

SUMMARY REPORT
QUARTZITE PROSPECTS IN NORTHWEST TASMANIA
HELD BY
MINERAL HOLDINGS AUSTRALIA PTY. LIMITED

MICROFILMED
FICHE No.013040-

Norman Shepherd
Mineral Resource Management Pty. Ltd.
February 1994

SUMMARY

A considerable amount of reconnaissance exploration has been carried out to investigate the Detention Sub-Group Quartzite for silica resources with suitable chemical and physical characteristics for silicon and ferrosilicon production.

Most exploration has been based on surface sampling and shallow percussion drilling. This has shown that the effects of weathering have resulted in the leaching of Al_2O_3 and Fe_2O_3 and enrichment in SiO_2 to a depth of about 10 metres forming a siliceous cap underlain by friable to medium hard sediments.

At some locations, possibly along ridge slopes or cross-cutting faults (eg. Hogarths Creek near Thomas Mountain and Hebe River) the percolating silica rich solutions have caused extensive silicification forming hard quartzite of higher purity. These locations (notably Hebe River) represent the best prospects in the region for locating resources of suitable quality silica to satisfy smelter specifications.

Potential exists at Thomas Mountain and Hebe River to prove up deposits of at least several hundred thousand tonnes of quartzite amenable to open pit mining. The Hebe River quartzite outcrops are very high purity ($> 99.5\% \text{SiO}_2$) and dense, however at Thomas Mountain Al_2O_3 and TiO_2 levels higher and sometimes close to or exceed smelter limits for premium grade silicon. Diamond drilling is needed to establish the size and quality of these deposits. Resources with impurity levels which exceed chemical grade silicon specifications may be suitable for the production of silicon for the secondary metallurgical market or ferrosilicon.

Further exploration in the area is also required to locate other silica resources, particularly along faults. Detention Sub-Group quartzite at depth contains at least $0.3\% \text{Al}_2\text{O}_3$ (mostly $> 0.5\% \text{Al}_2\text{O}_3$) and SiO_2 values are less than 99.0% . Hence future exploration should be directed to locate zones of silica enrichment resulting from weathering.

Bulk samples of quartzite from the Thomas Mountain mine have been tested with some success at the Temco ferrosilicon and Electrona silicon smelters. Thermal stability tests carried out by Dow Corning on the Hebe River quartzite indicate that it does not decrepitate under furnace conditions.

Quartzite resources of at least 2 million tonnes (preferably 3 - 5MT) are considered necessary to support a greenfields silicon smelter, unless suitable feed can be delivered from other locations at a competitive price.

Diamond drilling is required at the Hebe River (top priority) and Thomas Mountain prospects, in addition to exploration for other deposits, to prove up the required quartzite resources.

MINERAL HOLDINGS AUSTRALIA PTY LIMITED

1 INTRODUCTION

During the past 30 years Mineral Holdings Australia Pty Limited (MHA) has carried out exploration in north west Tasmania for quartzite deposits suitable for silicon and ferrosilicon production. Potential in the area for high purity silica sand to satisfy glass manufacturing specifications has also been investigated.

Mineral Resource Management Pty Limited was requested to prepare a report on quartzite resources within tenements held by MHA based on available exploration data (including reports on exploration by joint venture partners) and discussions with Consultant Geologist Vic Threader and geologists from the Tasmania Department of Mineral Resources.

A brief visit was made to inspect the Thomas Mountain, Hebe River and other quartzite prospects in the area.

2 TENEMENTS AND LOCATION (Figure 1)

Although exploration activities have covered extensive areas (EL 43/70 - 310 km²) southwest of Wynyard which are underlain by the prospective Rocky Cape Group, current tenements held by MHA have been reduced to three areas covering the best quartzite deposits identified to date:

EL 25/88	7 km ²	Dip Range - Thomas Mountain
EL 11/92	30 km ²	Meunna
ELA 20/93	8 km ²	Hebe River
CML 8M/89	161 hectares	Within EL25/88

The Thomas Mountain prospect, which occurs in the north Dip Range, is located about 25 km southwest of Wynyard and 20 km southeast of a deep water harbour - Port Latta. Access is via the township of Montumana on the Bass Highway, 25 km west of Wynyard. Thence 6 km south along Montumana and Newhaven Roads to a turn-off just east of Hogarths Creek (Figure 2).

The Hebe River prospect is located about 9 km south of Thomas Mountain, but access is by a 2 km track west off the sealed Myalla Road. Distance by road to the major port, Burnie is about 50 km.

The Meunna tenement adjoins the southwest boundary of the Hebe River ELA 20/93 covering extensions of the Detention Quartzite and also Jacob Quartzite formations.

3 REGIONAL GEOLOGY (Figure 3)

The original tenement (EL43/70 - 310 km²) held by MHA from 1960 to 1987 is underlain by Upper Proterozoic sediments belonging to the Rocky Cape Group. These formations are covered in some areas by Tertiary basalt.

The Rocky Cape Group stratigraphy comprises a folded sequence of slightly metamorphosed sediments.

	<u>Thickness (m)</u>
Jacob Quartzite	1130
Irby Siltstone	760
Detention Sub-group	1400
- Cave Quartzite	
- Port Slate	
- Bluff Quartzite	
Cowrie Siltstone	2240+

Although some exploration for silica resources has been carried out over the Jacob Quartzite, most recent activity by MHA and joint venture partners has been focused on quartzite formations within the Detention Sub-group.

Government geologists (Gee 1971) described the silica rich sediments in the Detention Sub-group as "uniformly fine grained orthoquartzites with a granular to glassy texture depending on the degree of cementation." Quartz is the dominant mineral with minor feldspar and sericite. A more recent Government Report (Geology and Mineral Resources of Tasmania - Special Publication, Geol Soc Aust 15 1989) refers to the quartzite formations as variably silicified quartz arenite.

In Longworth and McKenzie reports (1981), the Detention Sub-group quartzites are similarly described as erratically silicified quartzose sandstones with the degree of

silicification not necessarily being consistent within or between beds. Longworth and McKenzie noted from extensive shallow drilling in the Dip Range that silica levels were highest near surface and in general chemical purity decreases with depth due to surface leaching and precipitation at lower levels of Fe_2O_3 and Al_2O_3 . Other geologists view the quartzite as a thick-bedded sandstone and noted that on some ridge tops silica has been dissolved (leached) and the small amount of clay matrix washed or leached out during weathering leaving a clean, high purity friable sandstone (or silica sand). The silica in solution has reprecipitated to form a silica cap or moved to a lower level forming a hard cemented sandstone or quartzite along valley walls or in fault zones.

This explanation is supported by shallow drilling carried out by Longworth and McKenzie Pty Ltd on behalf of Kaiser Aluminium in 1981 which showed higher silica values in the upper 10 metres and increasing Al_2O_3 and other impurities at depth.

The degree of metamorphism in the area is relatively low, and the development of hard, high purity quartzite appears to be related more to weathering and diagenetic processes than regional metamorphism.

4 QUARTZ SPECIFICATIONS FOR PREMIUM QUALITY SILICON

		Pioneer Pechiney	Simcoa	Mannesmann DeMag	Globe Metallurgical	Dow Corning
% SiO_2	Min.		99.5	99.6 (99.5-99.7)	99.6	
% Al_2O_3	Max.	0.30	0.15	0.12 (0.10-0.15)	0.10	0.15
% Fe_2O_3	Max.	0.05	0.09	0.07 (0.06-0.095)	0.05	0.15
% TiO_2	Max.	0.05	0.02		0.017	0.016
% CaO				0.037 (0.03-0.045)		0.05
% P_2O_5						0.02
% V_2O_5						0.002
% LOI	Max.		0.2	0.15 (0.1-0.2)	0.5	
Size(mm)			30-120		1" - 4" 60% + 1.5"	40 - 120

Consistency of the physical and chemical characteristics of quartzite feed to a silicon smelter is very important. There is little tolerance for variations in impurity levels.

Quartzite must retain lump form at high temperatures to retain porosity in the furnace, ie must have thermal stability and not decrepitate when heated above 1000°C.

Indicative chemical specifications (maximum wt% unless otherwise indicated) for silicon for primary metallurgical and chemical applications are:

Primary Aluminium - 99.0% Si (min), 0.2% Al, 0.25% Fe, 0.10% Ti, 0.25% Cu, 0.05% Ca, 0.008% P, 0.05% C, 0.02% others, 0.20% others total

Chemical (Silicones) - 0.05% Ti, 0.05% P, 0.01% V (all maximum)

Aluminium and calcium can be reduced by refining silicon after tapping, however, other impurities from quartzite and carbon reductants report to the final product and cannot be removed.

5 QUARTZ REQUIREMENTS FOR 30,000 TPA SILICON SMELTER

Assumptions:

- 2.5 tonnes SiO₂ /tonne Si
- 20 year operation life
- feed size 25 - 120mm
- 40% losses (undersize) on crushing and wet screening

Require 75,000 tonnes SiO₂ per year smelter feed. Need to mine 125,000 tonnes SiO₂ (assume 50,000 tonnes rejected as fines < 25 mm). The quality of the lump quartzite feed can sometimes be upgraded appreciably, since the fines fraction typically contains a higher level of impurities.

Require mineable reserves of at least 2.5 million tonnes silica for 20 year operation.

6 EXPLORATION AT THE DIP RANGE (THOMAS MOUNTAIN) PROSPECT

From 1960 to 1987 MHA held a 310 km² Exploration Licence (EL43/70) covering the Dip Range which is underlain by the Detention Sub-Group Quartzite, considered prospective for silica of suitable quality for silicon and ferrosilicon production. Reconnaissance exploration and surface sampling by MHA led to a joint venture with BHP in 1975. BHP carried out bulk sampling and drilled two percussion drill holes at the Maynes Creek prospect (Jacob Quartzite) located in the east central part of the Exploration Licence, but quality requirements for silica were not met and the joint venture was terminated.

Consultants Longworth and McKenzie Pty Ltd (L & M) carried out an exploration programme over the northern half of EL43/70 in 1981 on behalf of Kaiser Aluminium Pty Ltd under a joint venture agreement with MHA. Most of their exploration activity was concentrated on the Dip Range No.1 prospect which extends 1.5 km north east from Hogarths Creek to a tributary of the Detention River (Figure 4). Prominent quartzite cliffs occur at both ends of the range but the ridge top is largely covered by quartzite scree. The programme included the excavation of five costeans, drilling 27 shallow percussion holes within the costeans and four vertical diamond drill holes (121 m total) to test the physical and chemical variations with depth in the quartzite/sandstone horizon and provide a basis for silica resource estimation.

The costeaning and percussion drilling on Dip Range north of Hogarths Creek (immediately northeast along strike from Thomas Mountain) indicated that the Dip Range was underlain by friable sandstone with isolated quartzite patches at least to the 15 m depth of testing. Results of the diamond drilling were also disappointing. In general the Detention Quartzite was described by L & M geologists as variably weathered to 15 m depth and resilicified at the surface to produce a siliceous cap and an underlying silica sand which grades down to an impure sandstone (refer Plate 6).

Longworth and McKenzie concluded that:

- there had been deep weathering and variable secondary silicification;
- below a leached zone, the rocks decrease in purity with depth with increasing Al₂O₃ (and decreasing SiO₂).

Kaiser subsequently withdrew from the joint venture with MHA. They sold out their Australian interests in silicion to Pioneer-Pechiney, who subsequently investigated Thomas Mountain as potential smelter feed for Electrona.

Shortly afterwards Monier Ltd drill tested an area about 100 metres north of Hogarths Creek and described the material as export quality glass sand (100-200 ppm Fe₂O₃).

In 1987 MHA sampled the cliffs on either side of Hogarths Creek and obtained permission to extract 4000 tonnes of high purity quartzite from Thomas Mountain (CML 33M/86). 4032 tonnes of quartzite were delivered to Temco for furnace trials. Average composition was 98.7% SiO₂, 0.2% Al₂O₃. Temco reported the quartzite was *satisfactory for ferrosilicon production and had some favourable characteristics (lower power factor).*

At Thomas Mountain, the quartzite dips at 45°NW. Plates 1 to 5 are photographs of Thomas Mountain, Thomas Mountain mine and a view of the crusher plant site and quartzite stockpiles.

A Temco geologist mapped Thomas Mountain and prospected the quartzite ridge for 500 metres along strike to the southwest.

The geologist with extensive experience in the area, considered that the quartzite formations were leached on the surface and had a silica enriched layer from 3-10 metre depth. He recommended to MHA that a hole should be drilled to test the quartzite sequence at Thomas Mountain for high grade sections at depth. A reverse circulation was collared on bench# 2 of the mined area and drilled to 102 metres at -45° on a southeast bearing. Cuttings were collected at 1 metre intervals, logged and analysed by BHP Temco (see Appendix 1).

The hole intersected medium to hard quartzite with several alternating beds of partly consolidated sandstone (Figure 5). Quality of the quartzite varied, with the highest grades occurring from 0 to 9.5 m and 52 to 69 m.

	%SiO ₂	%Al ₂ O ₃	%Fe ₂ O ₃ *	%TiO ₂
0-9.5 m	98.8	0.23	0.25	0.06
52-69 m	98.9	0.37	0.23	0.05

* BHP laboratory reported that values could be 0.2% Fe₂O₃ too high due to identified iron contamination from sample preparation.

This quality may be acceptable for ferrosilicon production but does not satisfy specifications for premium grade silicon. Some reduction in impurities may be achieved during crushing and high pressure wet screening, resulting in higher SiO₂.

Other quartzite beds intersected generally assayed less than 98.5% SiO₂ and 0.5-0.9% Al₂O₃ (reflecting higher sericite and clay impurities).

The BHP Temco geologist estimated that if the 17 metre thick quartzite bed intersected in the drill hole extended to surface and continued 400 metres southwest along strike, a potential silica resource of 1 million tonnes mineable by open pit could exist at Thomas Mountain. This tonnage would include material from the expected near surface silica enriched zone down to about 10 metres depth (Figure 6). Drilling would be required to prove up this resource.

Pioneer Silicon Industries Pty Ltd (PSI) investigated the Thomas Mountain mine site in 1988 to assess the quartzite quality for silicon smelter feedstock. Surface sampling of mullock and shallow drilling on benches #2 and #3 yielded hard, high purity quartzite. Average assays of samples collected by PSI are as follows:

	%Al ₂ O ₃	%Fe ₂ O ₃	%TiO ₂
Surface grab samples (3)	0.05	0.02	0.034
Percussion drilling Bench #2 (4 holes)	0.09	0.04	0.028
Percussion drilling Bench #3 (3 holes)	0.07	0.02	0.028

On the basis of site inspection and these quality assay results, PSI ordered a 200 tonne sample for testing at the Electrona silicon smelter. Bulk sample analyses of the 209 tonne shipment (1.2.89) were reported by PSI to be 0.11% Al₂O₃, 0.039% Fe₂O₃ and 0.025% TiO₂.

PSI obtained another bulk sample of crushed and sized quartzite (1"-4") in 1991 for furnace trials (704 tonnes). They reported to MHA that "the quartzite worked satisfactorily in the furnace once the effects of high Al₂O₃ were discounted. The Al₂O₃ levels were too high to do any more than trial the quartzite on a very limited basis". MHA considers that some contamination with schist may have occurred when the contractor crushed the samples at an off-site quarry. The Electrona smelter closed down a few months later (August 1991).

PSI sampled the Thomas Mountain stockpiles of crushed and sized quartzite in April 1991. This showed variable quality with two distinct distributions of material grading 0.1-0.15% Al_2O_3 and 0.35-0.5% Al_2O_3 .

The occurrence of the high alumina quartzite in the stockpiles highlighted the need for strict grade control at the time of mining. Due to inadequate controls, inferior quality quartzite from the lower bench #1 (blast hole sample analyses averaged 0.45% Al_2O_3 - range 0.1-0.7% Al_2O_3) had been mixed with better quality quartzite from the upper benches.

There is insufficient geological information available at the Thomas Mountain prospect to enable an estimation of quartzite resources of suitable quality for chemical or primary metallurgical grade silicon production. TiO_2 and Al_2O_3 levels often exceed smelter specification limits and are a cause for concern in proving up tonnage of suitable quality quartzite at this location.

The northeastern strike extension of the high grade quartzite horizon is limited to a maximum of 50 metres by percussion drilling carried out on behalf of Kaiser Aluminium in 1981 (quartzite beds are deeply weathered to friable sand - refer plate 6). The Temco geologist suggested in 1987 that drilling was required to test the potential extension of the quartzite for up to 400 metres southwest of the mine area. This has not been done to date.

Assuming the high grade quartzite bed of suitably quality for silicon production is 10 metres thick (maximum), and extends 30 metres up dip and 500 metres along strike then the potential tonnage at Thomas Mountain would be about 400,000 tonnes. This would be relatively easy to mine by open pit methods.

Exploration drilling will be required to test this potential and investigate possible extensions further along strike to the southwest. Two 50 metre holes (-45° SE) at 200 metre intervals southwest of the Thomas Mountain open cut mine are proposed.

7 HEBE RIVER PROSPECT (Figure 7)

A 150 metre gorge section in the upper Hebe River shows extensive glassy silicification of Detention Sub-group quartzites which locally form a 5-6 km long, NE-SW trending strike ridge along which bedding is commonly overturned and steeply dipping to the northwest.

The strong silicification in the gorge section has formed a steep ridge of extremely hard, pure quartzite (Plates 9 and 10.) Sampling of outcrops representative of about half of the 150 metre long silicified zone (only about 50% exposure due to overburden) confirmed the high quality with grades of 9 samples averaging 99.82% SiO₂, 0.03% Al₂O₃, 0.03% Fe₂O₃, 0.013% TiO₂ and 0.09% LOI (Figure 8). Detailed analyses of samples collected from the Hebe River prospect are presented in Appendix 3.

At one location exposures show that the vitreous quartzite extends for 30-40 metres along strike. The tonnage potential at the Hebe River prospect is highly dependent on proving up the strike extent and depth of dense quartzite in the 100 metre wide (true width) high grade sampled section.

Further exploration is required to determine the tonnage potential of this intensely silicified zone and search for other similar deposits which may be formed as a result of weathering effects along a cross-cutting fault. The silicification may also be related to groundwater movements under Tertiary basalt cover which occurs near the gorge section (silicified gravels commonly occur under Tertiary basalt at other locations in NW Tasmania).

Drilling is required to determine the tonnage potential of the high purity quartzite in the gorge section, but it could be about 300,000 to 500,000 tonnes which would be mineable by open pit with low stripping ratio (assuming the silicified zone is 40 metres wide, 150 metres long and 20-30 metres deep).

Southwest of the gorge section, along the crest of the strike ridge, many of the surface outcrops are also silicified. Sampling of outcrops along the Hebe River to the south and southwest of the silica enriched gorge section also indicated that silicification in the sedimentary sequence was patchy.

Prospecting for similar silica enriched zones within the Detention Sub-group quartzites could locate other similar deposits in the general area. A specialist study of the origin of silicification in quartzites in NW Tasmania would greatly assist reconnaissance

exploration and allow a more reliable assessment of tonnage potential from surface inspection.

8 MEUNNA PROSPECT

The Meunna Trig and Pokes Road quartzite prospects occur in the Jacob Quartzite formation. Inspection of a road gravel quarry on Pokes Road showed it to contain a 10 metre thick bed of medium hard orthoquartzite dipping 40°NW and flanked by siltstone. (Plate 8.)

The quartzite appears similar to weakly silicified sandstone/quartzite on Dip Range and is unlikely to be suitable for premium quality silicon production.

MHA records, include analyses of seven samples grading over 99.7% SiO₂, 0.04-0.07% Al₂O₃, 0.02-0.04% Fe₂O₃ and 0.02-0.08% TiO₂. However, these samples are described as sand from nearby quartzite outcrops. No analyses are available of rock samples from the area.

The Meunna Trig prospect on Myalla Road is also described as a thin quartzite bed (few metres thick) in siltstones.

These prospects do not warrant further exploration.

9 THOMAS MOUNTAIN MINE PRODUCTION

In 1987 MHA arranged for a contractor to mine about 8000 tonnes of quartzite to satisfy furnace trials for silicon and ferrosilicon production. Three benches were mined from a dip slope on the NW face of Thomas Mountain, immediately adjacent to Hogarths Creek. The upper two benches #2 and #3 produced high purity quartzite. Higher alumina quartzite was mined from the lowest bench #1 near creek level. The run of mine quartzite was crushed and sized with 1"-4" product being stockpiled separately from undersize material (<1").

Details of samples delivered to Temco for tests for ferrosilicon production and Pioneer Silicon Industries at Electrona for silicon production are as follows:

TEMCO (Bell Bay)

- June 1987 4032 tonnes quartzite grading 98.7% SiO₂, 0.2% Al₂O₃.
Furnace trial reported as satisfactory with good physical characteristics and some possible benefits such as improved power efficiency from use of Thomas Mountain quartzite.
- November 1992 258 tonnes grading, 99.5% SiO₂, 0.18% Al₂O₃,
0.1% Fe₂O₃ and 0.05% TiO₂ delivered to Temco for further trials. Temco subsequently announced that they were no longer producing ferrosilicon (switched to silico-manganese).

PIONEER (Electrona)

- February 1991 209 tonnes grading, 0.11% Al₂O₃, 0.04% Fe₂O₃
and 0.025% TiO₂
- April 1991 204 tonnes delivered. No analyses available but reported to contain higher than desirable Al₂O₃.

Limited furnace trials were carried out using this bulk sample before Electron silicon smelter closed down in August 1991.

Pioneer advised MHA that the quartzite worked satisfactorily in the furnace once the effects of high Al₂O₃ content were discounted. The Al₂O₃ levels were deemed too high to do any more than trial the quartzite on a very limited basis. MHA considers that the high Al₂O₃ may be in part attributable to contamination at the contractor's crusher site with impure sediments.

HOBART GLASS

A 6000 tonne shipment of sand from a pit 150 metres north of Thomas Mountain was sent to the Hobart Glass Company in 1992. The sand is of high purity. Analysis after washing averaged 99.92% SiO₂, 180 ppm Al₂O₃, 240 ppm TiO₂, 90 ppm Fe₂O₃, 1.5 ppm Cr and 0.06% LOI. A copy of the chemical and particle size analyses is presented in Appendix 2.

10 POTENTIAL UPGRADING OF SILICA BY CRUSHING AND WET SCREENING

An improvement in the quality of run of mine quartzite can be achieved by crushing and wet screening. This is attributable to the rejection of clay filled joints and fissures which contain most of the aluminous, ferrous and titaniferous impurities.

A large grab sample of quartzite from Thomas Mountain was forwarded to Amdel to assess possible upgrading from crushing and wet screening. Results confirmed an improvement in quality.

	%SiO ₂	Al ₂ O ₃	%Fe ₂ O ₃	%TiO ₂	ppmP ₂ O ₅	ppmV ₂ O ₅	%LOI
+1"-3"	99.2	0.26	0.03	0.034	25	4	0.07
-1"	99.1	0.27	0.06	0.044	35	5	0.06

SiO₂ was analysed by HF digestion and ICP analysis of residue to determine minor elements. SiO₂ by difference after analysis of minor elements was determined to be 99.5% compared with 99.2% by the classical wet digestion method.

11 THERMAL STABILITY

Globe Metallurgical tested one piece of Thomas Mountain quartzite in an oven at 950°C for 15 minutes. The sample fragmented into five pieces.

Temco (BHP) trialed Thomas Mountain quartzite from 24/2/91 to 31/3/91 and stated that it was suitable feed for ferrosilicon production provided it was price competitive with the company's own resources.

Longworth and McKenzie carried out thermal stability and decrepitation tests on a number of quartzite samples from Thomas Mountain in 1981 using the Temco technique (1000°C for one hour). Results were considered acceptable based on Temco parameters.

Dow Corning decrepitation tests indicated that Hebe River quartzite had better thermal characteristics than Thomas Mountain quartzite. After heating the Hebe River quartzite to 1200°C and holding at that temperature for 15 minutes, only 2.5% of the sample passed through a 4mm screen on tumbling (cf 6% for Thomas Mountain sample). 5 - 6% is considered acceptable for silicon smelting.

12 CONCLUSIONS

Insufficient exploration has been carried out within MHA tenements to establish resources of suitable quality quartzite to support a 30,000 tpa silicon smelter for 20-30 years. The Hebe River prospect which offers the best potential is relatively unexplored. More detailed mapping, including special studies to obtain an understanding of the origin of the intense silicification is required before undertaking a drilling programme to delineate the resource and establish if chemical and physical characteristics are satisfactory for premium grade silicon production.

The extent of silicification along strike and at depth will have an important bearing on tonnage potential of the 100 metre wide vitreous quartzite zone exposed at Hebe River. If the silicification is related to precipitation of silica from percolating groundwater in a fault zone (as considered likely) then resources may be limited to a few hundred thousand tonnes. Potential exists, however, for the discovery of other similar deposits in the area by targetted exploration.

Thomas Mountain represents a less attractive prospect for a significant high purity quartzite resource, although some potential exists southwest from the mine area. At least two shallow percussion drill holes would establish whether further exploration was required.

On the basis of current information, the potential for resources adequate for more than a few years supply for a silicon smelter would appear unlikely. Grade control of any eventual mining operation would be essential to ensure smelter specifications are satisfied.

TiO₂ impurities in the Detention Sub-Group orthoquartzites/silicified arenites or sandstones commonly exceed silicon smelter specifications (0.02% TiO₂) and may represent a problem at Thomas Mountain and other prospects in the area. Fe₂O₃ and Al₂O₃ contents are less of a problem in near surface exposures, but do appear to increase consistently at depth below the water table to unacceptable levels for primary grade silicon. More detailed analyses of quartzites in the Detention Sub-group indicate that P₂O₅ and V₂O₅ contents are low.

Some of the quartzite resources which do not meet chemical or primary metallurgical grade silicon could be developed for supply to ferrosilicon producers. The tonnage potential for lower grade quartzite which satisfies specifications for secondary metallurgical grade silicon and ferrosilicon production are considerably larger at Thomas Mountain (possibly 1-2 million tonnes).

Norman Shepherd

Norman Shepherd
Mineral Resource Management Pty Ltd

QUARTZITE PEAK

THOMAS MOUNTAIN

170017

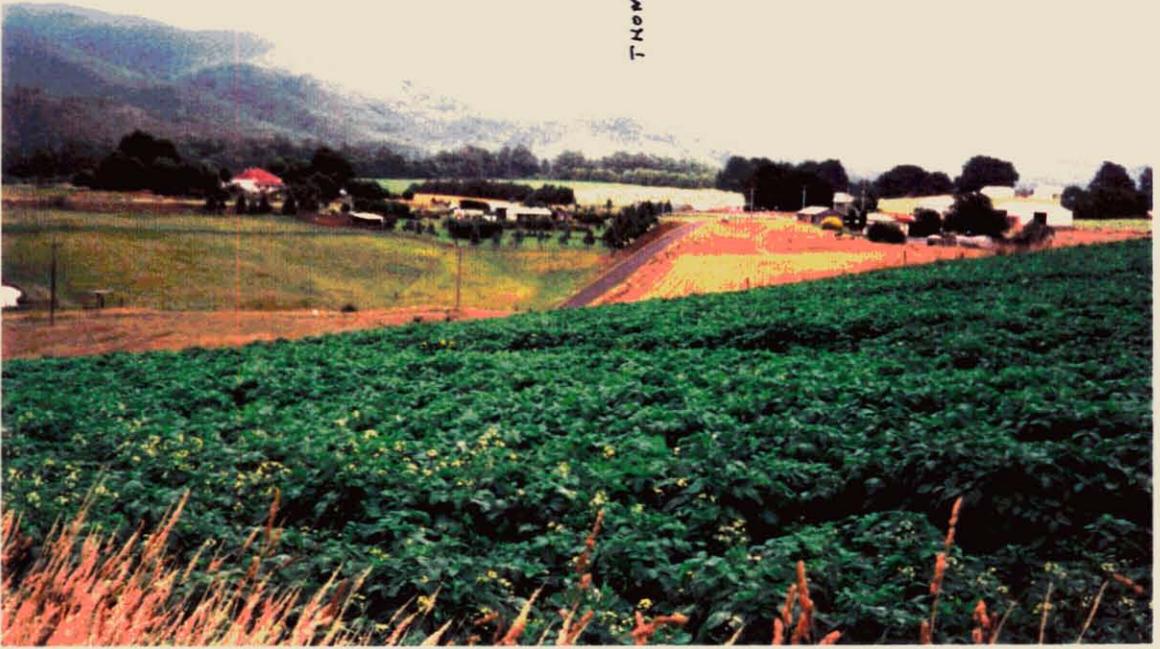


Plate 1 View of Quartzite Peak and Thomas Mountain in Dip Range from Bass Highway



Plate 2 Thomas Mountain mine showing benches 2 and 3. Note 45 - 50° dip of quartzite.

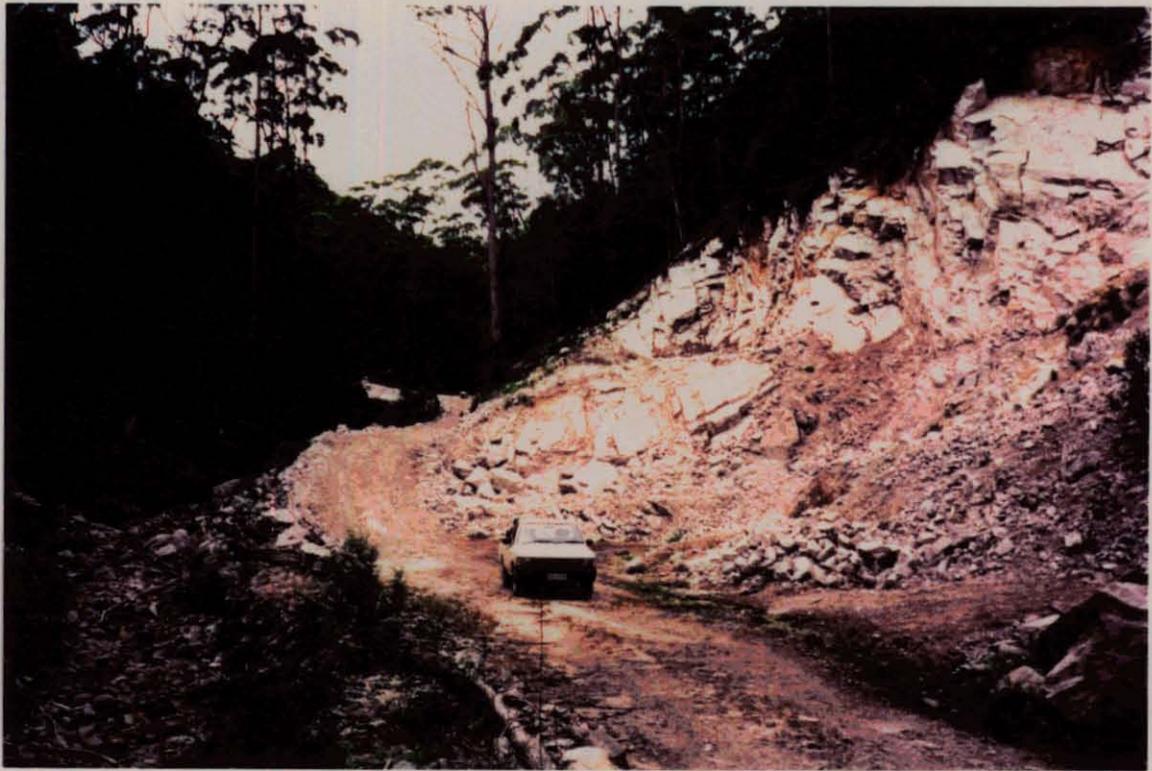


Plate 3 Hogarth's Creek with quartzite cliff on north side and Thomas Mountain mine south of road.



Plate 4 Stockpiles of crushed and screened quartzite from Thomas Mountain mine.



Plate 5 View of Thomas Mountain Mine from ridge north of Hogarth's Creek.



Plate 6 Friable sandstone pit located 150 metres north of Thomas Mountain mine.



Plate 7 North end of Dip Range North looking towards Bass Strait.
Note quartzite rubble on track.



Plate 8 Pokes Road quarry used for road building.



Plate 9 Outcrop of Hebe River quartzite



Plate 10 Outcrop of Hebe River quartzite.

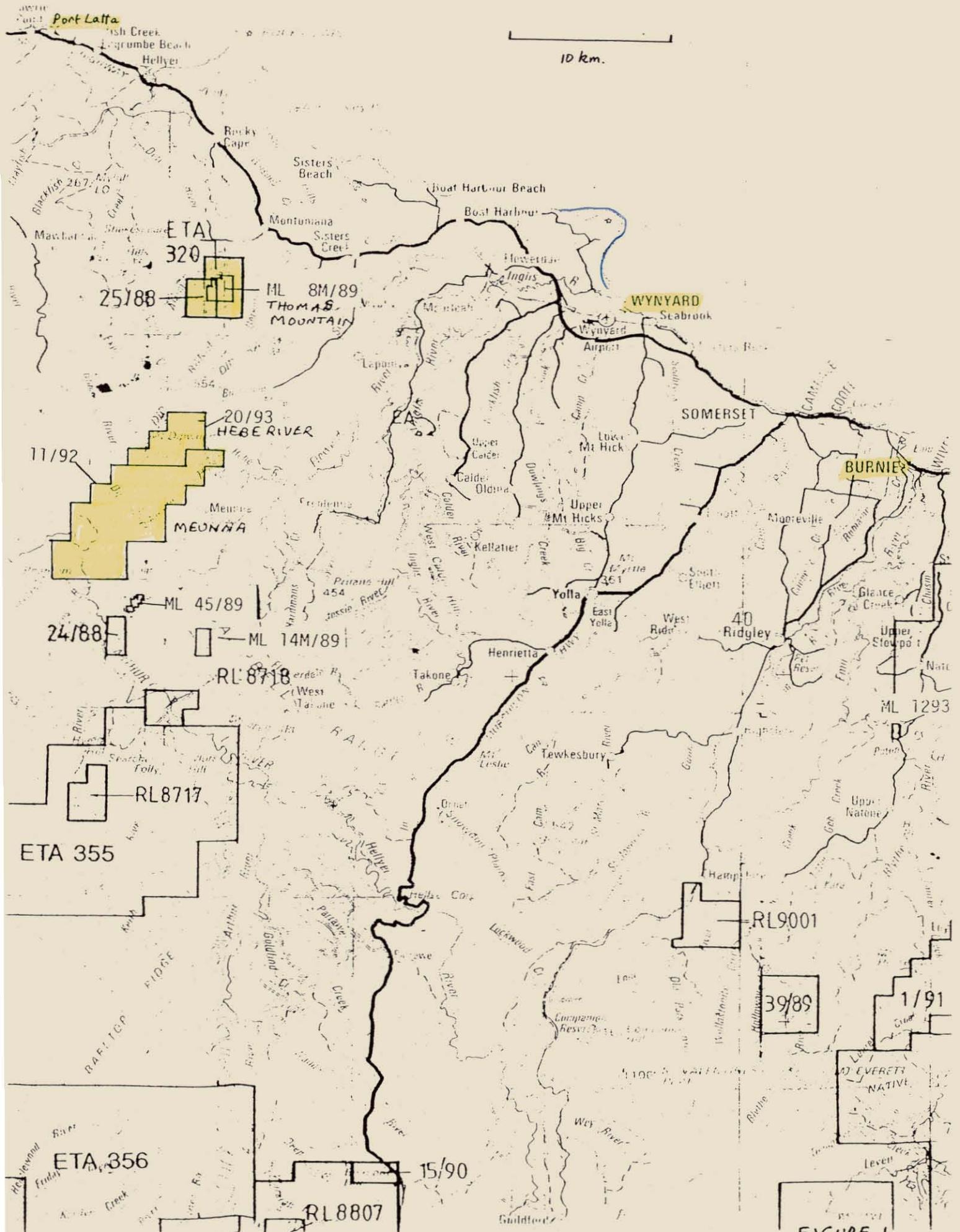


FIGURE 1

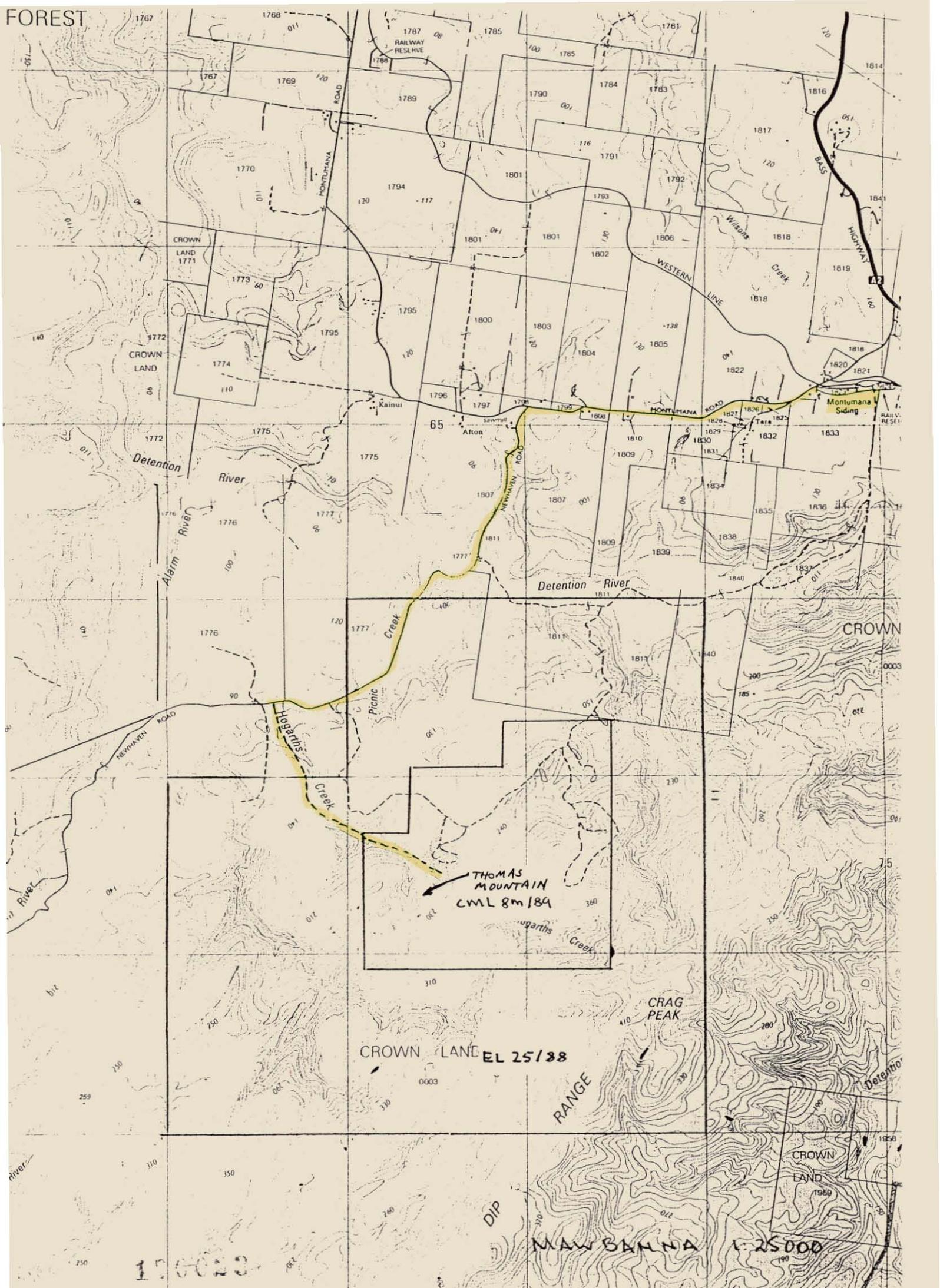
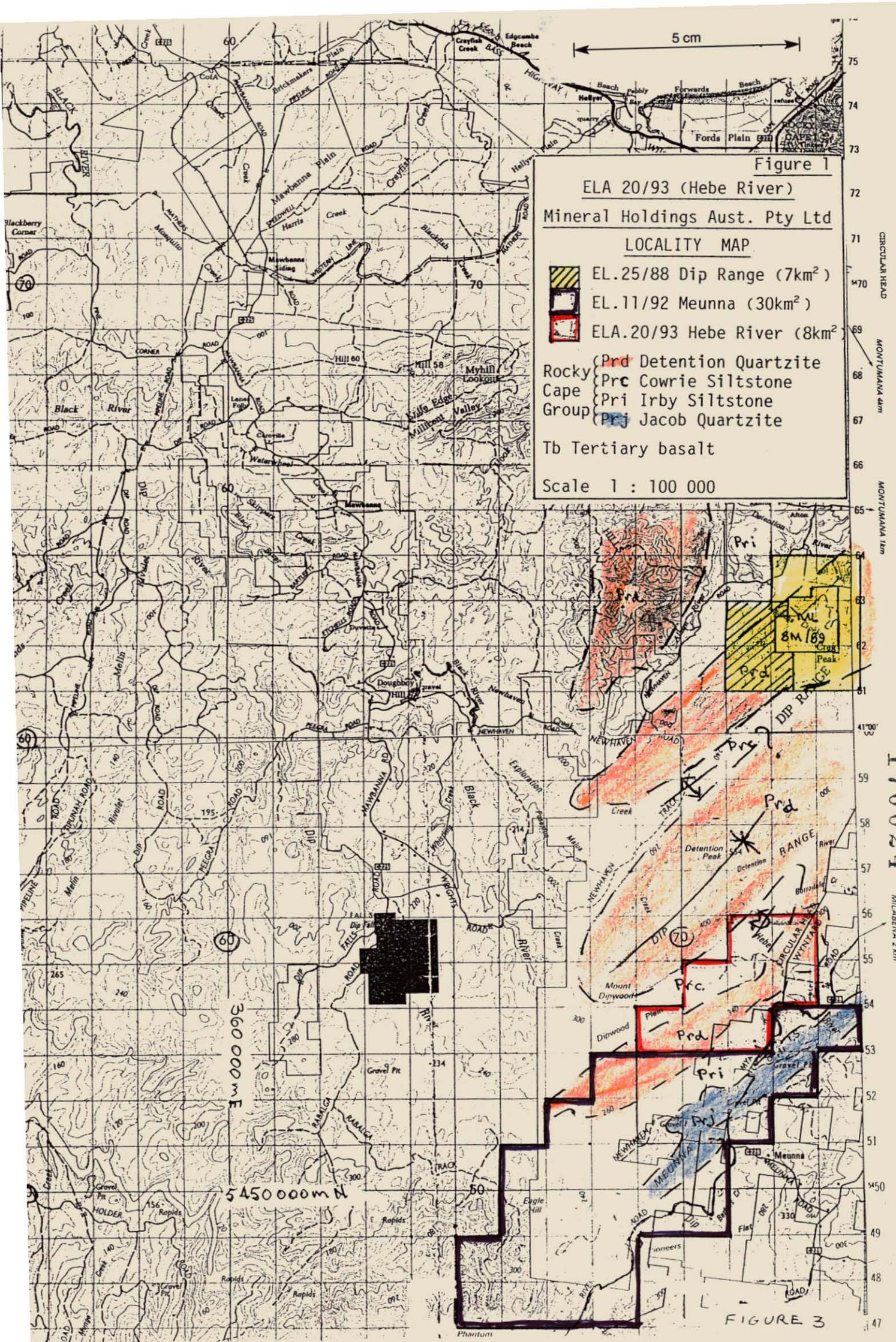


FIGURE 2



5 cm

Figure 1

ELA 20/93 (Hebe River)
Mineral Holdings Aust. Pty Ltd

LOCALITY MAP

- EL.25/88 Dip Range (7km²)
- EL.11/92 Meunna (30km²)
- ELA.20/93 Hebe River (8km²)

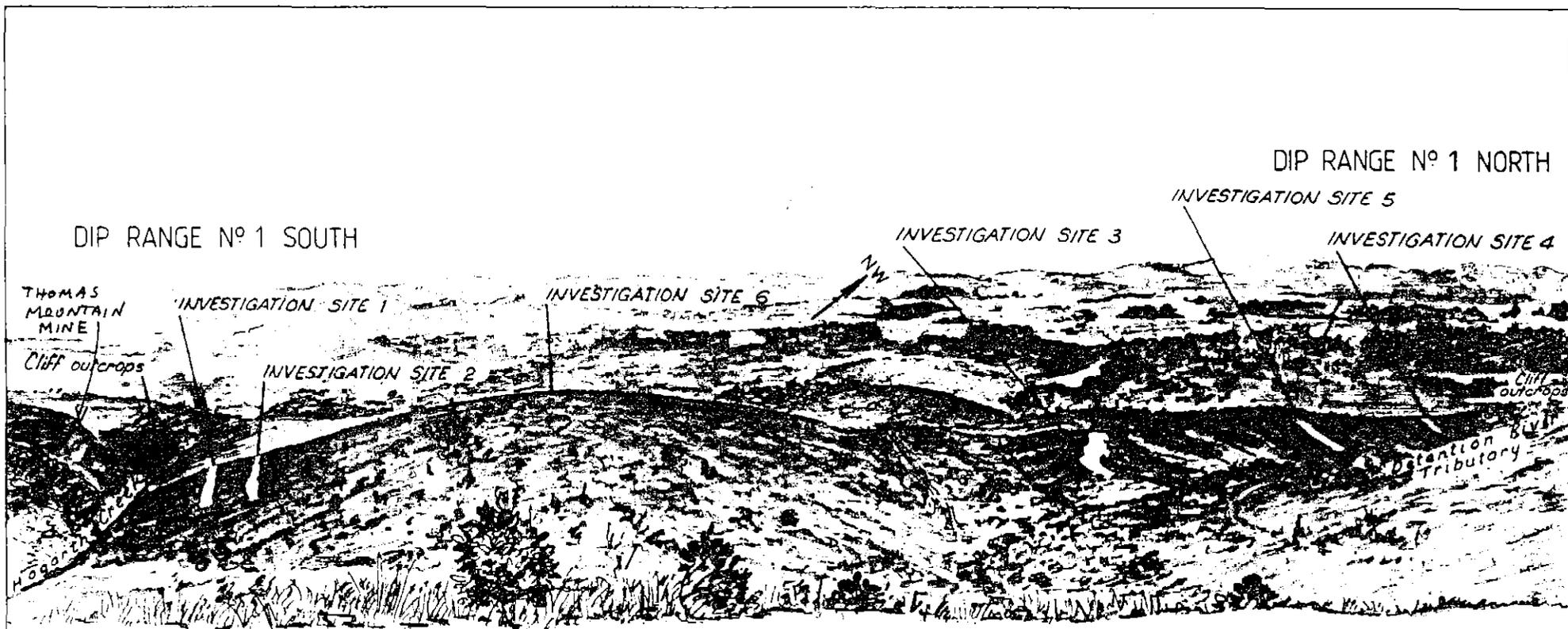
- Rocky (Prd) Detention Quartzite
- Cape (Prc) Cowrie Siltstone
- Group (Pri) Irby Siltstone
- (Prj) Jacob Quartzite

Tb Tertiary basalt

Scale 1 : 100 000

CIRCULAR HEAD
 MONTUMANA 4km
 MONTUMANA 1km
 170024
 MILABENA 2 km
 PREOLENA 3 km

FIGURE 3



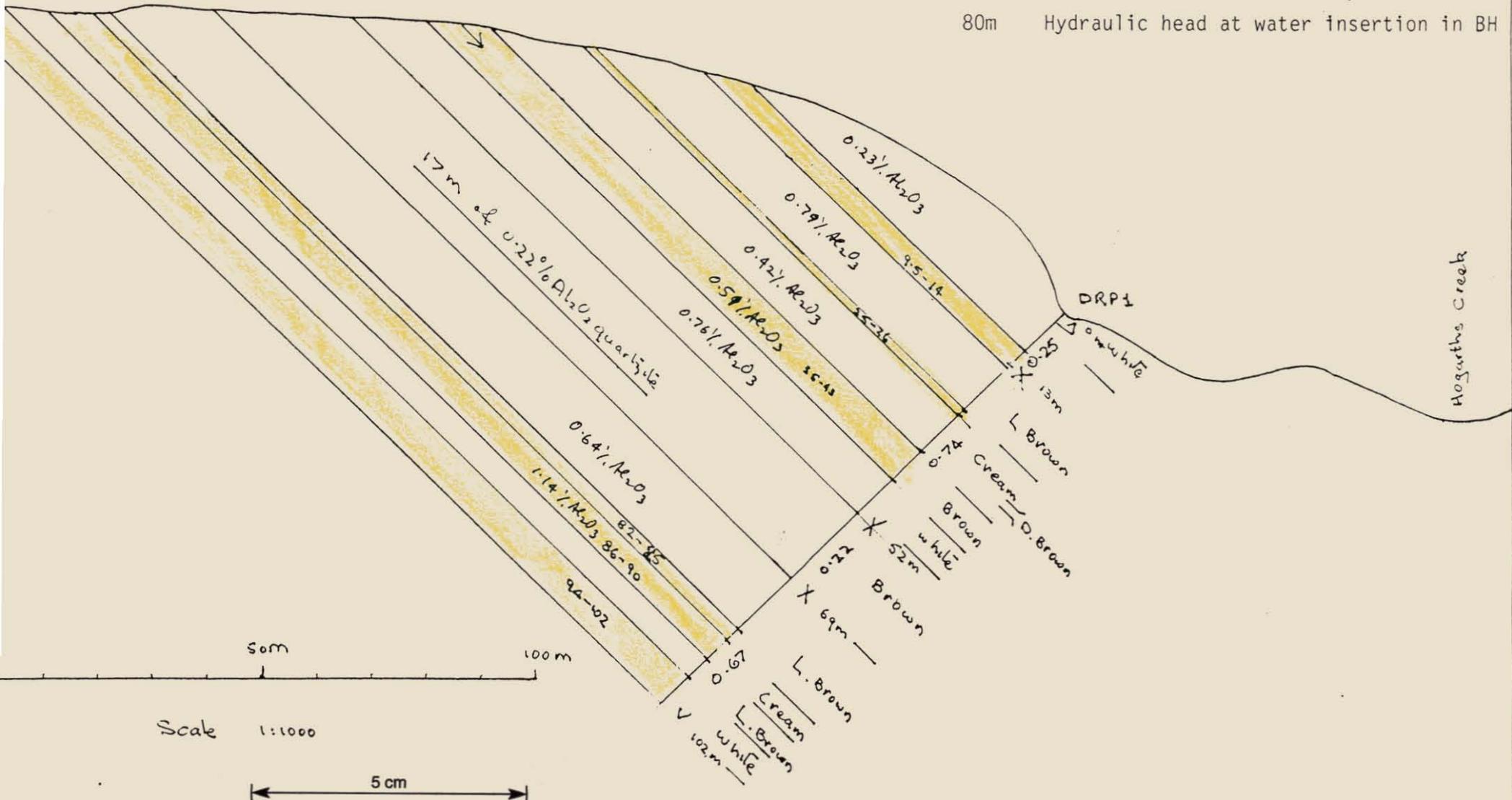
DIP RANGE Nº 1
(VIEW FROM QUARTZITE PEAK)

FIGURE Nº 4a

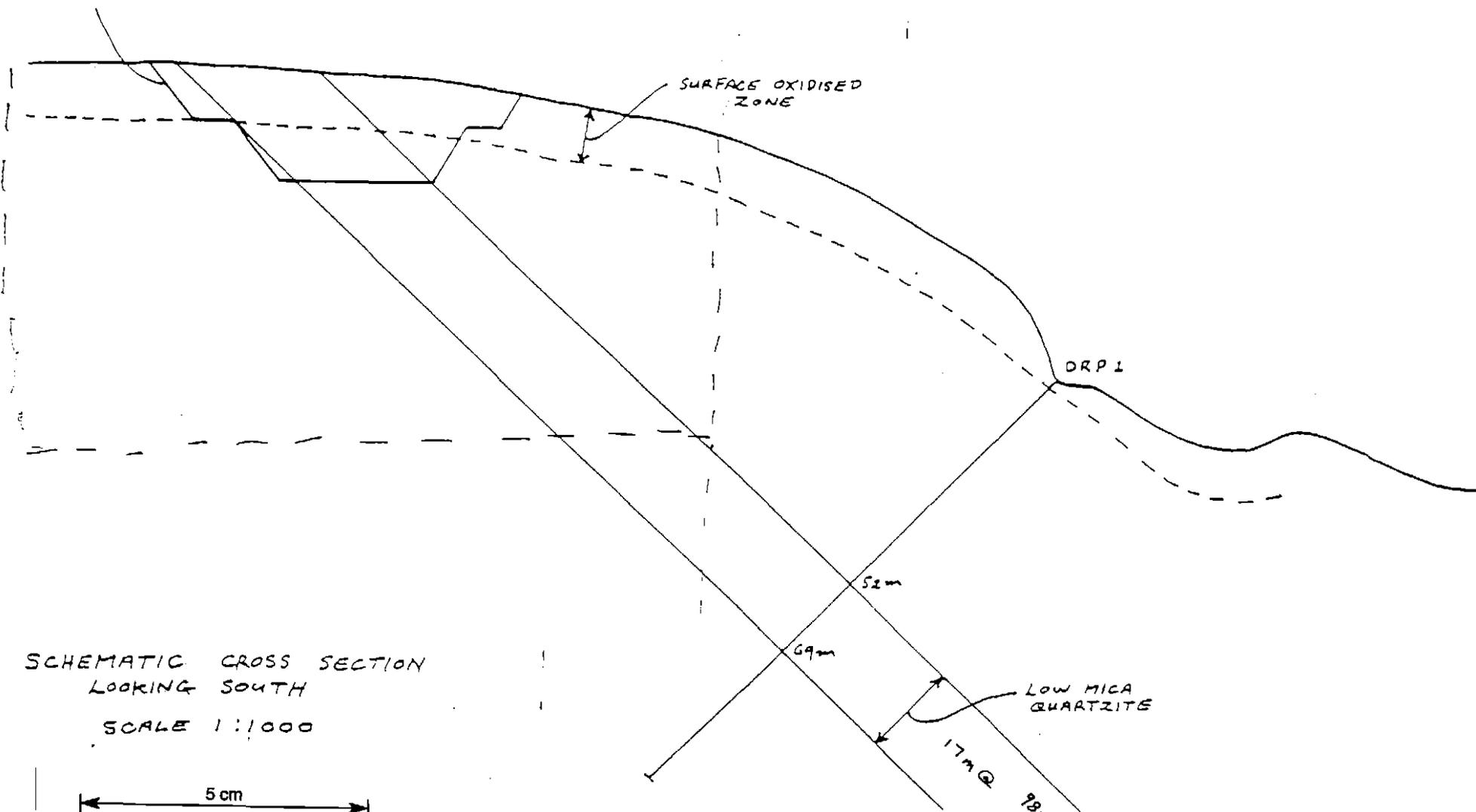
Section through Dip Range Percussion Hole No.1

13 < 0.25 > 0 Mean Al₂O₃ content, depth indicated

- 9.5-14 Sand or soft SS bed
- 35-43 Wet section in borehole
- > Probable water intake
- 80m Hydraulic head at water insertion in BH



POTENTIAL PIT PROFILE



SCHEMATIC CROSS SECTION
LOOKING SOUTH
SCALE 1:1000

5 cm

18.9% SiO₂
0.37% Al₂O₃
0.05% Tl₂O₃

170028

TEMCO
GEOLOGICAL INTERPRETATION
AT THOMAS MOUNTAIN.
FIGURE 6

E.L. Boundary
Surface sampled area (see figure 3)
Scale 1 : 25 000

5 cm

ELA 20/93 Hebe River
Mineral Holdings Aust. Pty Ltd

Section Line A-B

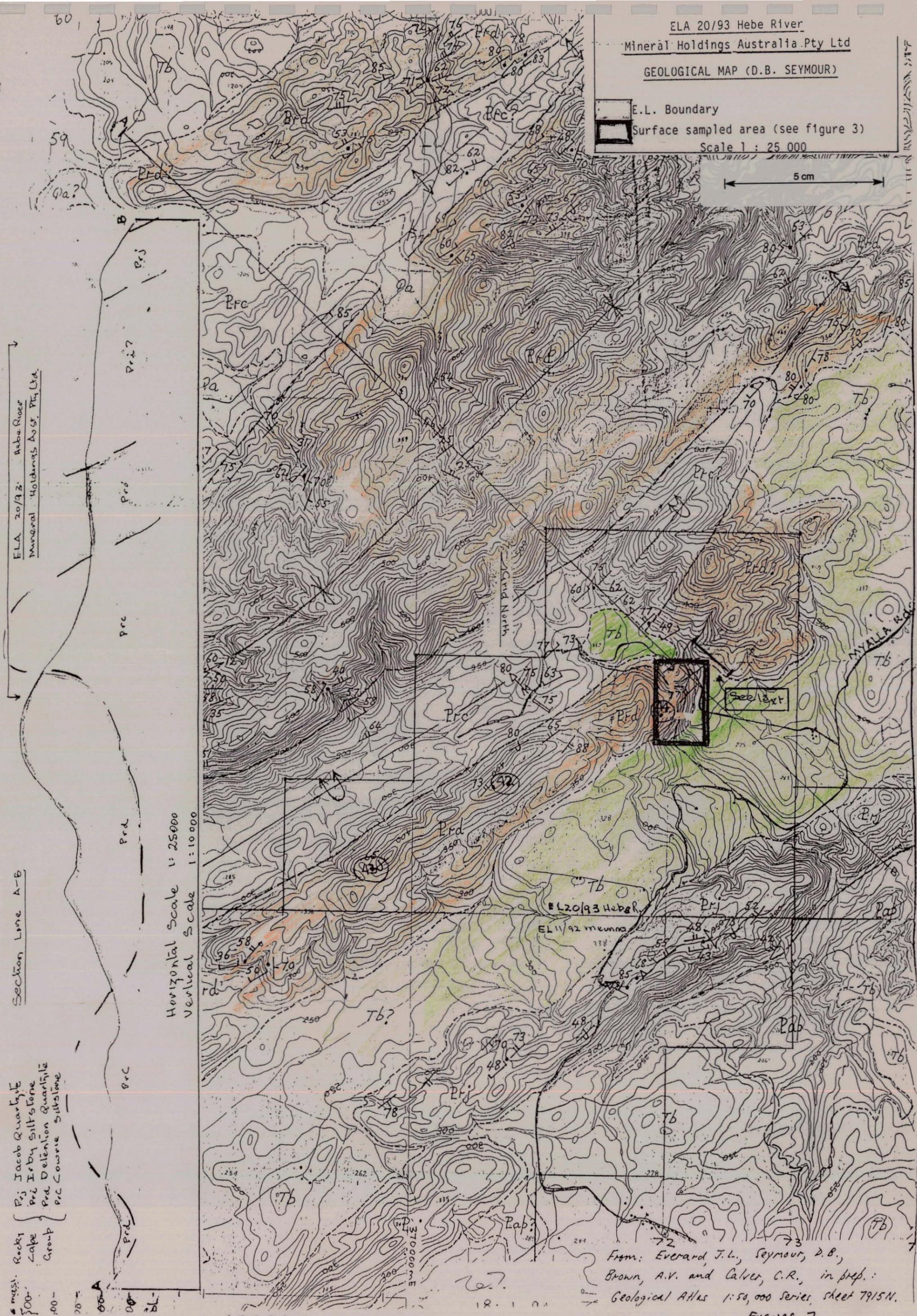
Rocky Cape Group
Pj Jacob Quartzite
Pr Irby Siltstone
Prd Delémion Quartzite
Prc Cowrie Siltstone

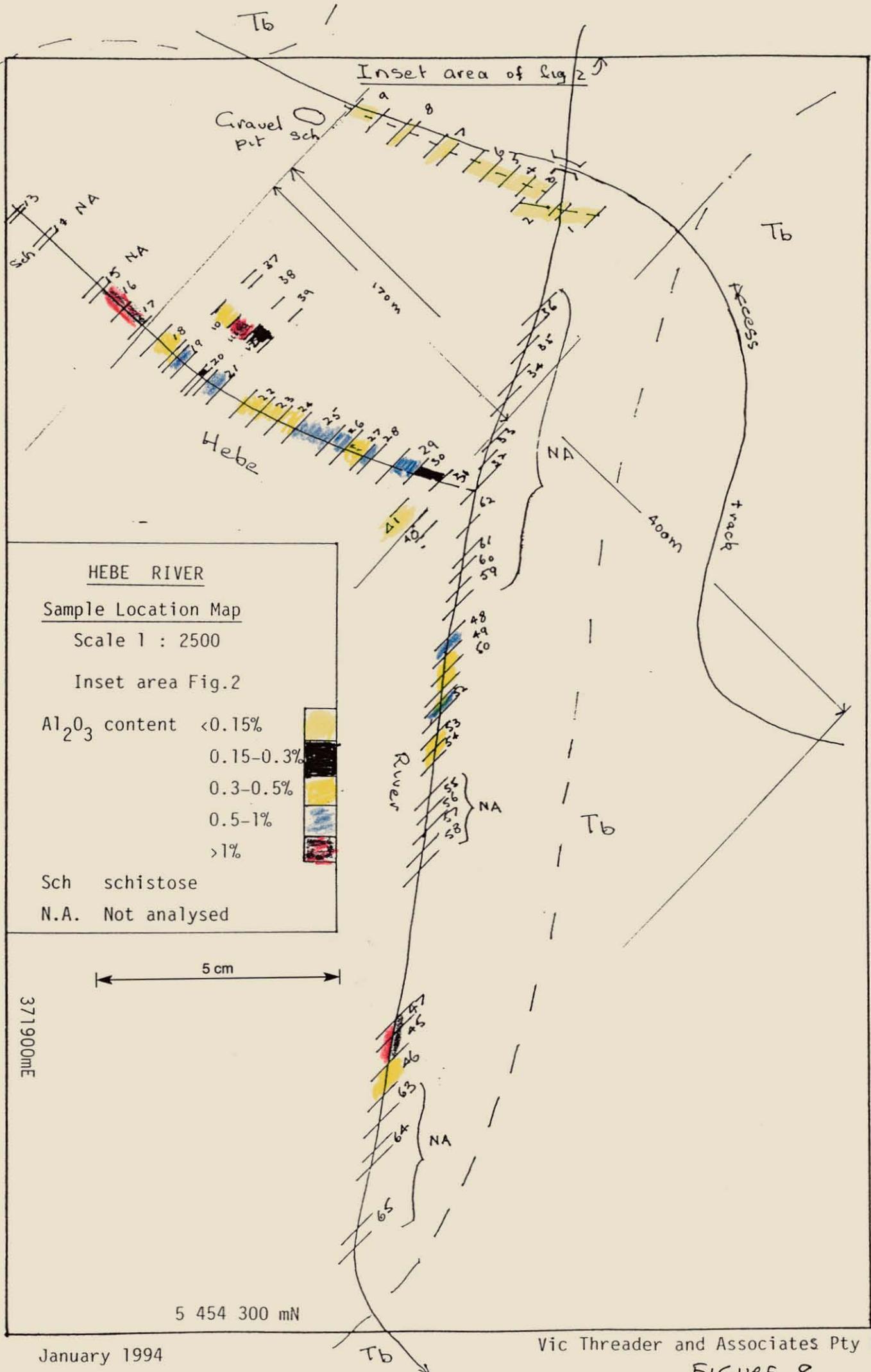
Horizontal Scale 1:25000
Vertical Scale 1:10000

170029

From: Everard, J.L., Seymour, D.B.,
Brown, A.V. and Calver, C.R., in prep.
Geological Atlas 1:50,000 Series, sheet 7915N.

FIGURE 7





January 1994

Vic Threader and Associates Pty Ltd

FIGURE 8

SAMPLE INTERVAL (M)	SiO2	Al2O3	Fe2O3	Cr2O3	TiO2	CaO	MgO	Na2O	K2O	MnO	P2O5	GEOLOGICAL LOG
0-2	98.20	0.25	0.20	0.02	0.05	< 0.01	0.1	< 0.1	0.1	0.01	0.03	0 - 2m Hard, Fine Grained White Quartzite
2-3	99.00	0.19	0.30	0.02	0.07	< 0.01	0.1	0.2	< 0.1	0.01	0.03	2 - 5m As above with soft patches up to 300mm in width
3-4	98.90	0.30	0.30	0.02	0.06	< 0.01	0.1	0.2	0.1	0.01	0.03	
4-5	99.40	0.15	0.30	0.03	0.08	< 0.01	0.1	< 0.1	< 0.1	0.01	0.03	5 - 9.5m As above and fairly hard, fine to medium grainsize
5-6	98.40	0.44	0.30	0.03	0.08	< 0.01	0.1	0.5	0.1	0.01	0.03	
6-7	98.70	0.36	0.20	0.02	0.07	< 0.01	0.1	0.4	0.1	0.01	0.03	
7-8	99.10	0.10	0.30	0.02	0.06	< 0.01	0.1	0.3	< 0.1	0.01	0.03	
8-9	99.20	0.22	0.20	0.02	0.07	< 0.01	0.1	< 0.1	0.1	0.01	0.03	9.5 - 13m Soft, Partly consolidated sand, fine grained. Possible limit of oxidised zone at 13 metres
9-10	98.90	0.05	0.20	0.02	0.05	< 0.01	0.1	0.5	< 0.1	0.02	0.03	
10-11	99.40	0.06	0.20	0.02	0.11	< 0.01	0.1	< 0.1	< 0.1	0.01	0.03	
11-12	98.80	0.37	0.40	0.04	0.06	< 0.01	0.1	0.1	0.1	0.02	0.04	13-14m Dark Brown unconsolidated fine grained sand
12-13	99.20	0.24	0.30	0.02	0.09	< 0.01	0.1	< 0.1	0.1	0.02	0.04	
13-14	98.10	0.92	0.30	0.02	0.06	< 0.01	0.1	0.3	0.1	0.03	0.04	14-20m Harder, fine to medium grained quartzite/sandstone, light brown to cream in colour
14-15	98.40	0.68	0.30	0.02	0.06	< 0.02	0.1	0.1	0.2	0.04	0.04	
15-16	98.60	0.65	0.30	0.02	0.06	< 0.01	0.1	< 0.1	0.2	0.01	0.03	20-25m Medium hard fine to medium grained light brown to cream coloured quartzite
16-17	98.50	0.79	0.30	0.02	0.07	< 0.01	0.1	< 0.1	0.1	0.02	0.04	
17-18	98.50	0.78	0.30	0.02	0.07	< 0.01	0.1	< 0.1	0.2	0.03	0.03	
18-19	98.20	0.73	0.30	0.02	0.06	< 0.01	0.1	0.3	0.2	0.03	0.04	
19-20	98.20	0.86	0.40	0.02	0.06	< 0.01	0.1	< 0.1	0.3	0.03	0.04	25-26m Soft, fine grained cream coloured sand.
20-21	98.20	0.66	0.30	0.02	0.06	< 0.01	0.1	0.3	0.2	0.03	0.03	
21-22	98.10	0.94	0.40	0.02	0.07	< 0.01	0.1	< 0.1	0.3	0.01	0.04	26-32m Medium hard cream to white, fine grained quartzite.
22-23	98.10	0.84	0.40	0.03	0.06	< 0.01	0.1	0.1	0.2	0.03	0.03	
23-24	98.20	0.86	0.40	0.03	0.08	< 0.01	0.1	0.1	0.2	0.01	0.03	32-33m Dark brown med grained, medium hard quartzite with some water.
24-25	98.30	0.79	0.40	0.03	0.06	< 0.01	0.1	< 0.1	0.2	0.01	0.03	
25-26	98.30	0.85	0.40	0.02	0.07	< 0.01	0.1	< 0.1	0.2	0.01	0.03	33-35m Medium hard, fine grained, cream coloured quartzite.
26-27	98.30	0.66	0.50	0.03	0.05	< 0.01	0.1	< 0.1	0.2	0.01	0.04	
27-28	98.50	0.59	0.40	0.02	0.06	< 0.01	0.1	< 0.1	0.2	0.01	0.03	35-43m Soft brown quartzite grading to medium hard lighter brown quartzite at 43m. Material generally fine grained and water in hole from 35m onwards. Hole abandoned at 43m due to loss of bit.
28-29	98.30	0.56	0.40	0.02	0.05	< 0.01	0.1	0.3	0.2	0.09	0.04	
29-30	98.50	0.66	0.40	0.02	0.05	< 0.01	0.1	< 0.1	0.2	0.02	0.03	43-50m Hard, fine grained, white to cream coloured quartzite.
30-31	98.60	0.61	0.40	0.02	0.05	< 0.01	0.1	< 0.1	0.1	0.02	0.03	
31-32	98.10	0.79	0.40	0.02	0.06	< 0.01	0.1	0.2	0.2	0.02	0.03	N.B. The overlapping interval between bores DRP1A and DRP1B, ie 40 to 43 metres, indicates some variation in colour and may give an indication of degree of variation
32-33	98.60	0.63	0.30	0.02	0.05	< 0.01	0.1	< 0.1	0.2	0.01	0.03	
33-34	97.80	1.04	0.50	0.02	0.08	< 0.01	0.1	< 0.1	0.3	0.01	0.03	44-45
34-35	97.70	1.02	0.50	0.03	0.08	< 0.01	0.1	0.2	0.3	0.05	0.03	
35-36	98.80	0.48	0.30	0.02	0.06	< 0.01	0.1	0.1	0.1	0.02	0.04	45-46
36-37	98.90	0.44	0.20	0.02	0.04	< 0.01	0.1	< 0.1	0.1	0.01	0.03	
37-38	98.80	0.56	0.40	0.03	0.04	< 0.01	0.1	< 0.1	0.2	0.01	0.03	46-47
38-39	NO SAMPLE											
39-40	98.90	0.42	0.20	0.02	0.04	< 0.01	0.1	0.1	0.1	0.01	0.03	46-47
40-41	98.70	0.55	0.50	0.03	0.05	< 0.01	0.1	0.3	0.1	0.01	0.03	
41-42	98.70	0.48	0.40	0.03	0.04	< 0.01	0.1	< 0.1	0.2	0.01	0.03	46-47
42-43	98.40	0.61	0.50	0.03	0.05	< 0.01	0.1	< 0.1	0.2	0.01	0.03	
43-44	98.00	0.88	0.40	0.03	0.07	< 0.01	0.1	< 0.1	0.3	0.05	0.04	46-47
44-45	98.20	0.79	0.50	0.02	0.07	< 0.01	0.1	< 0.1	0.2	0.01	0.02	
45-46	98.10	0.86	0.40	0.02	0.06	< 0.01	0.1	0.2	0.3	0.03	0.03	46-47
46-47	98.10	0.81	0.50	0.03	0.07	< 0.01	0.1	< 0.1	0.2	0.01	0.03	

*NOTE: The Fe2O3 values given above are known to be overstated by up to 0.2% due to sample preparation in steel grinding mills resulting in some "pick up" of iron.

BHP-TEMCO LOG AND ANALYSES OF CHIPS FROM PERCUSSION HOLE AT THOMAS MOUNTAIN.

APPENDIX I

170031

SAMPLE INTERVAL (M)	SiO2	Al2O3	Fe2O3	Cr2O3	TiO2	CaO	MgO	Na2O	K2O	MnO	P2O5	GEOLOGICAL LOG
47-48	98.30	0.74	0.50	0.04	0.06	< 0.01	0.1	< 0.1	0.2	0.01	0.03	along strike. Ground water level intersected at 45m.
48-49	98.30	0.73	0.60	0.02	0.06	< 0.01	0.1	< 0.1	0.2	0.01	0.03	
49-50	98.00	0.91	0.40	0.03	0.07	< 0.01	0.1	0.1	0.3	0.01	0.03	50-52m Medium to coarse grained unconsolidated sand with considerable water, light brown in colour.
50-51	98.40	0.65	0.30	0.02	0.06	< 0.01	0.1	0.1	0.1	0.05	0.03	
51-52	98.80	0.52	0.30	0.02	0.05	< 0.01	0.1	0.1	0.1	0.11	0.03	52-55m Hard, fine grained, light brown quartzite.
52-53	98.70	0.31	0.30	0.03	0.05	< 0.01	0.1	0.2	0.1	0.03	0.03	
53-54	98.80	0.31	0.20	0.02	0.05	< 0.01	0.1	0.2	0.1	0.08	0.03	55-59m Dark grading to light brown medium hard, fine to medium grained quartzite.
54-55	98.90	0.39	0.20	0.02	0.06	< 0.01	0.1	< 0.1	0.1	0.02	0.03	
55-56	98.50	0.60	0.30	0.02	0.06	< 0.01	0.1	0.1	0.2	0.02	0.03	59-60m As above but cream in colour.
56-57	98.60	0.40	0.30	0.03	0.05	< 0.01	0.1	0.3	0.1	0.01	0.03	
57-58	98.70	0.55	0.20	0.02	0.06	< 0.01	0.1	0.1	0.2	0.01	0.03	60-69m Alternating hard and soft fine to medium grained brown quartzite - predominantly hard material.
58-59	99.10	0.33	0.20	0.02	0.05	< 0.01	0.1	< 0.1	0.1	0.02	0.03	
59-60	98.70	0.50	0.20	0.03	0.06	< 0.01	0.1	0.1	0.2	0.02	0.03	69-82m Medium to fine grained, medium hard (some soft patches of minor extent) white to light brown quartzite. Notable softer patch from 76 to 79m.
60-61	99.00	0.32	0.30	0.03	0.05	< 0.01	0.1	0.1	0.1	0.02	0.02	
61-62	99.00	0.29	0.20	0.02	0.04	< 0.01	0.1	0.1	0.1	0.08	0.03	82-85m Soft, medium grained cream to white quartzite.
62-63	99.10	0.26	0.20	0.03	0.04	< 0.01	0.1	0.1	0.1	0.05	0.03	
63-64	99.20	0.22	0.20	0.02	0.03	< 0.01	0.1	< 0.1	0.1	0.02	0.04	85-86m Hard material of similar description to above.
64-65	98.90	0.42	0.20	0.02	0.06	< 0.01	0.1	< 0.1	0.1	0.02	0.03	
65-66	99.10	0.34	0.20	0.02	0.05	< 0.01	0.1	< 0.1	0.1	0.02	0.02	86-90m Soft unconsolidated sand. Fine to medium grain size, cream in colour.
66-67	99.10	0.37	0.20	0.02	0.05	< 0.01	0.1	< 0.1	0.1	0.01	0.02	
67-68	99.20	0.39	0.20	0.02	0.04	< 0.01	0.1	< 0.1	0.1	0.03	0.02	90-94m Darker material as above.
68-69	99.20	0.29	0.20	0.02	0.04	< 0.01	0.1	< 0.1	0.1	0.01	0.03	
69-70	98.60	0.73	0.20	0.02	0.08	< 0.01	0.1	< 0.1	0.2	0.01	0.03	90-94m Darker material as above.
70-71	98.70	0.62	0.20	0.01	0.06	< 0.01	0.1	< 0.1	0.2	0.03	0.03	
71-72	98.70	0.54	0.20	0.02	0.06	< 0.01	0.1	< 0.1	0.2	0.07	0.03	90-94m Darker material as above.
72-73	98.60	0.76	0.20	0.02	0.06	< 0.01	0.1	< 0.1	0.2	0.02	0.03	
73-74	98.60	0.79	0.20	0.02	0.07	< 0.01	0.1	< 0.1	0.2	0.01	0.03	90-94m Darker material as above.
74-75	98.50	0.65	0.30	0.02	0.08	< 0.01	0.1	< 0.1	0.2	0.01	0.03	
75-76	98.30	0.72	0.20	0.03	0.07	0.11	0.2	< 0.1	0.1	0.10	0.03	90-94m Darker material as above.
76-77	99.10	0.31	0.20	0.03	0.04	0.06	0.1	< 0.1	0.1	0.07	0.03	
77-78	98.80	0.37	0.10	0.01	0.06	0.05	0.1	< 0.1	0.1	0.22	0.03	90-94m Darker material as above.
78-79	98.90	0.41	0.20	0.02	0.05	< 0.01	0.1	0.2	0.1	0.14	0.03	
79-80	98.70	0.55	0.20	0.02	0.06	0.01	0.1	0.1	0.2	0.10	0.03	90-94m Darker material as above.
80-81	97.80	1.22	0.20	0.02	0.12	< 0.01	0.1	0.1	0.4	0.01	0.03	
81-82	98.50	0.63	0.20	0.03	0.07	< 0.01	0.1	0.1	0.2	0.04	0.03	90-94m Darker material as above.
82-83	99.00	0.23	0.40	0.03	0.04	0.01	0.1	< 0.1	0.1	0.02	0.02	
83-84	98.80	0.23	0.40	0.02	0.04	< 0.01	0.1	0.2	0.1	0.03	0.03	90-94m Darker material as above.
84-85	97.80	1.06	0.40	0.04	0.09	< 0.01	0.1	0.1	0.3	0.05	0.03	
85-86	98.90	0.32	0.40	0.04	0.04	< 0.01	0.1	< 0.1	0.1	0.03	0.03	90-94m Darker material as above.
86-87	96.90	1.46	0.40	0.04	0.12	< 0.01	0.1	0.4	0.5	0.01	0.03	
87-88	98.10	0.89	0.30	0.04	0.07	0.06	0.2	< 0.1	0.2	0.07	0.03	90-94m Darker material as above.
88-89	96.50	1.92	0.40	0.04	0.15	< 0.01	0.1	0.2	0.6	0.02	0.03	
89-90	98.80	0.30	0.40	0.03	0.05	< 0.01	0.1	0.1	0.1	0.02	0.03	90-94m Darker material as above.
90-91	99.00	0.27	0.40	0.04	0.04	0.07	< 0.1	< 0.1	0.1	0.01	0.02	
91-92	99.10	0.25	0.40	0.04	0.05	< 0.01	0.1	< 0.1	0.1	0.01	0.02	90-94m Darker material as above.
92-93	99.20	0.18	0.40	0.03	0.03	< 0.01	0.1	< 0.1	0.1	0.01	0.02	

*NOTE: The Fe2O3 values given above are known to be overstated by up to 0.2% due to sample preparation in steel grinding mills resulting in some "pick up" of iron.

BORE NO. DRP1A/B

SAMPLE INTERVAL (M)	SiO2	Al2O3	Fe2O3	Cr2O3	TiO2	CaO	MgO	Na2O	K2O	MnO	P2O5	GEOLOGICAL LOG
93-94	98.40	0.62	0.40	0.04	0.07	< 0.01	0.1	< 0.1	0.1	0.05	0.03	
94-95	98.90	0.33	0.40	0.04	0.04	0.05	0.1	< 0.1	0.1	0.05	0.04	94-95m Soft uncemented, fine grained white sand.
95-96	98.80	0.39	0.30	0.04	0.04	< 0.01	0.1	0.2	0.1	0.02	0.03	95-99m Medium to fine grained unconsolidated soft sand, cream in colour.
96-97	98.70	0.48	0.40	0.07	0.07	< 0.01	0.1	< 0.1	0.1	0.01	0.03	
97-98	98.80	0.45	0.40	0.06	0.06	< 0.01	0.1	< 0.1	0.1	0.01	0.03	
98-99	98.70	0.49	0.30	0.05	0.05	< 0.01	0.1	< 0.1	0.1	0.01	0.03	
99-100	99.20	0.20	0.30	0.04	0.04	< 0.01	0.1	< 0.1	0.1	< 0.01	0.03	99-100m Soft uncemented, fine grained white sand.
100-101	99.00	0.38	0.40	0.04	0.04	< 0.01	0.1	< 0.1	0.1	0.01	0.40	100-102m As for interval 95-99m - hole abandoned due to cave in of sand.
101-102	98.80	0.45	0.30	0.05	0.05	< 0.01	0.1	< 0.1	0.1	0.01	0.03	
* NOTE: The Fe2O3 values given above are known to be overstated by up to 0.2% due to sample preparation in steel grinding mills resulting in some "pick up" of iron.												EOH

MINERAL HOLDINGS AUSTRALIA PTY. LIMITED

INC. IN VIC.

Correspondence to:
2nd FLOOR,
135 COLLINS STREET,
MELBOURNE, VIC., AUSTRALIA, 3000
TELEPHONE: (03) 654 7999 (2 LINES)
FAX: (03) 650 3855

1st May, 1991

A P P E N D I X 2

(THOMAS MOUNTAIN)

<u>Composition</u>	<u>Size</u>	<u>% Retained</u>
SiO ₂ 99.91%	850u	2.8
Al ₂ O ₃ 180 ppm	600u	9.2
Fe ₂ O ₃ 90 ppm	425u	27.4
TiO ₂ 240 ppm	250u	60.0
MgO <100 ppm	150u	81.4
CaO <100 ppm	106u	89.5

SILICA FLOUR (CHAMPIONS ROAD)

Typical Characteristics

<u>Composition</u>	<u>Size</u>	<u>PSD</u> <u>% Retained</u>
SiO ₂ 99.60%	850u	13.5
Al ₂ O ₃ 440 ppm	600u	15.7
Fe ₂ O ₃ 100 ppm	425u	17.2
TiO ₂ 516 ppm	250u	22.4
MgO 335 ppm	150u	27.9
CaO 242 ppm	106u	34.6
	75u	41.3
	38u	60.3

Please note that the characteristics detailed above relate to unbeneficiated materials (i.e. no screening, washing, etc.). This Company is in process of establishing forward sales for all of its silica resources, and is currently producing lump silica for use by TEMCO and Pioneer Silicon Industries in Tasmania.

FACSIMILE TRANSMITTAL FORM

170035



Australian Glass Manufacturers Company

HOBART

(A unit of A.G.L. Operations Pty. Ltd. Inc. in Victoria)
10 Gormanston Road, Moorab, TASMANIA, 7009
Postal Address: Box 203 P.O. Moorab 7009
Telephone: 74 0900
Telex: 86163 - AGL110

DATE: 27/3/91

SENDER: H. Woolley

ADM REF: 03-6547499

FAX TO: Mineral Holdings Aust P.S.Y. Limited

ATTN: Neil Thomas

SUBJECT: THOMAS HOUSTAIN SAND

FAX NO. (002) 72 1718

INT. FAX No. 0011 81 02 72 1718

NOTE: Please advise by telex if any parts of transmission have failed.

9

4/4/91

No. of PAGES (including this page)

AS PROMISED YOUR SAND WAS SENT TO OUR LABORATORY FOR ANALYSIS AND THE RESULTS ARE SET OUT BELOW, WE ARE NOT IN A POSITION TO DO A TRIAL AT THE MOMENT, I WILL CONTACT YOU SHOULD THE NEED ARISE TO USE THOMAS HOUSTAIN SAND.

AGL ENGINEERING SERVICES PTY LTD 12/90 R942				No. 1 3650	
CONCENTRATION				APISAND	
SiO2+LOI 99.92%	Na2O 0.012%	K2O 0.01%	CaO 0.01%	MgO 0.01%	A12O3 0.018%
Fe2O3 0.024%	Fe2O3 0.001%	Cr2O3 1.48ppm	LOI 0.06%		
*****				***	

REGARDS
Hilary Woolley

APPENDIX 3
ANALYSES OF SURFACE ROCK CHIP SAMPLES FROM HEBE RIVER PROSPECT (REFER FIGURE 8)

Sample No.	Distance	Sample width	Estimated True Width	Field Description			Chemical Analysis													
				Colour	Hardness	Rock Type	Fe2O3	Al2O3	CaO	TiO2	P2O5	V2O5	Na2O	K2O	MgO	MnO	LoI	SiO2	Al2O3/K2O	
HR1	0-20	20	15	W	H	SS	0.007	0.02	0.004	0.016	0.001	0.0003	0.004	0.0055	0.003	0.0001	0.15	99.79	4	
	20-25			Creek bed on hard rock																
2	25-45	20	15	W	H	SS/Q	0.008	0.03	0.0032	0.012	0.004	0.0001	0.003	0.006	0.002	0.00009	0.21	99.72	5	
3	0-10	10	8	W	H	"	0.04	0.03	0.003	0.013	0.001	<0.0003	0.003	0.004	0.005	<0.002	0.10	99.80	7.5	
4	20	10	8	W	H	"	0.02	0.03	<0.003	0.012	0.001	<0.0003	0.002	0.004	0.003	<0.002	0.08	99.84	7.5	
5	30	10	8	W	H	"	0.02	0.02	<0.003	0.011	0.001	<0.0003	0.002	0.004	<0.003	<0.002	0.06	99.87	5	
6	40	10	8	W	H	"	0.05	0.03	0.003	0.021	0.001	<0.0003	0.003	0.005	0.004	0.004	0.07	99.80	4.6	
	52	12				-														
7	60	8	6	W	H	"	0.03	0.03	<0.003	0.013	0.001	<0.0003	0.003	0.004	0.003	<0.002		99.83	7.5	
	67					-														
	73	6	5	OW	Soft (friable)	SS														
	76					-														
8	80	4	3			SS/Q	0.04	0.03	<0.003	0.012	0.001	<0.0003	0.003	0.005	0.003	0.01	0.05	99.84	6	
	93	13	10																	
9	107	14	11	W	V.H.	Vitreous quartzite	0.04	0.02	0.003	0.009	0.001	<0.0003	0.002	0.004	<0.003	0.009	0.05	99.86	5	
10	0-10	10	8	OW	H	SS	0.04	1.00	0.005	0.056	0.005	0.001	0.011	0.30	0.039	<0.001	0.22	96.3	3.3	
11	20	10	8	OW	H	SS	0.03	0.58	0.005	0.035	0.005	0.001	0.009	0.17	0.025	<0.001	0.21	97.8	3.4	
12	30	10	8	OW	H	SS	0.02	0.26	0.006	0.026	0.005	0.000	0.006	0.07	0.013	<0.001	0.21	98.9	3.7	
13	0-3	3	3	W	H	SS	0.15	0.59	0.001	0.21	0.013	0.000	0.013	0.14	0.037	<0.001	0.43	97.3	4.2	
	21					-														
14	24	3	3	W, Br	H, S	SS, Sch														
	57	33				-														
15	60	3	3	OW	H, S	"														
16	75	15	10	OW	H, S	"	0.20	6.30	0.007	0.18	0.012	0.003	0.056	1.86	0.18	<0.001	0.92	84.5	3.4	

S. No.	Distance	Sample width	Estimated True Width	Colour	Hardness	Rock Type	Chemical Analysis													
							Fe2O3	Al2O3	CaO	TiO2	P2O5	V2O5	Na2O	K2O	MgO	MnO	LoI	S102	Al2O3/K2O	
17	88	13	9	OW, LB	H, S	SS, Sch	0.21	4.92	0.006	0.13	0.009	0.002	0.046	1.46	0.125	<0.001	0.81	88.4	3.4	
	98	10			-															
18	108	10	7	OW, LB	H, S	SS	0.04	0.93	<0.001	0.05	0.005	0.001	0.009	0.23	0.031	<0.001	0.23	96.8	4.0	
	110	2			-															
19	116	6	4	W	V. H	SS, Q, Sch	0.02	0.385	0.002	0.026	0.004	0.001	0.007	0.105	0.019	<0.001	0.13	96.9	3.6	
	123	7			-															
20	127	4	3	OW, L Br	H	SS, Sch	0.014	0.245	0.002	0.026	0.004	0.000	0.005	0.056	0.012	<0.001	0.03	98.6	4.4	
	130	3			-															
21	138	8	6	OW	H	SS	0.019	0.475	0.003	0.032	0.006	0.001	0.007	0.125	0.018	<0.001	0.18	98.4	3.8	
	152	14			-															
22	162	10	7	OW	H	SS	0.02	0.610	0.006	0.034	0.005	0.001	0.008	0.17	0.025	<0.001	0.19	98.0	3.6	
23	172	10	7	OW	H	SS	0.024	0.53	0.005	0.032	0.006	0.001	0.007	0.135	0.022	<0.001	0.20	98.1	3.9	
24	182	10	7	OW	H	SS	0.018	0.80	<0.001	0.036	0.005	0.001	0.010	0.22	0.028	<0.001	0.16	97.2	3.6	
25	200	18	13	OW	H	SS	0.015	0.50	0.006	0.025	0.004	0.001	0.006	0.115	0.019	<0.001	0.12	98.4	4.3	
26	210	10	7	OW	H	SS	0.265	0.445	0.003	0.033	0.007	0.001	0.008	0.12	0.017	0.001	0.38	97.9	3.7	
27	220	10	7	OW	H	SS	0.26	0.87	0.006	0.031	0.005	0.001	0.012	0.26	0.029	<0.001	0.19	97.1	3.3	
28	225	5	3	OW	H	SS	0.074	0.31	0.002	0.036	0.006	0.000	0.007	0.076	0.013	<0.001	0.13	98.3	4.1	
	237	12			-															
29	243	16	11	OW	H	SS	0.012	0.39	0.006	0.034	0.004	0.001	0.007	0.094	0.017	<0.001	0.15	98.6	4.1	
30	260	17	12	W, LB	S	SS	0.013	0.28	0.004	0.042	0.003	0.000	0.006	0.076	0.014	<0.001	0.18	98.3	3.7	
31	274	14	10	OW	S	SS														
					-															
32	0-17	17	12	OW	H, S	SS														
33	24	7	5	OW	S	SS														
	52																			
34	62	10	7	OW	H	SS														

170037

S No.	Distance	Sample width	Estimated True Width	Colour	Hardness	Rock type	Chemical Analysis													
							Fe2O3	Al2O3	CaO	TiO2	P2O5	V2O5	Na2O	K2O	MgO	MnO	LoI	SiO2	Al2O3/K2O	
35	78	16	11	OW	H	SS														
36		8	6	OW	H,S	SS														
37	0-5	5		OW, LBr	H	SS, Sch														
38	15	10		LBr		-														
39	30	15		OW, LBr	H	vitreous quartzite														
	38	8		W	H	SS and vitreous quartzite														
40		7	7	OW, Br	S	SS, Sch														
41		12	12	OW, LBr	H	SS	0.011	0.033	0.005	0.045	0.003	0.000	0.004	0.007	0.008	<0.001	0.16	99.5	4.7	
42		17	17	OW	H	SS/Q	0.038	1.58	0.006	0.045	0.004	0.001	0.019	0.485	0.06	<0.001	0.33	94.4	3.3	
43		30	30	OW	H	SS/Q	0.007	0.115	0.009	0.008	<0.001	0.000	0.011	0.033	0.011	<0.001	0.13	99.3	3.5	
44		2	2	OW, LB	H	SS														
45	0-15	15	10	OW	H	SS	0.06	1.52	0.001	0.058	0.006	0.002	0.019	0.445	0.044	<0.001	0.23	94.8	3.4	
46	30	15	10	OW-L.gy	H	SS	0.09	0.88	0.007	0.041	0.009	0.001	0.014	0.26	0.034	<0.001	0.17	96.8	3.4	
47	40	10	7	OW	H	SS	0.052	1.36	0.007	0.14	0.016	0.002	0.017	0.395	0.04	<0.001	0.25	95.2	3.4	
48	0-11	11	8	W	H	SS	0.015	0.405	0.002	0.035	0.004	0.001	0.007	0.115	0.018	<0.001	0.11	98.3	3.5	
49	21	10	7	W	H	SS	0.054	0.510	0.002	0.041	0.005	0.001	0.007	0.14	0.023	<0.001	0.18	97.7	3.6	
50	31	10	7	W	H	SS	0.02	0.71	<0.001	0.049	0.005	0.001	0.01	0.215	0.026	<0.001	0.14	96.7	3.3	
51	40	9	6	W	H	SS	0.021	0.60	<0.001	0.048	0.004	0.001	0.01	0.175	0.02	<0.001	0.11	97.0	3.4	
	45																			
52	50	5	3	OW	H	SS	0.02	0.435	0.004	0.044	0.003	0.001	0.006	0.125	0.017	<0.001	0.08	98.8	3.5	
	63																			
53	70	7	5	OW	H	SS	0.025	0.52	0.006	0.046	0.005	0.001	0.010	0.15	0.02	<0.001	0.07	98.4	3.5	
54	80	10	7	W	H,S	SS	0.04	1.24	0.004	0.038	0.005	0.001	0.015	0.37	0.39	<0.001	0.15	95.8	3.4	
	98					surface discolouration														
55	108	10	7	W	H,S	SS														

170038

<u>S No.</u>	<u>Distance</u>	<u>Sample width</u>	<u>Estimated True Width</u>	<u>Colour</u>	<u>Hardness</u>	<u>Rock Type</u>
56	118	10	7	OW	H,S	SS
57	128	110	7	OW	H,S	SS
58	137	9	8	OW	H,S	SS
	143				-	
NS	158	5	3	OW	S	SS Surface discolouration
-	214				-	
59	0-10	10	7	W	H	SS
60	20	10	7	Br	S	SS (ironstained)
61	27	7	5	W	H	SS
	45				-	
62	60	15	10	Br	H	SS
63	0-10	10	7	Br	H	SS
	25				-	
64	33	8	6	Br	H	SS
	56				-	
65	76	10	7	Br	S	Sch

(Revised Version)



P.O.Box 113, N-4791 Lillesand, Norway.

TELEFAX

170040

Company: Mineral Holding Australia PTY. From: KA.Støle
 Att: Neil M.Thomas Date: Oct. 10,1996
 Fax No.: 0061 3 9650 3855 Fax No.: 47 372 80011
 Page: 1 of 1 Phone:
 CC: P.E.Levy

Subject: Potential material usage

Dear Mr. Thomas,

Reference is made to your fax of Oct.4 concerning a possible future need of raw materials. As stated earlier, our main interest is in the field of SiC. If we find the conditions satisfactory, I would envision the building of a SiC crude plant to be our primary objective. Again, depending on the conditions, Norton may want to expand this activity by also adding refining capacity. The capacity of the crude plant has not been decided on, but I would think a plant of 20000 tons with possibility to expand to 40000 tons would be realistic. The corresponding need of silica would, in this case, amount to approximately 32000 tons, respectively 64000 tons pr. year. The 30mm and finer Quartzite referred to in your fax of Febr.23, 1996 seems perfect if the material could be upgraded to meet our quality requirements.

Since our business focus on SiC only, I can not answer if a potential exists to supply bauxite to other business units within the company. I can however confirm that Norton imports calcined bauxite from Australia. The Saint Gobain Company belongs, as you may know, to the world leading producers of glass which means that the company is also a large consumer of glass quality silica.

In view of the above, I think our focus while visiting Tasmania, will be to get a best possible understanding of all relevant issues pertaining to a possible investment- and operation of a SiC producing plant as outlined above. Secondly we would like also to gather information about other opportunities (like bauxite production etc.) which could be of interest to other business units within the Saint Gobain group.

I regret that I cannot be more specific at this point in time.

Looking forward to meet with you on Oct. 20.

Best regards

Kjell A. Støle
 Kjell A. Støle

335711

MINERAL RESOURCE MANAGEMENT PTY LIMITED

ACN 062 964 809

24 Juniper Road
Wantirna Victoria 3152

Telephone: (03) 283 3648

A/H: (03) 800 1126

Facsimile: (03) 283 3643



15 March 1994

Mr Brian McBride
Assistant General Manager -
Development Mining & Mineral Processing
Tasmania Development & Resources
30 Gordons Hill Road
Rosny Park Tasmania 7018

Dear Brian

I have made a few changes to the subject report and attach a copy of the revised version.

In particular, the previous Appendix I has been changed to Appendix III.

Would you please substitute the revised text and appendices into the copy of the report which you previously received.

Yours sincerely

Handwritten signature of Norman Shepherd in cursive.

Norman Shepherd
Mineral Resource Management Pty Limited

att.

SUMMARY REPORT
QUARTZITE PROSPECTS IN NORTHWEST TASMANIA
HELD BY
MINERAL HOLDINGS AUSTRALIA PTY. LIMITED

Norman Shepherd
Mineral Resource Management Pty. Ltd.
February 1994

SUMMARY

A considerable amount of reconnaissance exploration has been carried out to investigate the Detention Sub-Group Quartzite for silica resources with suitable chemical and physical characteristics for silicon and ferrosilicon production.

Most exploration has been based on surface sampling and shallow percussion drilling. This has shown that the effects of weathering have resulted in the leaching of Al_2O_3 and Fe_2O_3 and enrichment in SiO_2 to a depth of about 10 metres forming a siliceous cap underlain by friable to medium hard sediments.

At some locations, possibly along ridge slopes or cross-cutting faults (eg. Hogarths Creek near Thomas Mountain and Hebe River) the percolating silica rich solutions have caused extensive silicification forming hard quartzite of higher purity. These locations (notably Hebe River) represent the best prospects in the region for locating resources of suitable quality silica to satisfy smelter specifications.

Potential exists at Thomas Mountain and Hebe River to prove up deposits of at least several hundred thousand tonnes of quartzite amenable to open pit mining. The Hebe River quartzite outcrops are very high purity ($> 99.5\% SiO_2$) and dense, however at Thomas Mountain Al_2O_3 and TiO_2 levels higher and sometimes close to or exceed smelter limits for premium grade silicon. Diamond drilling is needed to establish the size and quality of these deposits. Resources with impurity levels which exceed chemical grade silicon specifications may be suitable for the production of silicon for the secondary metallurgical market or ferrosilicon.

Further exploration in the area is also required to locate other silica resources, particularly along faults. Detention Sub-Group quartzite at depth contains at least $0.3\% Al_2O_3$ (mostly $> 0.5\% Al_2O_3$) and SiO_2 values are less than 99.0% . Hence future exploration should be directed to locate zones of silica enrichment resulting from weathering.

Bulk samples of quartzite from the Thomas Mountain mine have been tested with some success at the Temco ferrosilicon and Electrona silicon smelters. Thermal stability tests carried out by Dow Corning on the Hebe River quartzite indicate that it does not decrepitate under furnace conditions.

Quartzite resources of at least 2 million tonnes (preferably 3 - 5MT) are considered necessary to support a greenfields silicon smelter, unless suitable feed can be delivered from other locations at a competitive price.

Diamond drilling is required at the Hebe River (top priority) and Thomas Mountain prospects, in addition to exploration for other deposits, to prove up the required quartzite resources.

MINERAL HOLDINGS AUSTRALIA PTY LIMITED

1 INTRODUCTION

During the past 30 years Mineral Holdings Australia Pty Limited (MHA) has carried out exploration in north west Tasmania for quartzite deposits suitable for silicon and ferrosilicon production. Potential in the area for high purity silica sand to satisfy glass manufacturing specifications has also been investigated.

Mineral Resource Management Pty Limited was requested to prepare a report on quartzite resources within tenements held by MHA based on available exploration data (including reports on exploration by joint venture partners) and discussions with Consultant Geologist Vic Threader and geologists from the Tasmania Department of Mineral Resources.

A brief visit was made to inspect the Thomas Mountain, Hebe River and other quartzite prospects in the area.

2 TENEMENTS AND LOCATION (Figure 1)

Although exploration activities have covered extensive areas (EL 43/70 - 310 km²) southwest of Wynyard which are underlain by the prospective Rocky Cape Group, current tenements held by MHA have been reduced to three areas covering the best quartzite deposits identified to date:

EL 25/88	7 km ²	Dip Range - Thomas Mountain
EL 11/92	30 km ²	Meunna
◁ ELA 20/93	8 km ²	Hebe River ▷
CML 8M/89	161 hectares	Within EL25/88

The Thomas Mountain prospect, which occurs in the north Dip Range, is located about 25 km southwest of Wynyard and 20 km southeast of a deep water harbour - Port Latta. Access is via the township of Montumana on the Bass Highway, 25 km west of Wynyard. Thence 6 km south along Montumana and Newhaven Roads to a turn-off just east of Hogarths Creek (Figure 2).

The Hebe River prospect is located about 9 km south of Thomas Mountain, but access is by a 2 km track west off the sealed Myalla Road. Distance by road to the major port, Burnie is about 50 km.

The Meunna tenement adjoins the southwest boundary of the Hebe River ELA 20/93 covering extensions of the Detention Quartzite and also Jacob Quartzite formations.

3 REGIONAL GEOLOGY (Figure 3)

The original tenement (EL43/70 - 310 km²) held by MHA from 1960 to 1987 is underlain by Upper Proterozoic sediments belonging to the Rocky Cape Group. These formations are covered in some areas by Tertiary basalt.

The Rocky Cape Group stratigraphy comprises a folded sequence of slightly metamorphosed sediments.

	<u>Thickness (m)</u>
Jacob Quartzite	1130
Irby Siltstone	760
Detention Sub-group	1400
- Cave Quartzite	
- Port Slate	
- Bluff Quartzite	
Cowie Siltstone	2240+

Although some exploration for silica resources has been carried out over the Jacob Quartzite, most recent activity by MHA and joint venture partners has been focused on quartzite formations within the Detention Sub-group.

Government geologists (Gee 1971) described the silica rich sediments in the Detention Sub-group as "uniformly fine grained orthoquartzites with a granular to glassy texture depending on the degree of cementation." Quartz is the dominant mineral with minor feldspar and sericite. A more recent Government Report (Geology and Mineral Resources of Tasmania - Special Publication, Geol Soc Aust 15 1989) refers to the quartzite formations as variably silicified quartz arenite.

In Longworth and McKenzie reports (1981), the Detention Sub-group quartzites are similarly described as erratically silicified quartzose sandstones with the degree of

silicification not necessarily being consistent within or between beds. Longworth and McKenzie noted from extensive shallow drilling in the Dip Range that silica levels were highest near surface and in general chemical purity decreases with depth due to surface leaching and precipitation at lower levels of Fe₂O₃ and Al₂O₃. Other geologists view the quartzite as a thick-bedded sandstone and noted that on some ridge tops silica has been dissolved (leached) and the small amount of clay matrix washed or leached out during weathering leaving a clean, high purity friable sandstone (or silica sand). The silica in solution has reprecipitated to form a silica cap or moved to a lower level forming a hard cemented sandstone or quartzite along valley walls or in fault zones.

This explanation is supported by shallow drilling carried out by Longworth and McKenzie Pty Ltd on behalf of Kaiser Aluminium in 1981 which showed higher silica values in the upper 10 metres and increasing Al₂O₃ and other impurities at depth.

The degree of metamorphism in the area is relatively low, and the development of hard, high purity quartzite appears to be related more to weathering and diagenetic processes than regional metamorphism.

4 QUARTZ SPECIFICATIONS FOR PREMIUM QUALITY SILICON

		Pioneer Pechiney	Simcoa	Mannesmann DeMag	Globe Metallurgical	Dow Corning
% SiO ₂	Min.		99.5	99.6 (99.5-99.7)	99.6	
% Al ₂ O ₃	Max.	0.30	0.15	0.12 (0.10-0.15)	0.10	0.15
% Fe ₂ O ₃	Max.	0.05	0.09	0.07 (0.06-0.095)	0.05	0.15
% TiO ₂	Max.	0.05	0.02		0.017	0.016
% CaO				0.037 (0.03-0.045)		0.05
% P ₂ O ₅						0.02
% V ₂ O ₅						0.002
% LOI	Max.		0.2	0.15 (0.1-0.2)	0.5	
Size(mm)			30-120		1" - 4" 60% + 1.5"	40 - 120

pp 11
2500
1500
140
500
200
20

Consistency of the physical and chemical characteristics of quartzite feed to a silicon smelter is very important. There is little tolerance for variations in impurity levels.

Quartzite must retain lump form at high temperatures to retain porosity in the furnace, ie must have thermal stability and not decrepitate when heated above 1000°C.

Indicative chemical specifications (maximum wt% unless otherwise indicated) for silicon for primary metallurgical and chemical applications are:

Primary Aluminium - 99.0% Si (min), 0.2% Al, 0.25% Fe, 0.10% Ti, 0.25% Cu, 0.05% Ca, 0.008% P, 0.05% C, 0.02% others, 0.20% others total

Chemical (Silicones) - 0.05% Ti, 0.05% P, 0.01% V (all maximum)

Aluminium and calcium can be reduced by refining silicon after tapping, however, other impurities from quartzite and carbon reductants report to the final product and cannot be removed.

5 QUARTZ REQUIREMENTS FOR 30,000 TPA SILICON SMELTER

Assumptions:

- 2.5 tonnes SiO₂ /tonne Si
- 20 year operation life
- feed size 25 - 120mm
- 40% losses (undersize) on crushing and wet screening

Require 75,000 tonnes SiO₂ per year smelter feed. Need to mine 125,000 tonnes SiO₂ (assume 50,000 tonnes rejected as fines < 25 mm). The quality of the lump quartzite feed can sometimes be upgraded appreciably, since the fines fraction typically contains a higher level of impurities.

Require mineable reserves of at least 2.5 million tonnes silica for 20 year operation.

6 EXPLORATION AT THE DIP RANGE (THOMAS MOUNTAIN) PROSPECT

From 1960 to 1987 MHA held a 310 km² Exploration Licence (EL43/70) covering the Dip Range which is underlain by the Detention Sub-Group Quartzite, considered prospective for silica of suitable quality for silicon and ferrosilicon production. Reconnaissance exploration and surface sampling by MHA led to a joint venture with BHP in 1975. BHP carried out bulk sampling and drilled two percussion drill holes at the Maynes Creek prospect (Jacob Quartzite) located in the east central part of the Exploration Licence, but quality requirements for silica were not met and the joint venture was terminated.

Consultants Longworth and McKenzie Pty Ltd (L & M) carried out an exploration programme over the northern half of EL43/70 in 1981 on behalf of Kaiser Aluminium Pty Ltd under a joint venture agreement with MHA. Most of their exploration activity was concentrated on the Dip Range No.1 prospect which extends 1.5 km north east from Hogarths Creek to a tributary of the Detention River (Figure 4). Prominent quartzite cliffs occur at both ends of the range but the ridge top is largely covered by quartzite scree. The programme included the excavation of five costeans, drilling 27 shallow percussion holes within the costeans and four vertical diamond drill holes (121 m total) to test the physical and chemical variations with depth in the quartzite/sandstone horizon and provide a basis for silica resource estimation.

The costeaning and percussion drilling on Dip Range north of Hogarths Creek (immediately northeast along strike from Thomas Mountain) indicated that the Dip Range was underlain by friable sandstone with isolated quartzite patches at least to the 15 m depth of testing. Results of the diamond drilling were also disappointing. In general the Detention Quartzite was described by L & M geologists as variably weathered to 15 m depth and resilicified at the surface to produce a siliceous cap and an underlying silica sand which grades down to an impure sandstone (refer Plate 6).

Longworth and McKenzie concluded that:

- there had been deep weathering and variable secondary silicification;
- below a leached zone, the rocks decrease in purity with depth with increasing Al₂O₃ (and decreasing SiO₂).

Kaiser subsequently withdrew from the joint venture with MHA. They sold out their Australian interests in silicion to Pioneer-Pechiney, who subsequently investigated Thomas Mountain as potential smelter feed for Electrona.

Shortly afterwards Monier Ltd drill tested an area about 100 metres north of Hogarths Creek and described the material as export quality glass sand (100-200 ppm Fe₂O₃).

In 1987 MHA sampled the cliffs on either side of Hogarths Creek and obtained permission to extract 4000 tonnes of high purity quartzite from Thomas Mountain (CML 33M/86). 4032 tonnes of quartzite were delivered to Temco for furnace trials. Average composition was 98.7% SiO₂, 0.2% Al₂O₃. Temco reported the quartzite was satisfactory for ferrosilicon production and had some favourable characteristics (lower power factor).

At Thomas Mountain, the quartzite dips at 45°NW. Plates 1 to 5 are photographs of Thomas Mountain, Thomas Mountain mine and a view of the crusher plant site and quartzite stockpiles.

A Temco geologist mapped Thomas Mountain and prospected the quartzite ridge for 500 metres along strike to the southwest.

The geologist with extensive experience in the area, considered that the quartzite formations were leached on the surface and had a silica enriched layer from 3-10 metre depth. He recommended to MHA that a hole should be drilled to test the quartzite sequence at Thomas Mountain for high grade sections at depth. A reverse circulation was collared on bench# 2 of the mined area and drilled to 102 metres at -45° on a southeast bearing. Cuttings were collected at 1 metre intervals, logged and analysed by BHP Temco (see Appendix 1).

The hole intersected medium to hard quartzite with several alternating beds of partly consolidated sandstone (Figure 5). Quality of the quartzite varied, with the highest grades occurring from 0 to 9.5 m and 52 to 69 m.

	%SiO ₂	%Al ₂ O ₃	%Fe ₂ O ₃ *	%TiO ₂
0-9.5 m	98.8	0.23	0.25	0.06
52-69 m	98.9	0.37	0.23	0.05

* BHP laboratory reported that values could be 0.2% Fe₂O₃ too high due to identified iron contamination from sample preparation.

This quality may be acceptable for ferrosilicon production but does not satisfy specifications for premium grade silicon. Some reduction in impurities may be achieved during crushing and high pressure wet screening, resulting in higher SiO₂.

Other quartzite beds intersected generally assayed less than 98.5% SiO₂ and 0.5-0.9% Al₂O₃ (reflecting higher sericite and clay impurities).

The BHP Temco geologist estimated that if the 17 metre thick quartzite bed intersected in the drill hole extended to surface and continued 400 metres southwest along strike, a potential silica resource of 1 million tonnes mineable by open pit could exist at Thomas Mountain. This tonnage would include material from the expected near surface silica enriched zone down to about 10 metres depth (Figure 6). Drilling would be required to prove up this resource.

Pioneer Silicon Industries Pty Ltd (PSI) investigated the Thomas Mountain mine site in 1988 to assess the quartzite quality for silicon smelter feedstock. Surface sampling of mullock and shallow drilling on benches #2 and #3 yielded hard, high purity quartzite. Average assays of samples collected by PSI are as follows:

	%Al ₂ O ₃	%Fe ₂ O ₃	%TiO ₂
Surface grab samples (3)	0.05	0.02	0.034
Percussion drilling Bench #2 (4 holes)	0.09	0.04	0.028
Percussion drilling Bench #3 (3 holes)	0.07	0.02	0.028

On the basis of site inspection and these quality assay results, PSI ordered a 200 tonne sample for testing at the Electrona silicon smelter. Bulk sample analyses of the 209 tonne shipment (1.2.89) were reported by PSI to be 0.11% Al₂O₃, 0.039% Fe₂O₃ and 0.025% TiO₂.

PSI obtained another bulk sample of crushed and sized quartzite (1"-4") in 1991 for furnace trials (704 tonnes). They reported to MHA that "the quartzite worked satisfactorily in the furnace once the effects of high Al₂O₃ were discounted. The Al₂O₃ levels were too high to do any more than trial the quartzite on a very limited basis". MHA considers that some contamination with schist may have occurred when the contractor crushed the samples at an off-site quarry. The Electrona smelter closed down a few months later (August 1991).

PSI sampled the Thomas Mountain stockpiles of crushed and sized quartzite in April 1991. This showed variable quality with two distinct distributions of material grading 0.1-0.15% Al_2O_3 and 0.35-0.5% Al_2O_3 .

The occurrence of the high alumina quartzite in the stockpiles highlighted the need for strict grade control at the time of mining. Due to inadequate controls, inferior quality quartzite from the lower bench #1 (blast hole sample analyses averaged 0.45% Al_2O_3 - range 0.1-0.7% Al_2O_3) had been mixed with better quality quartzite from the upper benches.

There is insufficient geological information available at the Thomas Mountain prospect to enable an estimation of quartzite resources of suitable quality for chemical or primary metallurgical grade silicon production. TiO_2 and Al_2O_3 levels often exceed smelter specification limits and are a cause for concern in proving up tonnage of suitable quality quartzite at this location.

The northeastern strike extension of the high grade quartzite horizon is limited to a maximum of 50 metres by percussion drilling carried out on behalf of Kaiser Aluminium in 1981 (quartzite beds are deeply weathered to friable sand - refer plate 6). The Temco geologist suggested in 1987 that drilling was required to test the potential extension of the quartzite for up to 400 metres southwest of the mine area. This has not been done to date.

Assuming the high grade quartzite bed of suitably quality for silicon production is 10 metres thick (maximum), and extends 30 metres up dip and 500 metres along strike then the potential tonnage at Thomas Mountain would be about 400,000 tonnes. This would be relatively easy to mine by open pit methods.

Exploration drilling will be required to test this potential and investigate possible extensions further along strike to the southwest. Two 50 metre holes (-45° SE) at 200 metre intervals southwest of the Thomas Mountain open cut mine are proposed.

7 HEBE RIVER PROSPECT (Figure 7)

A 150 metre gorge section in the upper Hebe River shows extensive glassy silicification of Detention Sub-group quartzites which locally form a 5-6 km long, NE-SW trending strike ridge along which bedding is commonly overturned and steeply dipping to the northwest.

The strong silicification in the gorge section has formed a steep ridge of extremely hard, pure quartzite (Plates 9 and 10.) Sampling of outcrops representative of about half of the 150 metre long silicified zone (only about 50% exposure due to overburden) confirmed the high quality with grades of 9 samples averaging 99.82% SiO₂, 0.03% Al₂O₃, 0.03% Fe₂O₃, 0.013% TiO₂ and 0.09% LOI (Figure 8). Detailed analyses of samples collected from the Hebe River prospect are presented in Appendix 3.

At one location exposures show that the vitreous quartzite extends for 30-40 metres along strike. The tonnage potential at the Hebe River prospect is highly dependent on proving up the strike extent and depth of dense quartzite in the 100 metre wide (true width) high grade sampled section.

Further exploration is required to determine the tonnage potential of this intensely silicified zone and search for other similar deposits which may be formed as a result of weathering effects along a cross-cutting fault. The silicification may also be related to groundwater movements under Tertiary basalt cover which occurs near the gorge section (silicified gravels commonly occur under Tertiary basalt at other locations in NW Tasmania).

Drilling is required to determine the tonnage potential of the high purity quartzite in the gorge section, but it could be about 300,000 to 500,000 tonnes which would be mineable by open pit with low stripping ratio (assuming the silicified zone is 40 metres wide, 150 metres long and 20-30 metres deep).

Southwest of the gorge section, along the crest of the strike ridge, many of the surface outcrops are also silicified. Sampling of outcrops along the Hebe River to the south and southwest of the silica enriched gorge section also indicated that silicification in the sedimentary sequence was patchy.

Prospecting for similar silica enriched zones within the Detention Sub-group quartzites could locate other similar deposits in the general area. A specialist study of the origin of silicification in quartzites in NW Tasmania would greatly assist reconnaissance

exploration and allow a more reliable assessment of tonnage potential from surface inspection.

8 MEUNNA PROSPECT

The Meunna Trig and Pokes Road quartzite prospects occur in the Jacob Quartzite formation. Inspection of a road gravel quarry on Pokes Road showed it to contain a 10 metre thick bed of medium hard orthoquartzite dipping 40°NW and flanked by siltstone. (Plate 8.)

The quartzite appears similar to weakly silicified sandstone/quartzite on Dip Range and is unlikely to be suitable for premium quality silicon production.

MHA records, include analyses of seven samples grading over 99.7% SiO₂, 0.04-0.07% Al₂O₃, 0.02-0.04% Fe₂O₃ and 0.02-0.08% TiO₂. However, these samples are described as sand from nearby quartzite outcrops. No analyses are available of rock samples from the area.

The Meunna Trig prospect on Myalla Road is also described as a thin quartzite bed (few metres thick) in siltstones.

These prospects do not warrant further exploration.

9 THOMAS MOUNTAIN MINE PRODUCTION

In 1987 MHA arranged for a contractor to mine about 8000 tonnes of quartzite to satisfy furnace trials for silicon and ferrosilicon production. Three benches were mined from a dip slope on the NW face of Thomas Mountain, immediately adjacent to Hogarths Creek. The upper two benches #2 and #3 produced high purity quartzite. Higher alumina quartzite was mined from the lowest bench #1 near creek level. The run of mine quartzite was crushed and sized with 1"-4" product being stockpiled separately from undersize material (<1").

Details of samples delivered to Temco for tests for ferrosilicon production and Pioneer Silicon Industries at Electrona for silicon production are as follows:

TEMCO (Bell Bay)

- June 1987 4032 tonnes quartzite grading 98.7% SiO₂, 0.2% Al₂O₃.
Furnace trial reported as satisfactory with good physical characteristics and some possible benefits such as improved power efficiency from use of Thomas Mountain quartzite.
- November 1992 258 tonnes grading, 99.5% SiO₂, 0.18% Al₂O₃,
0.1% Fe₂O₃ and 0.05% TiO₂ delivered to Temco for further trials. Temco subsequently announced that they were no longer producing ferrosilicon (switched to silico-manganese).

PIONEER (Electrona)

- February 1991 209 tonnes grading, 0.11% Al₂O₃, 0.04% Fe₂O₃
and 0.025% TiO₂
- April 1991 204 tonnes delivered. No analyses available but reported to contain higher than desirable Al₂O₃.

Limited furnace trials were carried out using this bulk sample before Electron silicon smelter closed down in August 1991.

Pioneer advised MHA that the quartzite worked satisfactorily in the furnace once the effects of high Al₂O₃ content were discounted. The Al₂O₃ levels were deemed too high to do any more than trial the quartzite on a very limited basis. MHA considers that the high Al₂O₃ may be in part attributable to contamination at the contractor's crusher site with impure sediments.

HOBART GLASS

A 6000 tonne shipment of sand from a pit 150 metres north of Thomas Mountain was sent to the Hobart Glass Company in 1992. The sand is of high purity. Analysis after washing averaged 99.92% SiO₂, 180 ppm Al₂O₃, 240 ppm TiO₂, 90 ppm Fe₂O₃, 1.5 ppm Cr and 0.06% LOI. A copy of the chemical and particle size analyses is presented in Appendix 2.

10 POTENTIAL UPGRADING OF SILICA BY CRUSHING AND WET SCREENING

An improvement in the quality of run of mine quartzite can be achieved by crushing and wet screening. This is attributable to the rejection of clay filled joints and fissures which contain most of the aluminous, ferriferous and titaniferous impurities.

A large grab sample of quartzite from Thomas Mountain was forwarded to Amdel to assess possible upgrading from crushing and wet screening. Results confirmed an improvement in quality.

	%SiO ₂	Al ₂ O ₃	%Fe ₂ O ₃	%TiO ₂	ppmP ₂ O ₅	ppmV ₂ O ₅	%LOI
+1"-3"	99.2	0.26	0.03	0.034	25	4	0.07
-1"	99.1	0.27	0.06	0.044	35	5	0.06

SiO₂ was analysed by HF digestion and ICP analysis of residue to determine minor elements. SiO₂ by difference after analysis of minor elements was determined to be 99.5% compared with 99.2% by the classical wet digestion method.

11 THERMAL STABILITY

Globe Metallurgical tested one piece of Thomas Mountain quartzite in an oven at 950°C for 15 minutes. The sample fragmented into five pieces.

Temco (BHP) trialed Thomas Mountain quartzite from 24/2/91 to 31/3/91 and stated that it was suitable feed for ferrosilicon production provided it was price competitive with the company's own resources.

Longworth and McKenzie carried out thermal stability and decrepitation tests on a number of quartzite samples from Thomas Mountain in 1981 using the Temco technique (1000°C for one hour). Results were considered acceptable based on Temco parameters.

Dow Corning decrepitation tests indicated that Hebe River quartzite had better thermal characteristics than Thomas Mountain quartzite. After heating the Hebe River quartzite to 1200°C and holding at that temperature for 15 minutes, only 2.5% of the sample passed through a 4mm screen on tumbling (cf 6% for Thomas Mountain sample). 5 - 6% is considered acceptable for silicon smelting.

12 CONCLUSIONS

Insufficient exploration has been carried out within MHA tenements to establish resources of suitable quality quartzite to support a 30,000 tpa silicon smelter for 20-30 years. The Hebe River prospect which offers the best potential is relatively unexplored. More detailed mapping, including special studies to obtain an understanding of the origin of the intense silicification is required before undertaking a drilling programme to delineate the resource and establish if chemical and physical characteristics are satisfactory for premium grade silicon production.

The extent of silicification along strike and at depth will have an important bearing on tonnage potential of the 100 metre wide vitreous quartzite zone exposed at Hebe River. If the silicification is related to precipitation of silica from percolating groundwater in a fault zone (as considered likely) then resources may be limited to a few hundred thousand tonnes. Potential exists, however, for the discovery of other similar deposits in the area by targeted exploration.

Thomas Mountain represents a less attractive prospect for a significant high purity quartzite resource, although some potential exists southwest from the mine area. At least two shallow percussion drill holes would establish whether further exploration was required.

On the basis of current information, the potential for resources adequate for more than a few years supply for a silicon smelter would appear unlikely. Grade control of any eventual mining operation would be essential to ensure smelter specifications are satisfied.

TiO₂ impurities in the Detention Sub-Group orthoquartzites/silicified arenites or sandstones commonly exceed silicon smelter specifications (0.02% TiO₂) and may represent a problem at Thomas Mountain and other prospects in the area. Fe₂O₃ and Al₂O₃ contents are less of a problem in near surface exposures, but do appear to increase consistently at depth below the water table to unacceptable levels for primary grade silicon. More detailed analyses of quartzites in the Detention Sub-group indicate that P₂O₅ and V₂O₅ contents are low.

Some of the quartzite resources which do not meet chemical or primary metallurgical grade silicon could be developed for supply to ferrosilicon producers. The tonnage potential for lower grade quartzite which satisfies specifications for secondary metallurgical grade silicon and ferrosilicon production are considerably larger at Thomas Mountain (possibly 1-2 million tonnes).

Norman Shepherd

Norman Shepherd
Mineral Resource Management Pty Ltd

SAMPLE INTERVAL (M)	SiO2	Al2O3	Fe2O3	Cr2O3	TiO2	CaO	MnO	Na2O	K2O	MgO	P2O5	GEOLOGICAL LOG
0-2	98.20	0.25	0.20	0.02	0.05	< 0.01	0.1	< 0.1	0.1	0.01	0.03	0 - 2m Hard, Fine Grained White Quartzite
2-3	99.00	0.19	0.30	0.02	0.07	< 0.01	0.1	0.2	< 0.1	0.01	0.03	2 - 5m As above with soft patches up to 300mm in width
3-4	98.90	0.30	0.30	0.02	0.06	< 0.01	0.1	0.2	0.1	0.01	0.03	
4-5	99.40	0.15	0.30	0.03	0.08	< 0.01	0.1	< 0.1	< 0.1	0.01	0.03	
5-6	98.40	0.44	0.30	0.03	0.08	< 0.01	0.1	0.5	0.1	0.01	0.03	5 - 9.5m As above and fairly hard, fine to medium grainsize
6-7	98.70	0.36	0.20	0.02	0.07	< 0.01	0.1	0.4	0.1	0.01	0.03	
7-8	99.10	0.10	0.30	0.02	0.06	< 0.01	0.1	0.3	< 0.1	0.01	0.03	
8-9	99.20	0.22	0.20	0.02	0.07	< 0.01	0.1	< 0.1	0.1	0.01	0.03	9.5 - 13m Soft, Partly consolidated sand, fine grained. Possible limit of oxidised zone at 13 metres
9-10	98.90	0.05	0.20	0.02	0.05	< 0.01	0.1	0.5	< 0.1	0.02	0.03	
10-11	99.40	0.06	0.20	0.02	0.11	< 0.01	0.1	< 0.1	< 0.1	0.01	0.03	
11-12	98.80	0.37	0.40	0.04	0.06	< 0.01	0.1	0.1	0.1	0.02	0.04	13-14m Dark Brown unconsolidated fine grained sand
12-13	99.20	0.24	0.30	0.02	0.09	< 0.01	0.1	< 0.1	0.1	0.02	0.04	
13-14	98.10	0.92	0.30	0.02	0.06	< 0.01	0.1	0.3	0.1	0.03	0.04	
14-15	98.40	0.68	0.30	0.02	0.06	< 0.02	0.1	0.1	0.2	0.04	0.04	14-20m Harder, fine to medium grained quartzite/sandstone, light brown to cream in colour
15-16	98.60	0.65	0.30	0.02	0.06	< 0.01	0.1	< 0.1	0.2	0.01	0.03	
16-17	98.50	0.79	0.30	0.02	0.07	< 0.01	0.1	< 0.1	0.1	0.02	0.04	
17-18	98.50	0.78	0.30	0.02	0.07	< 0.01	0.1	< 0.1	0.2	0.03	0.03	20-25m Medium hard fine to medium grained light brown to cream coloured quartzite
18-19	98.20	0.73	0.30	0.02	0.06	< 0.01	0.1	0.3	0.2	0.03	0.04	
19-20	98.20	0.86	0.40	0.02	0.06	< 0.01	0.1	< 0.1	0.3	0.03	0.04	
20-21	98.20	0.66	0.30	0.02	0.06	< 0.01	0.1	0.3	0.2	0.03	0.03	25-26m Soft, fine grained cream coloured sand.
21-22	98.10	0.94	0.40	0.02	0.07	< 0.01	0.1	< 0.1	0.3	0.01	0.04	
22-23	98.10	0.84	0.40	0.03	0.06	< 0.01	0.1	0.1	0.2	0.03	0.03	
23-24	98.20	0.86	0.40	0.03	0.08	< 0.01	0.1	0.1	0.2	0.01	0.03	26-32m Medium hard cream to white, fine grained quartzite.
24-25	98.30	0.79	0.40	0.03	0.06	< 0.01	0.1	< 0.1	0.2	0.01	0.03	
25-26	98.30	0.85	0.40	0.02	0.07	< 0.01	0.1	< 0.1	0.2	0.01	0.03	
26-27	98.30	0.66	0.50	0.03	0.05	< 0.01	0.1	< 0.1	0.2	0.01	0.04	32-33m Dark brown med grained, medium hard quartzite with some water.
27-28	98.50	0.59	0.40	0.02	0.06	< 0.01	0.1	< 0.1	0.2	0.01	0.03	
28-29	98.30	0.56	0.40	0.02	0.05	< 0.01	0.1	0.3	0.2	0.09	0.04	
29-30	98.50	0.66	0.40	0.02	0.05	< 0.01	0.1	< 0.1	0.2	0.02	0.03	33-35m Medium hard, fine grained, cream coloured quartzite.
30-31	98.60	0.61	0.40	0.02	0.05	< 0.01	0.1	< 0.1	0.1	0.02	0.03	
31-32	98.10	0.79	0.40	0.02	0.06	< 0.01	0.1	0.2	0.2	0.02	0.03	
32-33	98.60	0.63	0.30	0.02	0.05	< 0.01	0.1	< 0.1	0.2	0.01	0.03	35-43m Soft brown quartzite grading to medium hard lighter brown quartzite at 43m. Material generally fine grained and water in hole from 35m onwards. Hole abandoned at 43m due to loss of bit.
33-34	97.80	1.04	0.50	0.02	0.08	< 0.01	0.1	< 0.1	0.3	0.01	0.03	
34-35	97.70	1.02	0.50	0.03	0.08	< 0.01	0.1	0.2	0.3	0.05	0.03	
35-36	98.80	0.48	0.30	0.02	0.06	< 0.01	0.1	0.1	0.1	0.02	0.04	43-50m Hard, fine grained, white to cream coloured quartzite.
36-37	98.90	0.44	0.20	0.02	0.04	< 0.01	0.1	< 0.1	0.1	0.01	0.03	
37-38	98.80	0.56	0.40	0.03	0.04	< 0.01	0.1	< 0.1	0.2	0.01	0.03	
38-39	NO SAMPLE											N.B. The overlapping interval between bores DRP1A and DRP1B, ie 40 to 43 metres, indicates some variation in colour and may give an indication of degree of variation
39-40	98.90	0.42	0.20	0.02	0.04	< 0.01	0.1	0.1	0.1	0.01	0.03	
40-41	98.70	0.55	0.50	0.03	0.05	< 0.01	0.1	0.3	0.1	0.01	0.03	
41-42	98.70	0.48	0.40	0.03	0.04	< 0.01	0.1	< 0.1	0.2	0.01	0.03	43-50m Hard, fine grained, white to cream coloured quartzite.
42-43	98.40	0.61	0.50	0.03	0.05	< 0.01	0.1	< 0.1	0.2	0.01	0.03	
43-44	98.00	0.88	0.40	0.03	0.07	< 0.01	0.1	< 0.1	0.3	0.05	0.04	
44-45	98.20	0.79	0.50	0.02	0.07	< 0.01	0.1	< 0.1	0.2	0.01	0.02	N.B. The overlapping interval between bores DRP1A and DRP1B, ie 40 to 43 metres, indicates some variation in colour and may give an indication of degree of variation
45-46	98.10	0.86	0.40	0.02	0.06	< 0.01	0.1	0.2	0.3	0.03	0.03	
46-47	98.10	0.81	0.50	0.03	0.07	< 0.01	0.1	< 0.1	0.2	0.01	0.03	

*NOTE: The Fe2O3 values given above are known to be overstated by up to 0.2% due to sample preparation in steel grinding mills resulting in some "pick up" of iron.

BHP-TEMCO LOG AND ANALYSES OF CHIPS FROM PERCUSSION HOLE AT THOMAS MOUNTAIN.

APPENDIX I

170058

*
BORE NO. DRP1A/B

SAMPLE INTERVAL (M)	SiO2	Al2O3	Fe2O3	Cr2O3	TiO2	CaO	MnO	Na2O	K2O	MgO	P2O5	GEOLOGICAL LOG
47-48	98.30	0.74	0.50	0.04	0.06	< 0.01	0.1	< 0.1	0.2	0.01	0.03	along strike. Ground water level intersected at 45m.
48-49	98.30	0.73	0.60	0.02	0.06	< 0.01	0.1	< 0.1	0.2	0.01	0.03	
49-50	98.00	0.91	0.40	0.03	0.07	< 0.01	0.1	0.1	0.3	0.01	0.03	50-52m Medium to coarse grained unconsolidated sand with considerable water, light brown in colour.
50-51	98.40	0.65	0.30	0.02	0.06	< 0.01	0.1	0.1	0.1	0.05	0.03	
51-52	98.80	0.52	0.30	0.02	0.05	< 0.01	0.1	0.1	0.1	0.11	0.03	
52-53	98.70	0.31	0.30	0.03	0.05	< 0.01	0.1	0.2	0.1	0.03	0.03	52-55m Hard, fine grained, light brown quartzite.
53-54	98.80	0.31	0.20	0.02	0.05	< 0.01	0.1	0.2	0.1	0.08	0.03	55-59m Dark grading to light brown medium hard, fine to medium grained quartzite.
54-55	98.90	0.39	0.20	0.02	0.06	< 0.01	0.1	< 0.1	0.1	0.02	0.03	
55-56	98.50	0.60	0.30	0.02	0.06	< 0.01	0.1	0.1	0.2	0.02	0.03	
56-57	98.60	0.40	0.30	0.03	0.05	< 0.01	0.1	0.3	0.1	0.01	0.03	59-60m As above but cream in colour.
57-58	98.70	0.55	0.20	0.02	0.06	< 0.01	0.1	0.1	0.2	0.01	0.03	
58-59	99.10	0.33	0.20	0.02	0.05	< 0.01	0.1	< 0.1	0.1	0.02	0.03	
59-60	98.70	0.50	0.20	0.03	0.06	< 0.01	0.1	0.1	0.2	0.02	0.03	60-69m Alternating hard and soft fine to medium grained brown quartzite - predominantly hard material.
60-61	99.00	0.32	0.30	0.03	0.05	< 0.01	0.1	0.1	0.1	0.02	0.02	
61-62	99.00	0.29	0.20	0.02	0.04	< 0.01	0.1	0.1	0.1	0.08	0.03	
62-63	99.10	0.26	0.20	0.03	0.04	< 0.01	0.1	0.1	0.1	0.05	0.03	69-82m Medium to fine grained, medium hard (some soft patches of minor extent) white to light brown quartzite. Notable softer patch from 76 to 79m.
63-64	99.20	0.22	0.20	0.02	0.03	< 0.01	0.1	< 0.1	0.1	0.02	0.04	
64-65	98.90	0.42	0.20	0.02	0.06	< 0.01	0.1	0.1	0.1	0.02	0.03	
65-66	99.10	0.34	0.20	0.02	0.05	< 0.01	0.1	< 0.1	0.1	0.02	0.02	82-85m Soft, medium grained cream to white quartzite.
66-67	99.10	0.37	0.20	0.02	0.05	< 0.01	0.1	< 0.1	0.1	0.01	0.02	
67-68	99.20	0.39	0.20	0.02	0.04	< 0.01	0.1	< 0.1	0.1	0.03	0.02	
68-69	99.20	0.29	0.20	0.02	0.04	< 0.01	0.1	< 0.1	0.1	0.01	0.03	85-86m Hard material of similar description to above.
69-70	98.60	0.73	0.20	0.02	0.08	< 0.01	0.1	< 0.1	0.2	0.01	0.03	
70-71	98.70	0.62	0.20	0.01	0.06	< 0.01	0.1	< 0.1	0.2	0.03	0.03	
71-72	98.70	0.54	0.20	0.02	0.06	< 0.01	0.1	< 0.1	0.2	0.07	0.03	86-90m Soft unconsolidated sand. Fine to medium grain size, cream in colour.
72-73	98.60	0.76	0.20	0.02	0.06	< 0.01	0.1	< 0.1	0.2	0.02	0.03	
73-74	98.60	0.79	0.20	0.02	0.07	< 0.01	0.1	< 0.1	0.2	0.01	0.03	
74-75	98.50	0.65	0.30	0.02	0.08	< 0.01	0.1	< 0.1	0.2	0.01	0.03	90-94m Darker material as above.
75-76	98.30	0.72	0.20	0.03	0.07	0.11	0.2	< 0.1	0.1	0.10	0.03	
76-77	99.10	0.31	0.20	0.03	0.04	0.06	0.1	< 0.1	0.1	0.07	0.03	
77-78	98.80	0.37	0.10	0.01	0.06	0.05	0.1	< 0.1	0.1	0.22	0.03	90-94m Darker material as above.
78-79	98.90	0.41	0.20	0.02	0.05	< 0.01	0.1	0.2	0.1	0.14	0.03	
79-80	98.70	0.55	0.20	0.02	0.06	0.01	0.1	0.1	0.2	0.10	0.03	
80-81	97.60	1.22	0.20	0.02	0.12	< 0.01	0.1	0.1	0.4	0.01	0.03	90-94m Darker material as above.
81-82	98.50	0.63	0.20	0.03	0.07	< 0.01	0.1	0.1	0.2	0.04	0.03	
82-83	99.00	0.23	0.40	0.03	0.04	0.01	0.1	< 0.1	0.1	0.02	0.02	
83-84	98.80	0.23	0.40	0.02	0.04	< 0.01	0.1	0.2	0.1	0.03	0.03	90-94m Darker material as above.
84-85	97.80	1.06	0.40	0.04	0.09	< 0.01	0.1	0.1	0.3	0.05	0.03	
85-86	98.90	0.32	0.40	0.04	0.04	< 0.01	0.1	< 0.1	0.1	0.03	0.03	
86-87	96.90	1.46	0.40	0.04	0.12	< 0.01	0.1	0.4	0.5	0.01	0.03	90-94m Darker material as above.
87-88	98.10	0.89	0.30	0.04	0.07	0.06	0.2	< 0.1	0.2	0.07	0.03	
88-89	96.50	1.92	0.40	0.04	0.15	< 0.01	0.1	0.2	0.6	0.02	0.03	
89-90	98.80	0.30	0.40	0.03	0.05	< 0.01	0.1	0.1	0.1	0.02	0.03	90-94m Darker material as above.
90-91	99.00	0.27	0.40	0.04	0.04	0.07	< 0.1	< 0.1	0.1	0.01	0.02	
91-92	99.10	0.25	0.40	0.04	0.05	< 0.01	0.1	< 0.1	0.1	0.01	0.02	
92-93	99.20	0.18	0.40	0.03	0.03	< 0.01	0.1	< 0.1	0.1	0.01	0.02	

*NOTE: The Fe2O3 values given above are known to be overstated by up to 0.2% due to sample preparation in steel grinding mills resulting in some "pick up" of iron.

*
BORE NO. DRP1A/B

SAMPLE INTERVAL (M)	SiO2	Al2O3	Fe2O3	Cr2O3	TiO2	CaO	MgO	Na2O	K2O	MnO	P2O5	GEOLOGICAL LOG
93-94	98.40	0.62	0.40	0.04	0.07	< 0.01	0.1	< 0.1	0.1	0.05	0.03	
94-95	98.90	0.33	0.40	0.04	0.04	0.05	0.1	< 0.1	0.1	0.05	0.04	94-95m Soft uncemented, fine grained white sand.
95-96	98.80	0.39	0.30	0.04	0.04	< 0.01	0.1	0.2	0.1	0.02	0.03	95-99m Medium to fine grained unconsolidated soft sand, cream in colour.
96-97	98.70	0.48	0.40	0.07	0.07	< 0.01	0.1	< 0.1	0.1	0.01	0.03	
97-98	98.80	0.45	0.40	0.06	0.06	< 0.01	0.1	< 0.1	0.1	0.01	0.03	
98-99	98.70	0.49	0.30	0.05	0.05	< 0.01	0.1	< 0.1	0.1	0.01	0.03	
99-100	99.20	0.20	0.30	0.04	0.04	< 0.01	0.1	< 0.1	0.1	< 0.01	0.03	99-100m Soft uncemented, fine grained white sand.
100-101	99.00	0.38	0.40	0.04	0.04	< 0.01	0.1	< 0.1	0.1	0.01	0.40	100-102m As for interval 95-99m - hole abandoned due to cave in of sand.
101-102	98.80	0.45	0.30	0.05	0.05	< 0.01	0.1	< 0.1	0.1	0.01	0.03	
* NOTE: The Fe2O3 values given above are known to be overstated by up to 0.2% due to sample preparation in steel grinding mills resulting in some "pick up" of iron.												EOH

MINERAL HOLDINGS AUSTRALIA PTY. LIMITED

INC. IN VIC.

Correspondence to:

2nd FLOOR,
135 COLLINS STREET,
MELBOURNE, VIC., AUSTRALIA, 3000
TELEPHONE: (03) 654 7999 (2 LINES)
FAX: (03) 650 3855

1st May, 1991

A P P E N D I X 2

(THOMAS MOUNTAIN)

<u>Composition</u>	<u>Size</u>	<u>% Retained</u>
SiO ₂ 99.91%	850u	2.8
Al ₂ O ₃ 180 ppm	600u	9.2
Fe ₂ O ₃ 90 ppm	425u	27.4
TiO ₂ 240 ppm	250u	60.0
MgO <100 ppm	150u	81.4
CaO <100 ppm	106u	89.5

SILICA FLOUR (CHAMPIONS ROAD)

Typical Characteristics

<u>Composition</u>	<u>Size</u>	<u>FSD</u> <u>% Retained</u>
SiO ₂ 99.60%	850u	13.5
Al ₂ O ₃ 440 ppm	600u	15.7
Fe ₂ O ₃ 100 ppm	425u	17.2
TiO ₂ 516 ppm	250u	22.4
MgO 335 ppm	150u	27.9
CaO 242 ppm	106u	34.6
	75u	41.3
	38u	60.3

Please note that the characteristics detailed above relate to unbeneficiated materials (i.e. no screening, washing, etc.). This Company is in process of establishing forward sales for all of its silica resources, and is currently producing lump silica for use by TEMCO and Pioneer Silicon Industries in Tasmania.

Mar 27 '91 14:58 ncl hcl hcl 002 721718

FACSIMILE TRANSMITTAL FORM

170062



Australian Glass Manufacturers Company
HOBART

DATE: 27/3/91

SENDER: H. Woolley

ADM REF: 01-6547999

TO: Mineral Holdings Aust P.S.Y. Limited

ATTN: Neil Thomas

SUBJECT: THOMAS HOUSTON SAND

(A Unit of A.G. Operations Pty. Ltd. Inc. in Victoria)
110 Gormanston Road, Moorabool, TARDAGLIA, 3000
Postal Address: Box 203 P.O. Moorabool 3000
Telephone: 74 0000
Telex: 88183 - AGL10

FAX NO. (002) 72 1718

INT. FAX No. 0011 61 02 72 1718

NOTE: Please Advise by telex if any parts of transmission have failed.

9

4/7/91

No. of PAGES (including this page)

AS PROMISED YOUR SAND WAS SENT TO OUR LABORATORY FOR ANALYSIS AND THE RESULTS ARE SET OUT BELOW, WE ARE NOT IN A POSITION TO DO A TRIAL AT THE MOMENT, I WILL CONTACT YOU SHOULD THE NEED ARISE TO USE THOMAS HOUSTON SAND.

AGL ENGINEERING SERVICES PTY LTD				14-MAR-91 14120	
101 410816 HQ THOMAS NT 12/90 R942				14-MAR-91 12138	
CONCENTRATION				AP18AND	
SiO2+LO	Na2O	K2O	CaO	MgO	Al2O3
99.92%	0.012%	0.01%	0.01%	0.01%	0.018%
TiO2	Fe2O3	OP203	LOI		
0.024%	0.004%	1.48ppm	0.06%		

Regards
Nellay Woolley

APPENDIX 4

ANALYSES OF SURFACE ROCK CHIP SAMPLES FROM HEBE RIVER PROJECT, (REFER FIGURE 8)

Sample No.	Distance	Sample width	Estimated True Width	Field Description			Chemical Analysis											A1203/K20	
				Colour	Hardness	Rock Type	Fe2O3	Al2O3	CaO	TiO2	P2O5	V2O5	Na2O	K2O	MgO	MnO	LoI		SiO2
HR1	0-20	20	15	W	H	SS	0.007	0.02	0.004	0.016	0.001	0.0003	0.004	0.0055	0.003	0.0001	0.15	99.79	4
	20-25			Creek bed on hard rock															
2	25-45	20	15	W	H	SS/Q	0.008	0.03	0.0032	0.012	0.004	0.0001	0.003	0.006	0.002	0.00009	0.21	99.72	5
3	0-10	10	8	W	H	"	0.04	0.03	0.003	0.013	0.001	<0.0003	0.003	0.004	0.005	<0.002	0.10	99.80	7.5
4	20	10	8	W	H	"	0.02	0.03	<0.003	0.012	0.001	<0.0003	0.002	0.004	0.003	<0.002	0.08	99.84	7.5
5	30	10	8	W	H	"	0.02	0.02	<0.003	0.011	0.001	<0.0003	0.002	0.004	<0.003	<0.002	0.06	99.87	5
6	40	10	8	W	H	"	0.05	0.03	0.003	0.021	0.001	<0.0003	0.003	0.005	0.004	0.004	0.07	99.80	4.6
	52	12																	
7	60	8	6	W	H	"	0.03	0.03	<0.003	0.013	0.001	<0.0003	0.003	0.004	0.003	<0.002		99.83	7.5
	67																		
	73	6	5	OW	Soft (friable)	SS													
	76																		
8	80	4	3			SS/Q	0.04	0.03	<0.003	0.012	0.001	<0.0003	0.003	0.005	0.003	0.01	0.05	99.84	6
	93	13	10																
9	107	14	11	W	V.H.	Vitreous quartzite	0.04	0.02	0.003	0.009	0.001	<0.0003	0.002	0.004	<0.003	0.009	0.05	99.86	5
10	0-10	10	8	OW	H	SS	0.04	1.00	0.005	0.056	0.005	0.001	0.011	0.30	0.039	<0.001	0.22	96.3	3.3
11	20	10	8	OW	H	SS	0.03	0.58	0.005	0.035	0.005	0.001	0.009	0.17	0.025	<0.001	0.21	97.8	3.4
12	30	10	8	OW	H	SS	0.02	0.26	0.006	0.026	0.005	0.000	0.006	0.07	0.013	<0.001	0.21	98.9	3.7
13	0-3	3	3	W	H	SS	0.15	0.59	0.001	0.21	0.013	0.000	0.013	0.14	0.037	<0.001	0.43	97.3	4.2
	21																		
14	24	3	3	W, Br	H, S	SS, Sch													
	57	33																	
15	60	3	3	OW	H, S	"													
16	75	15	10	OW	H, S	"	0.20	6.30	0.007	0.18	0.012	0.003	0.056	1.86	0.18	<0.001	0.92	84.5	3.4

170063

S. No.	Distance	Sample width	Estimated True Width	Colour	Hardness	Rock Type	Chemical Analysis													
							Fe2O3	Al2O3	CaO	TiO2	P2O5	V2O5	Na2O	K2O	MgO	MnO	LoI	SiO2	Al2O3/K2O	
17	88	13	9	OW, LB	H, S	SS, Sch	0.21	4.92	0.006	0.13	0.009	0.002	0.046	1.46	0.125	<0.001	0.81	88.4	3.4	
98	10			-																
18	108	10	7	OW, LB	H, S	SS	0.04	0.93	<0.001	0.05	0.005	0.001	0.009	0.23	0.031	<0.001	0.23	96.8	4.0	
110	2			-																
19	116	6	4	W	V.H	SS, Q, Sch	0.02	0.385	0.002	0.026	0.004	0.001	0.007	0.105	0.019	<0.001	0.13	96.9	3.6	
123	7			-																
20	127	4	3	OW, L Br	H	SS, Sch	0.014	0.245	0.002	0.026	0.004	0.000	0.005	0.056	0.012	<0.001	0.03	98.6	4.4	
130	3			-																
21	138	8	6	OW	H	SS	0.019	0.475	0.003	0.032	0.006	0.001	0.007	0.125	0.018	<0.001	0.18	98.4	3.8	
152	14			-																
22	162	10	7	OW	H	SS	0.02	0.610	0.006	0.034	0.005	0.001	0.008	0.17	0.025	<0.001	0.19	98.0	3.6	
23	172	10	7	OW	H	SS	0.024	0.53	0.005	0.032	0.006	0.001	0.007	0.135	0.022	<0.001	0.20	98.1	3.9	
24	182	10	7	OW	H	SS	0.018	0.80	<0.001	0.036	0.005	0.001	0.010	0.22	0.028	<0.001	0.16	97.2	3.6	
25	200	18	13	OW	H	SS	0.015	0.50	0.006	0.025	0.004	0.001	0.006	0.115	0.019	<0.001	0.12	98.4	4.3	
26	210	10	7	OW	H	SS	0.265	0.445	0.003	0.033	0.007	0.001	0.008	0.12	0.017	0.001	0.38	97.9	3.7	
27	220	10	7	OW	H	SS	0.26	0.87	0.006	0.031	0.005	0.001	0.012	0.26	0.029	<0.001	0.19	97.1	3.3	
28	225	5	3	OW	H	SS	0.074	0.31	0.002	0.036	0.006	0.000	0.007	0.076	0.013	<0.001	0.13	98.3	4.1	
237	12			-																
29	243	16	11	OW	H	SS	0.012	0.39	0.006	0.034	0.004	0.001	0.007	0.094	0.017	<0.001	0.15	98.6	4.1	
30	260	17	12	W, LB	S	SS	0.013	0.28	0.004	0.042	0.003	0.000	0.006	0.076	0.014	<0.001	0.18	98.3	3.7	
31	274	14	10	OW	S	SS														
				-																
32	0-17	17	12	OW	H, S	SS														
33	24	7	5	OW	S	SS														
	52																			
34	62	10	7	OW	H	SS														

170064

S No.	Distance	Sample width	Estimated True Width	Dur	Hardness	Rock type	Chemical Analysis										Al2O3/K2O			
							Fe2O3	Al2O3	CaO	TiO2	P2O5	V2O5	Na2O	K2O	MgO	MnO		LoI	SiO2	
35	78	16	11	OW	H	SS														
36		8	6	OW	H,S	SS														
37	0-5	5		OW,LBr	H	SS,Sch														
38	15	10		LBr		-														
39	30	15		OW,LBr	H	vitreous quartzite														
	38	8		W	H	SS and vitreous quartzite														
40		7	7	OW,Br	S	SS, Sch														
41		12	12	OW,LBr	H	SS	0.011	0.033	0.005	0.045	0.003	0.00	0.004	0.007	0.008	<0.001	0.16	99.5	4.7	
42		17	17	OW	H	SS/Q	0.038	1.58	0.006	0.045	0.004	0.001	0.019	0.485	0.06	<0.001	0.33	94.4	3.3	
43		30	30	OW	H	SS/Q	0.007	0.115	0.009	0.008	<0.001	0.000	0.011	0.033	0.011	<0.001	0.13	99.3	3.5	
44		2	2	OW,LB	H	SS														
45	0-15	15	10	OW	H	SS	0.06	1.52	0.001	0.058	0.006	0.002	0.019	0.445	0.044	<0.001	0.23	94.8	3.4	
46	30	15	10	OW-L.gy	H	SS	0.09	0.88	0.007	0.041	0.009	0.001	0.014	0.26	0.034	<0.001	0.17	96.8	3.4	
47	40	10	7	OW	H	SS	0.052	1.36	0.007	0.14	0.016	0.002	0.017	0.395	0.04	<0.001	0.25	95.2	3.4	
48	0-11	11	8	W	H	SS	0.015	0.405	0.002	0.035	0.004	0.001	0.007	0.115	0.018	<0.001	0.11	98.3	3.5	
49	21	10	7	W	H	SS	0.054	0.510	0.002	0.041	0.005	0.001	0.007	0.14	0.023	<0.001	0.18	97.7	3.6	
50	31	10	7	W	H	SS	0.02	0.71	<0.001	0.049	0.005	0.001	0.01	0.215	0.026	<0.001	0.14	96.7	3.3	
51	40	9	6	W	H	SS	0.021	0.60	<0.001	0.048	0.004	0.001	0.01	0.175	0.02	<0.001	0.11	97.0	3.4	
52	50	5	3	OW	H	SS	0.02	0.435	0.004	0.044	0.003	0.001	0.006	0.125	0.017	<0.001	0.08	98.8	3.5	
53	70	7	5	OW	H	SS	0.025	0.52	0.006	0.046	0.005	0.001	0.010	0.15	0.02	<0.001	0.07	98.4	3.5	
54	80	10	7	W	H,S	SS	0.04	1.24	0.004	0.038	0.005	0.001	0.015	0.37	0.39	<0.001	0.15	95.8	3.4	
	98					surface discolouration														
55	108	10	7	W	H,S	SS														

170065

<u>S. No.</u>	<u>Distance</u>	<u>Sample width</u>	<u>Estimated True Width</u>	<u>Colour</u>	<u>Hardness</u>	<u>Rock Type</u>
56	118	10	7	OW	H,S	SS
57	128	110	7	OW	H,S	SS
58	137	9	8	OW	H,S	SS
	143				-	
NS	158	5	3	OW	S	SS Surface discolouration
-	214				-	
59	0-10	10	7	W	H	SS
60	20	10	7	Br	S	SS (ironstained)
61	27	7	5	W	H	SS
	45				-	
62	60	15	10	Br	H	SS
63	0-10	10	7	Br	H	SS
	25				-	
64	33	8	6	Br	H	SS
	66				-	
65	76	10	7	Br	S	Sch