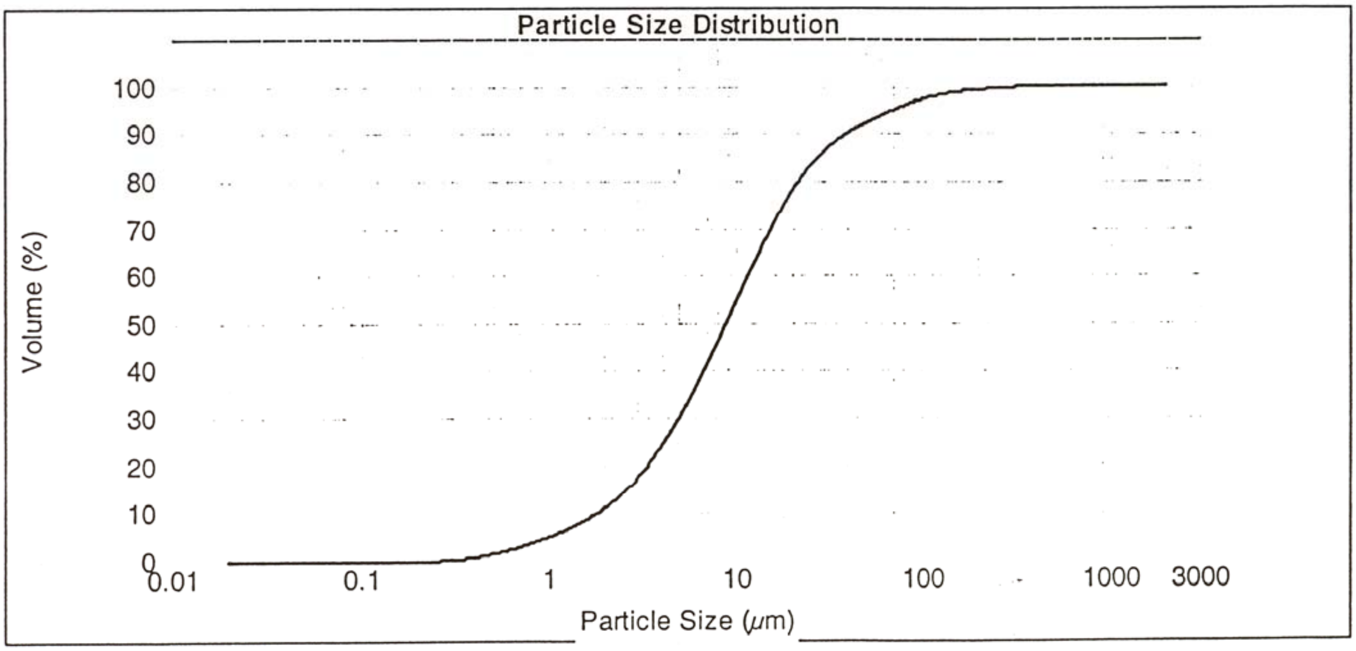
Batch No : R027270

PAS ID No : P39225

Dispersant :	Water	**SOP Name :**	
Additives :	10 millilitres Sodium hexametaphosphate	**Analysis model :**	General purpose
Sonication :	20 minutes in ultrasonic bath	**Result units :**	Volume

---

Concentration :	0.0130 %Vol	**Vol. Weighted Mean D[4,3] :**	18.503 µm	**d(0.1) :**	1.819 µm
Obscuration :	23.71 %	**Surface Weighted Mean D[3,2] :**	4.118 µm	**d(0.5) :**	9.008 µm
Weighted Residual :	0.544 %	**Specific Surface Area :**	1.46 m²/cc	**d(0.8) :**	21.938 µm



Size (μm)	Vol Under %
0.020	0.00
0.022	0.00
0.025	0.00
0.028	0.00
0.032	0.00
0.036	0.00
0.040	0.00
0.045	0.00
0.050	0.00
0.056	0.00
0.063	0.00
0.071	0.00
0.080	0.00
0.089	0.00
0.100	0.00
0.112	0.00
0.126	0.00

Size (μm)	Vol Under %
0.142	0.00
0.159	0.00
0.178	0.00
0.200	0.00
0.224	0.00
0.252	0.00
0.283	0.05
0.317	0.17
0.356	0.38
0.399	0.66
0.448	1.00
0.502	1.40
0.564	1.86
0.632	2.36
0.710	2.91
0.796	3.51
0.893	4.16

Size (μm)	Vol Under %
1.002	4.87
1.125	5.65
1.262	6.52
1.416	7.48
1.589	8.56
1.783	9.77
2.000	11.13
2.244	12.66
2.518	14.37
2.825	16.29
3.170	18.44
3.557	20.85
3.991	23.53
4.477	26.49
5.024	29.75
5.637	33.28
6.325	37.08

Size (μm)	Vol Under %
7.096	41.11
7.962	45.33
8.934	49.68
10.024	54.10
11.247	58.51
12.619	62.82
14.159	66.96
15.887	70.85
17.825	74.43
20.000	77.67
22.440	80.54
25.179	83.04
28.251	85.21
31.698	87.06
35.566	88.65
39.905	90.03
44.774	91.24

Size (μm)	Vol Under %
50.238	92.32
56.368	93.31
63.246	94.23
70.963	95.08
79.621	95.87
89.337	96.58
100.237	97.21
112.468	97.75
126.191	98.20
141.589	98.56
158.866	98.84
178.250	99.07
200.000	99.25
224.404	99.42
251.785	99.58
282.508	99.72
316.979	99.85

Size (μm)	Vol Under %
355.656	99.96
399.052	100.00
447.744	100.00
502.377	100.00
563.677	100.00
632.456	100.00
709.627	100.00
796.214	100.00
893.367	100.00
1002.374	100.00
1124.683	100.00
1261.915	100.00
1415.892	100.00
1588.656	100.00
1782.502	100.00
2000.000	100.00

Analysis Report

CSIRO
Division of Minerals
Particle Analysis Service

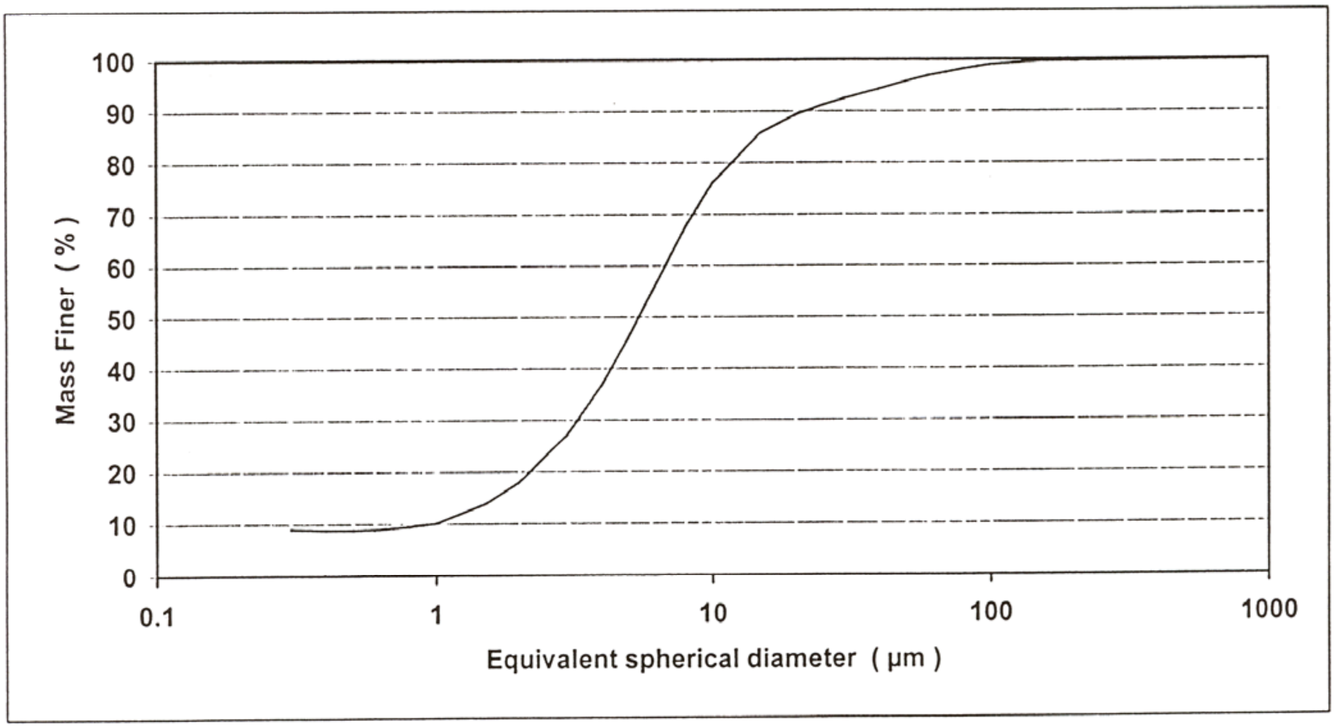
Client: Golder Associates
Sample name: Tube A (#6830)
Report No: R016676
PAS ID No: P36828

Analysis: X-ray sedimentation by Sedigraph 5100
Dispersant: Water
Additives: 10mL sodium hexametaphosphate

Analysis temp.: 35.5 °C
Sonication: 20 min
Concentration: 10 % w/w

Sample density: 2.791 g/cm^3 (as measured by ASTM D4892 - '89,'Helium Pycnometry')
Liquid density: 0.994 g/cm^3
Liquid viscosity: 0.715 cp

Reynolds No: 6.41
Critical diameter: 52.67 μm



Max size (μm)	Min size (μm)	In %
2000.00	150.00	0.50
150.00	100.00	0.55
100.00	80.00	0.80
80.00	60.00	1.30
60.00	50.00	1.10
50.00	40.00	1.50
40.00	30.00	1.80
30.00	25.00	1.50
25.00	20.00	1.80

Max size (μm)	Min size (μm)	In %
20.00	15.00	1.30
15.00	10.00	1.90
10.00	8.00	3.50
8.00	6.00	9.70
6.00	5.00	8.50
5.00	4.00	13.10
4.00	3.00	8.20
3.00	2.00	9.20
2.00	1.50	9.70

Max size (μm)	Min size (μm)	In %
1.50	1.00	9.30
1.00	0.80	4.20
0.80	0.60	3.70
0.60	0.50	0.70
0.50	0.40	0.50
0.40	0.30	0.10
0.30	0.00	8.85

Derived diameters	Size (μm)
d (0.9)	20.43
d (0.5)	5.37
d (0.1)	0.81

NOTE : *Data from 2000 μm to 150 μm by wet screening*

APPENDIX D

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT

Important Information About Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfil the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. *No one except you* should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you* – should apply the report for any purpose or project except the one originally contemplated.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include : the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, *do not rely on a geotechnical engineering report* that was :

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical change that can erode the reliability of an existing geotechnical engineering report include those that affect :

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *Geotechnical Engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by : the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions *only* at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgement to render an *opinion* about subsurface conditions throughout the site. Actual subsurface conditions may differ – sometimes significantly – from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final*, because geotechnical engineers develop them principally from judgement and opinion. Geotechnical engineers can finalise their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for* *the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognise that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognise that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce such risks, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labelled "limitations", many of these provisions indicate where geotechnical engineers responsibilities begin and end, to help others recognise their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Rely on Your Geotechnical Engineer for Additional Assistance

Membership in ASFE exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE member geotechnical engineer for more information.

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