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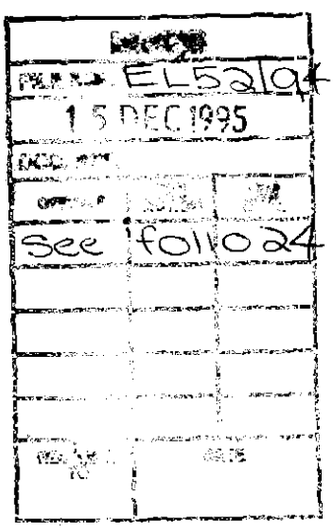
Copper Mines of Tasmania Pty Ltd

LINDA **EL 52/94 Annual Report**

Year 1 (13-1-95 to 13-1-96)

95-3804

LINDA ANNUAL REPORT 1995-96 EL 52/94
COPPER MINES OF TAS, MORRISON K C,
WILLS K A J, CORDERY G R, **VOL 1 OF 5**



K.C. Morrison
K.A.J. Wills
G.R. Cordery
12 December 1995

S22C02

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SUMMARY

A literature review of previous exploration in the area now covered by EL 52/94 generated four targets requiring further exploration.

- Known copper clays deposits and possible extensions and additional deposits down plunge from the old workings in the western Linda Valley (Copper Clays Prospect).
- Possible zinc mineralisation hosted in Gordon Group marine sediments in the central Linda Valley (Chamounix Zinc Prospect)
- Possible pollymetallic massive sulphide or silica-gold mineralisation hosted in lower Tyndall Group volcanics on the eastern flank of Mt Lyell (Burbury Volcanics Prospect).
- Possible fault hosted gold mineralisation along strike from McDowells workings within the North Lyell Fault zone, northern Linda Valley (North Lyell Fault Prospect).

It is recognised that potential exists for fault displaced portions of the Mt Lyell orebodies to reside at depth below the thick Denison Group cover in the far western Linda Valley but their exploration is not part of the current brief on EL 52/94.

A comprehensive study of the geology, mining history, remaining resource estimates and future pre mining appraisal requirements was completed.

A high resolution helimagnetics survey was flown over both the EL and mine leases. Imaging and interpretation is in progress, with valuable detail of the structural/stratigraphic character of the Burbury volcanics and of the sub Quaternary rocks in the Linda Valley revealed to date.

Orientation mapping and sampling in the Linda Valley has located outcropping shale hosted zinc mineralisation at Cemetery Creek and a strong stream sediment gold anomaly below the fault contact of Tyndall Group Volcanics and Owen Conglomerate in the eastern Linda Valley. Field exploration on the four prospects is continuing.

1. TENEMENT INFORMATION

EL 52/94 (Figure 1, Table 1) is a 37 km^2 tenement resulting from the amalgamation of the original EL 52/94 (a 34 km^2 licence awarded to Copper Mines of Tasmania Pty Ltd as the successful tenderer for ETA 364) and E.L.A. 5/95 (a 3 km^2 EL Application over the former Exempt Area between the Mineral Lease 1M/95 and the original EL 52/94).

It extends from the eastern edge of the Mount Lyell Mineral Lease to Lake Burbury in the King River Valley and covers the Sedgwick (Comstock) and Chamouni (Linda) valleys, most of Mt. Lyell and the central and eastern portions of Mt. Owen. The Lyell Highway runs east-west through the middle of the EL, including the townsites of Gormanston and Linda.

Competitor companies hold adjoining exploration licences to the north, west and south, reflecting the position of the Mount Read Volcanics. Exclusions from within EL 52/94 total 6.06 km^2 (see Map 1), comprising; 1 km^2 of Crown Reserves associated with the Gormanston and Linda townsites, 5 km^2 Hydro Electric Commission land, including part of Lake Burbury, and 6 hectares of Mining Leases consisting of 2W/88 (Wiggins and Batchelor Pty Ltd -4 ha) and 47M/73 (P, K and B Smith -2 ha).

EL 52/94 is held 100% by CMT and is currently in licence Year 1 which expires on 13 January 1996.

This report describes exploration completed up until 13 December 1995.

2. REVIEW OF PREVIOUS EXPLORATION

a) Early Prospecting

In February 1862 a party of bushmen and prospectors led by Charles Gould left their camp in upper King River Valley and entered and named the valley of Linda Creek (Chamouni Valley). Gould had been contracted by the State Government for a second attempt to explore for gold in the area between Lake St. Clair and Macquarie Harbour. Despite camping for 12 days at the head of Linda Valley, they found neither alluvial gold in the creeks nor the Mount Lyell mineralisation (Binks, 1980; Blainey 1967).

The first gold panned in the Linda Valley was in January 1883 when the soon to be famous McDonough brothers and Johannes Karlson treked from the Queen River northeastwards across the Lyell-Owen divide and re-established Gould's campsite at the head of the valley. They panned detrital gold in Cooney's Creek, a steep upper tributary of Linda Creek and discovered the gossan over the Iron Blow deposit.

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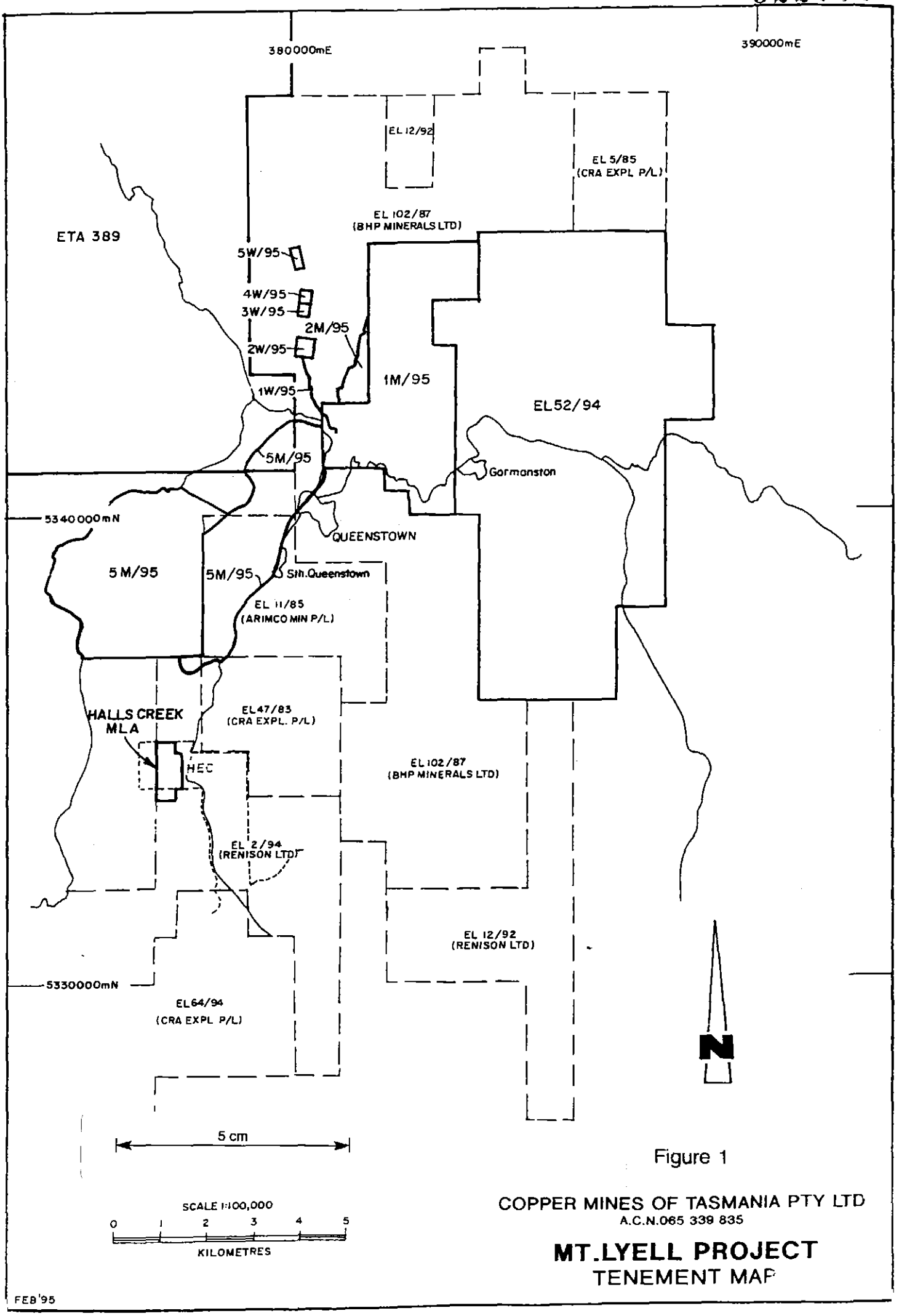


Figure 1

COPPER MINES OF TASMANIA PTY LTD
A.C.N.065 339 835

MT.LYELL PROJECT
TENEMENT MAP

Table 1: EL 52/94 Co-ordinates

LAND DISTRICT OF MONTAGU
VICINITY OF MT LYELL
MUNICIPALITY OF WEST COAST
EXPLORATION LICENCE 52/94 37 SKM
COPPER MINES OF TASMANIA PTY LTD

Commencing at a south east corner at grid coordinates 387 000 metres E 5 336 000 metres N thence grid west to 384 000 metres E grid north to 5 340 000 metres N again grid west to 383 500 metres E again grid north to 5 343 600 metres N again grid west to 383 000 metres E again grid north to 5 344 600 metres N grid east to 384 000 metres E aforesaid again grid north to 5 346 000 metres N again grid east to 388 000 metres E grid south to 5 344 000 metres N again grid east to 389 000 metres E again grid south to 5 342 000 metres N again grid west to 388 000 metres E aforesaid again grid south to 5 338 000 metres N again grid west to 387 000 metres E aforesaid thence again grid south to the point of commencement.

This area excludes:- 1 skm Crown Reserves
5 skm Land Vested in the HEC
6 ha Mining Leases

LAND TENURE:-
This area comprises: Crown Land

The area contains part of the Queenstown Urban Conservation Area , Australian Heritage Commission Act, registered entry

Note: This land tenure table is a guide only.

Within a year 60 miners worked alluvial gold in the valley but by the end of the first summer only 20 remained, one of whom was James Crotty, later to manage the North Mount Lyell Company operations (Blainey, 1967).

Up to 2,500 people lived in the Linda Valley during its peak in 1902-3 but they were all sustained by the mines in the Mount Lyell field. Total alluvial gold production recorded from the Queenstown area during the 1903-1913 decade was 47 kg (Bottrill, 1991). Although such returns are usually understatements, the extremely low figure is consistent with the general historic picture of very little gold production in the Linda Valley and probably less in the Comstock Valley. Horvath (1967) shows several small alluvial diggings in the valley, apparently in glacial sediments, but apart from several small copper and gold workings on the eastern edge of the Mount Lyell field (Bird, 1984, Map 4), only one confirmed mine is documented in the licence area. McDowells is a group of small hard rock open cut and underground abandoned gold workings in the middle to upper Linda Valley (Map 4). The main working is south of and against the North Lyell Fault at a contact between Cambro-Ordovician Owen Conglomerate and Ordovician Gordon Group sediments. Dates and production figures have not been located but the main pit is only 30 x 10 metres (Wilde and Kerr, 1990).

In addition to gold and copper, some early zinc prospecting occurred in the upper Linda Valley. Gordon Limestone outcropping through windows in the Quaternary glacial sediments was covered by a zinc Reward Claim between 1902 and 1908. Loftus Hills (1965) refers to outcropping sphalerite in limestone near Cemetery Creek, close to the earlier tenement, but no confirmation of these exposures was found in the later company exploration reports.

b) Modern Company Exploration

Despite its location and geology surprisingly little exploration has occurred. Corbett (1994) in a review of the exploration history of the ground covered by ETA 364 subdivided the area geographically into the Comstock Valley, Linda Valley-Mt. Lyell, and Mt. Owen areas. He wrote a succinct account of modern exploration based on 17 references. A literature search of the data held in the CMT Queenstown library and 422 Open File reports found by searching the Tasmania Development and Resources Tasexplor database within the relevant quadrangles (Figure 2) added some detail to and expanded Corbett's review but the essential coverage and findings have not changed.

Electrical geophysical surveys (Equipotential and Self Potential) by Blazey and Douglas (1930s) and the Bureau of Mineral Resources (1940s) extend from the Mount Lyell field into the upper Comstock Valley (Bishop, 1982) and in 1957 Rio Tinto Australia Exploration Pty Ltd established a grid in the Tasman Crown Lyell area and conducted Turam EM, gravity and IP surveys which straddle the western boundary of EL 52/94 (Map 4).

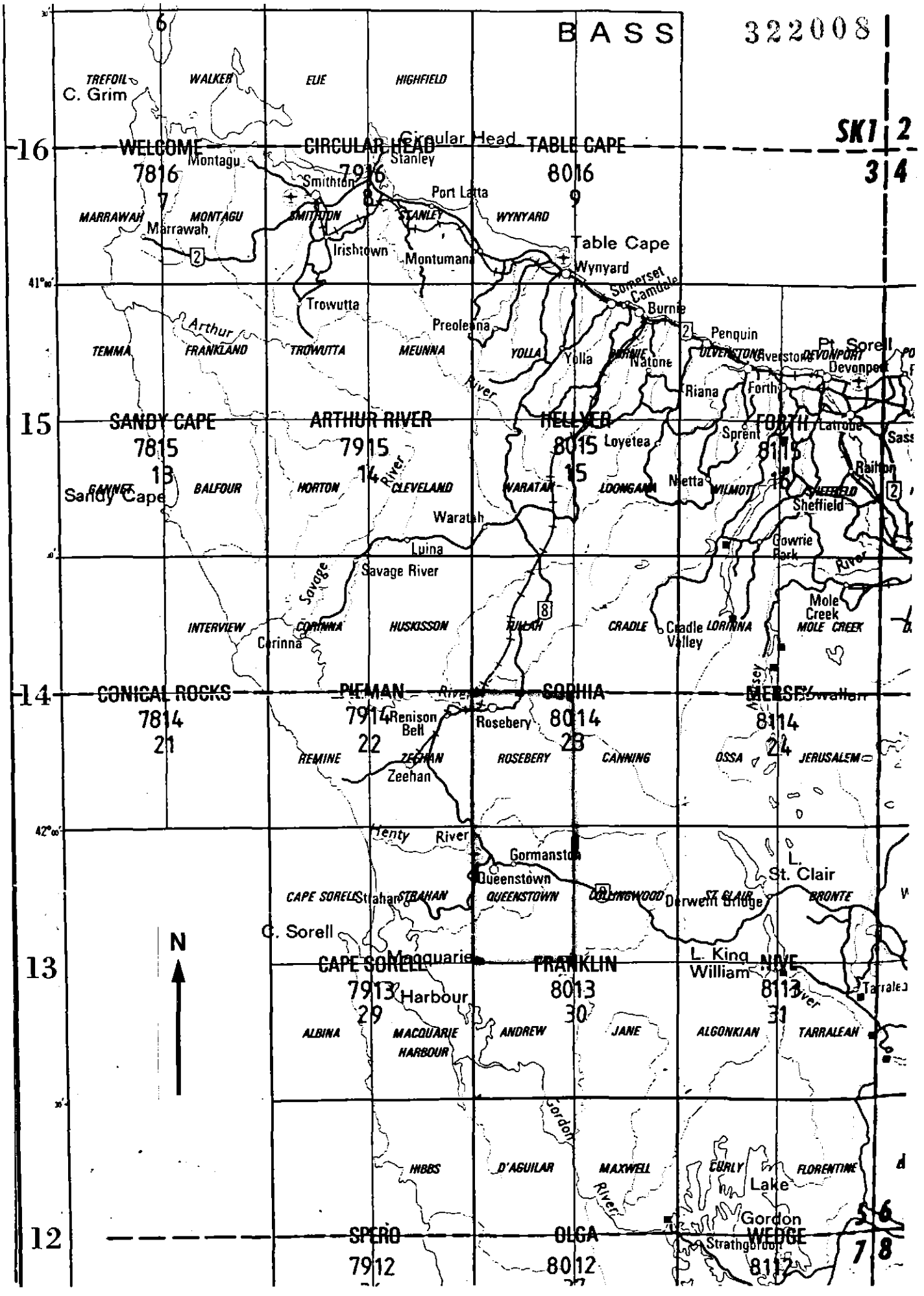


Figure 2: Tasexplorer Search Quadrangles

Between 1960 and 1967 Broken Hill Propriety, Pickands Mather and Company and Utah Development Company held large exploration licences (over 8000 km^2 in each case) blanketing most of western Tasmania. With the exception of minor grid work at Little Owen by Pickands Mather and the RTAE Tasman Crown Lyell grid, both of which were later over gridded by the Mount Lyell Mining and Railway Company Ltd., and some work within the Mount Lyell Consolidated Leases now located on the western edge of EL 52/94, exploration extended from 1966 to the present and to date has been conducted by seven companies within five exploration tenements (Figure 3).

Mt Lyell Mining and Railway Company Ltd.	EL 9/66 (+10/69 & Leases)	1966-1984
Placer Exploration Ltd	SPL-6	1966-1967
Gold Fields Exploration Pty Ltd	ATP Queenstown	1984-1987
CRA Exploration Pty Ltd	EL 5/85	1985-1988
BHP Minerals Ltd	EL 102/87	1987-1991
Aberfoyle Resources Ltd	EL 5/85	1988-1993
RGC Exploration Pty Ltd	EL 102/87	1991-1994

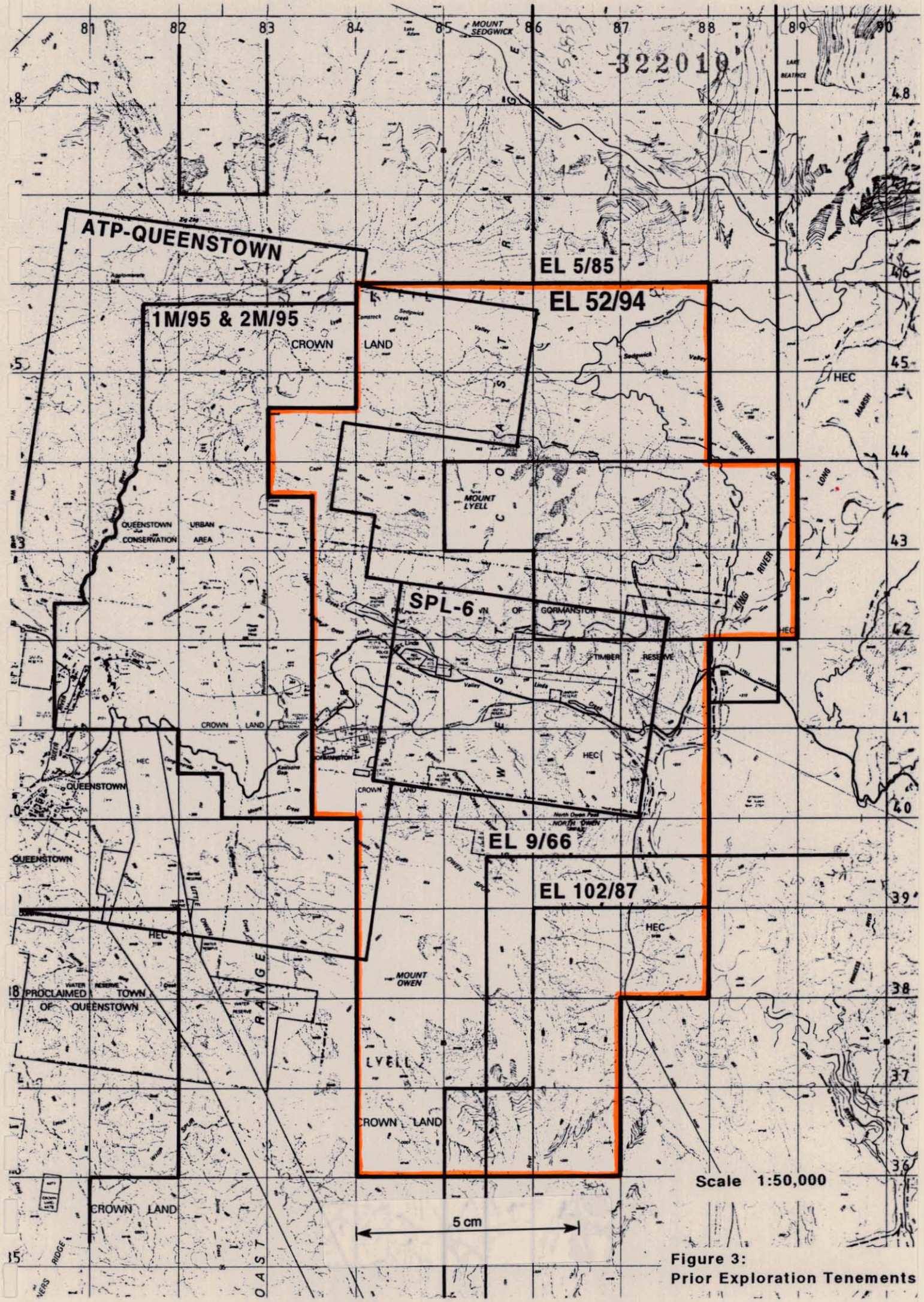


Figure 3:
Prior Exploration Tenements

Exploration grids and drillholes established by these companies are shown on Map 4. Apart from work by MLMRC around Mt. Owen, Gormanston, the copper clays workings and Mt. Sedgwick, all near the western and northern EL boundaries, only two exploration grids and five holes occur in the Comstock and Linda valleys.

Placer Exploration Ltd. - SPL-6

In 1966-67 Placer pegged 4 x 5,000 ft north-south grid lines, at 800 ft spacing, in the Linda Valley (Horvath, 1967). Their aim was to test the methods of soil geochemistry and Self Potential for copper and zinc exploration in an area contaminated by smelter fallout and by electrical wires, buildings and earthworks associated with the towns in the valley. The area also had been targeted by Loftus Hills (1965) with reported sphalerite in outcrop near the site of a 1902-1908 zinc Reward Claim (Figure 4).

Four areas with anomalously low SP were identified (Figure 5) but not interpreted relative to terrain, rock types or models of target mineralisation. Soil samples were taken by spade 30 cm below the surface to avoid contamination. No information on analytical method is provided but the results revealed a background Zn level of about 10 ppm regardless of whether the dominant soil component was sand, clay, peat or glacial gravel. A strong Zn peak of 2500 ppm on line 2800W coincides with a weaker Cu anomaly and is close to an SP low on the end of line 3200W. In this area Gordon Limestone is partly exposed through the glacial cover. Copper anomalies (>100 ppm) also occur on the southern end of line 1400W and on line 00. Maps 2 and 4 show that glacial sediments outcrop at these sites but they are probably underlain by limestone. The largest SP anomalies appear to extend along the northern limits of the grid which is close to the projected position of the North Lyell Fault (Map 2). The SP anomalies on line 1600W are claimed to coincide with gossans (northern anomaly) and quartz veining (southern anomaly) by Horvath (1967). The position is on the edge of Gormanston near a mapped contact between Gordon Limestone and Pioneer Sandstone.

Mount Lyell Mining and Railway Company Ltd - EL 9/66, EL 10/69, Consolidated Mount Lyell leases.

EL 9/66 was originally a 212 km^2 licence well north of the EL 52/94 area but as part of the complicated tenement dealings undertaken by MLMRC in the pre 1984 period, in 1978 EL 9/66 became consolidated from portions of the former ELs 10/69 and 4/71 and the Consoldiated Lease pre 30M/80.

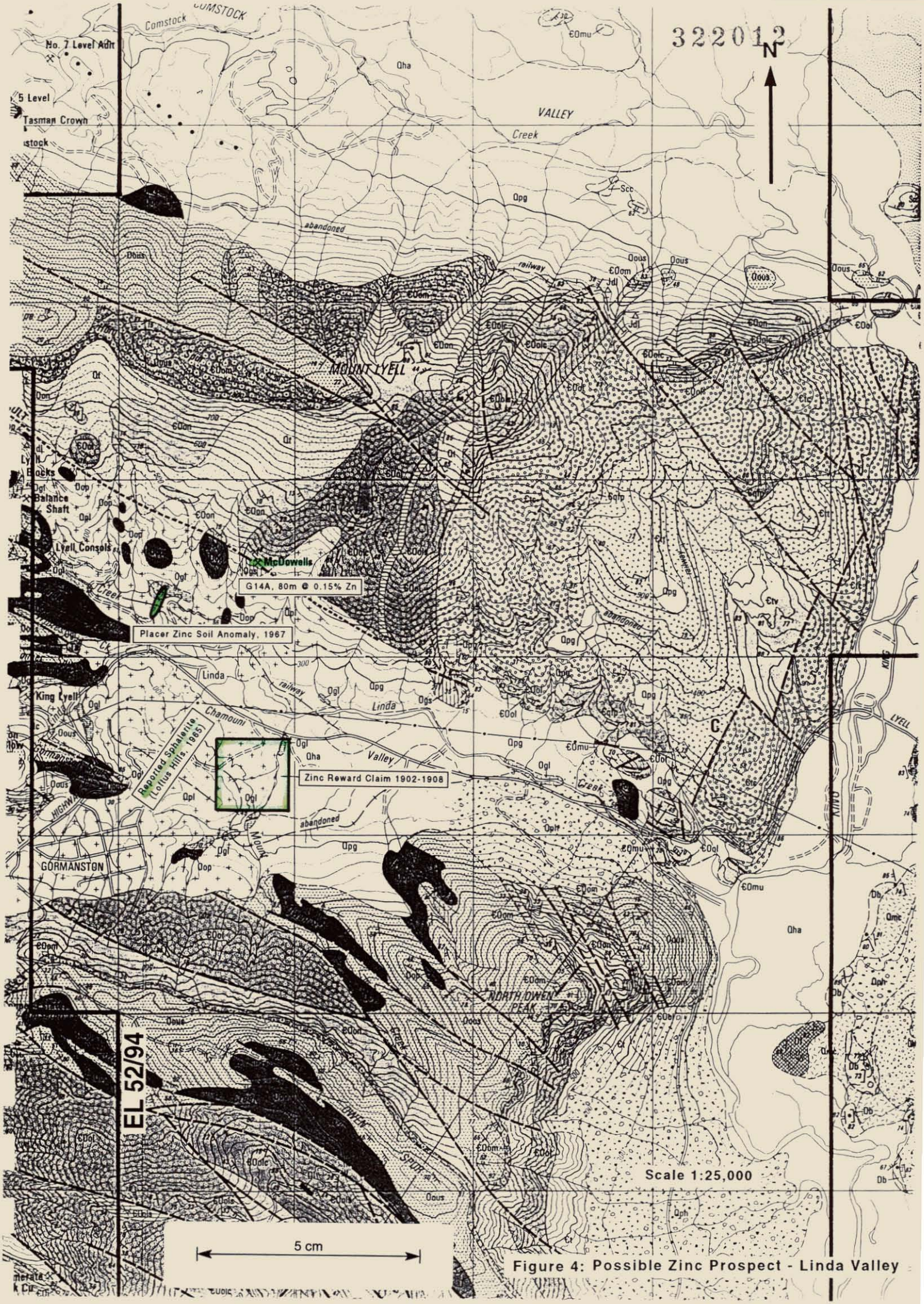


Figure 4: Possible Zinc Prospect - Linda Valley

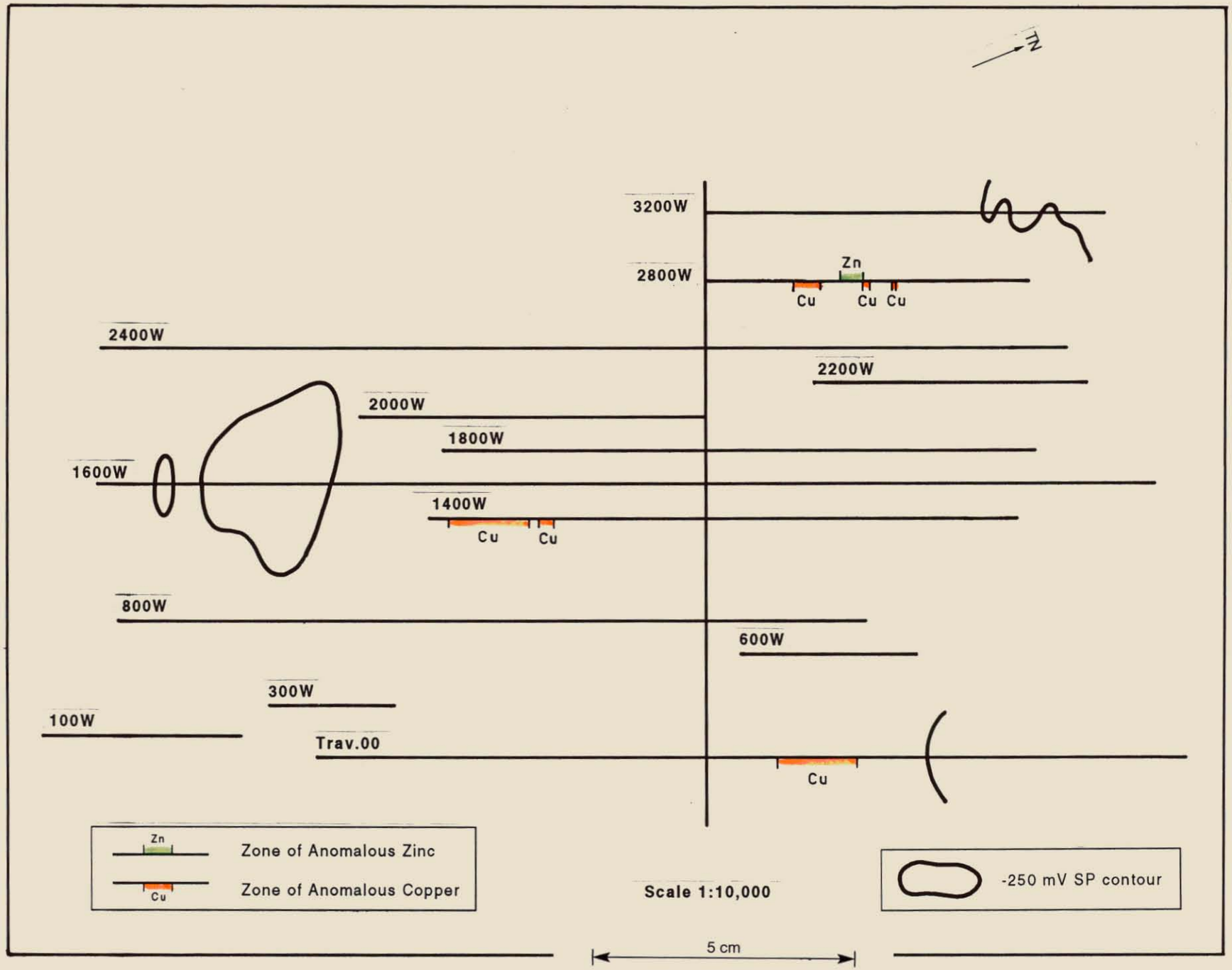


Figure 5: Placer 1967 Exploration - Linda Grid (from Horvath, 1967)

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Records of exploration by MLMRC outside the mining leases are sparse and poorly reported and it is difficult to separate mine exploration from new target exploration outside the Mount Lyell field. In 1902 three vertical holes were drilled on the eastern side of the King Lyell workings. Further copper clays prospects were drilled at Lyell Blocks and Lyell Consols in 1963-64 and again at King Lyell in 1970. Twenty two holes are collared inside EL 52/94 (Map 4) and their geology is covered in detail in Kevin Wills' report on copper clays.

At Gormanston predicted mineralisation close to the subsurface southern extension of the Great Lyell Fault was explored in 1948-49 with grid based Equipotential and Self Potential, followed by five angled drill holes in 1967-68 (Map 4). The geophysics is of poor quality and the drill holes intersected Owen Conglomerates below glacial gravels (Bird, 1984). As with the copper clays, any further exploration would be tied to easterly extensions of Mount Lyell mineralisation, possibly at great depth in the case of a sub Owen Conglomerate target at Gormanston. In the 1980s, Gold Fields Exploration followed up the Gormanston target with more drilling, including two holes inside the EL 52/94 border (Map 4).

In the 1960s (exact dates not discovered) MLMRC developed grids in the Comstock Valley and on the southern margin of Mt Sedgwick (Beatrice Grid). The Comstock Valley Grid was developed to extend the 1957 RTAE Tasman Crown Lyell Grid, preceding BMR SP, IP and Turam EM surveys in 1971 (Bishop, 1982). Three holes (C49, C51, C54) drilled on IP anomalies went through the glacial sediments into barren Gordon Limestone with basal clays containing low grade copper over unknown intervals (Figure 6).

In the late 1960s and 1970s, MLMRC conducted stream sediment and grid based geochemistry and IP on the Beatrice Grid, mainly north of the EL 52/94 area (Reid et al, 1979). A 1200 x 350 metre zone of anomalous soil base metals was defined (Mt Sedgwick Anomalous Zone), to the east of and parallel with a porphyry body and coincident IP anomaly on the southern slopes of Mt Sedgwick and north of EL 52/94. Three drill holes tested the soil anomaly and all encountered low grade mineralisation (eg MS3-44m @ 0.2% Zn). BHP continued exploration in the Comstock-Mt Sedgwick region within EL 102/87 (Wilde and Kerr, 1989, 1990).

In 1974 the Little Owen Grid was extended from an original Pickands Mather 1960s grid on which a zone of copper enrichment was detected at Roaring Meg Creek. The southeastern tail of the extended Little Owen Grid enters EL 52/94 (Map 4) but all the exploration activity was centered to the northwest, on the Great Lyell, Little Owen and Moores areas where several generations of soil and stream geochemistry, mapping, magnetics, IP and drilling discovered a zone of alteration and gold mineralisation

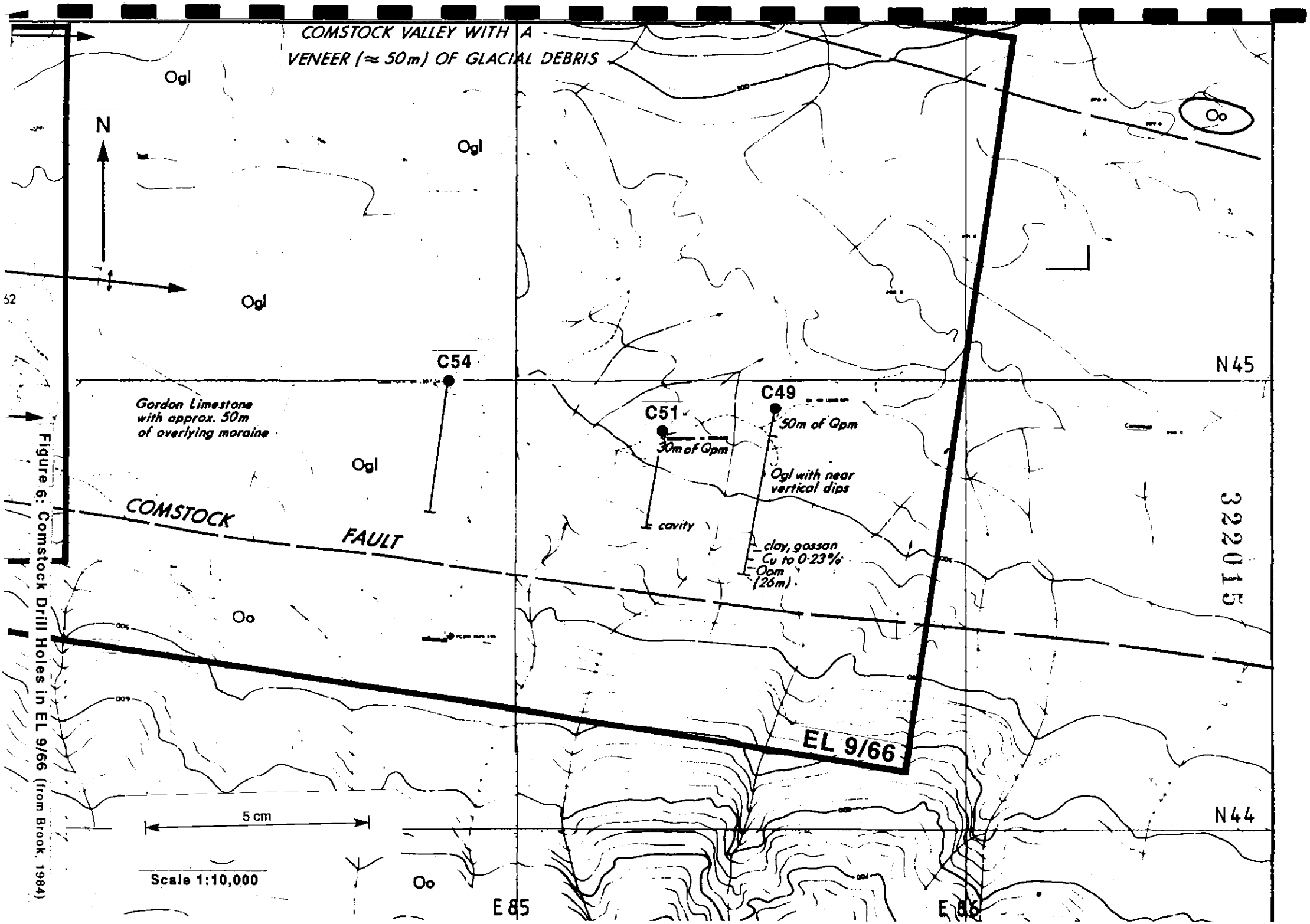


Figure 6: Comstock Drill Holes in EL 9/66 (from Brook, 1984)

which continued to be explored by Gold Fields (Roberts, 1987; Fleming, 1989; Dufty, 1990 and 1991).

Gold Fields Exploration Pty Ltd - ATP Queenstown.

In 1984 an area surrounding Consolidated Mineral Lease 30M/80 was granted to MLMRC as ATP Queenstown (previously referred to by MLMRC as the Buffer Zone) to be excluded from the remainder of EL 9/66 which was the subject of a joint venture between MLMRC and Getty Oil Development Company Ltd in 1976. ATP Queenstown was managed by Gold Fields and they carried out work on several prospects.

The Gormanston prospect was then based on the idea that mineralised volcanics may exist in thrust slices at the southern end of the Great Lyell Fault, where some 600 metres of predicted fault length remained untested (Bird, 1984). Five holes (G2-6) had been drilled in 1968-69 following 1948-49 grid based EP and SP surveys (see Map 4). All holes finished in either Pioneer Beds or Owen Conglomerate but there was consistent difficulty distinguishing unconsolidated glacial sediments from weathered or altered clayey Gordon Group units. This problem still exists in interpreting copper clays host geology and in the mapping of black clays outcropping in Linda Valley.

Because Mount Lyell mineralisation was considered volcanigenic in the late 1960s, Gormanston was downgraded until 1982-84 when Bird, Beddows, Sillitoe and Brooke promoted the concept of a Devonian epigenetic origin and the interpretation of the Gordon Group puggy clay being a hydrothermal alteration product. Bird (1984) mapped an alteration zone inthe Gordon Group rocks, using the previous electrical geophysics and drill logs, and proposed three more drill holes as well as one at McDowells and one at Cemetery Creek, both considered as gold prospects.

The three Gormanston holes (only G12 and G13 are within EL 52/94) and the McDowells hole (G14A) were drilled, together with two holes at Lyell Blocks (NL1101, NL 1102 - both within 30M/80) (Beddows, 1985).

G12 and G13 drilled 380 and 435 metres respectively of glacials overlying ?Pioneer Beds and Owen Conglomerate. Base metal assays on spot samples from G12 all returned < 0.01% and no core from G13 was assayed due to an absence of logged alteration.

At McDowells a 421 metre northwesterly dipping hole (G14A) was drilled under the strike projection of the old workings (Map 4). It intersected a range of clay, sand and gravel-rich unconsolidated materials, interpreted by Gold Fields as either entirely glacial sediments against a fault scarp in Owen Conglomerate or as a "slide block" of Eldon Group metasediments slumped into glacials. The former interpretation implies a thickness of glacial sediments > 268 metres (hole declination 53°), compared to the 150 metres maximum shown by mapping on the more elevated basement near Gormanston.

Composite grab samples over 20 metre intervals were assayed and all returned < 0.2% Pb, Zn and < 0.01% Cu. BHP would later relog and reassay the G14A core, interpreting some of the clayey lithologies as Gordon Group and assaying an 80 metre down hole interval grading 0.15% Zn. This core and the core from the Comstock Valley holes require further work by CMT.

The application of gold in moss prospecting was tested at a regional scale by Gold Fields (Beddows, 1985). Approximately 1 kg of moss was collected, just above water level, and forced through a sieve, yielding 200-300 g of sediment which was panned and the gold particles counted. Map 3 shows that the results were grouped into ranges and that the Cemetery Creek and McDowells sites score 4-7 specks per dish.

After reviewing the results of the 1984-85 work Gold Fields concluded that the Comstock and Linda Valleys had no further potential and those areas were included in a 1,956 ha partial relinquishment of the ATP in 1987 (Fitzgerald, 1987).

The area around known Comstock mineralisation was incorporated into Lease 30M/80 and the ATP, by then reduced to 413 hectares, covered the Little Owen/Great Lyell prospects, south of 30M/80 and west of EL 52/94 (Fleming, 1989). Substantial mapping, sampling, geophysics and drilling within 30M/80 and ATP Queenstown was conducted by Gold Fields at Little Owen and Glen Lyell until 1991 (Dufty, 1990; 1991) and at Comstock until 1994 (Halley, 1992; 1993; 1994). Part of the Little Owen grid extends onto EL 52/94 (Map 4) but the alteration zone and gold mineralisation are entirely west of the EL.

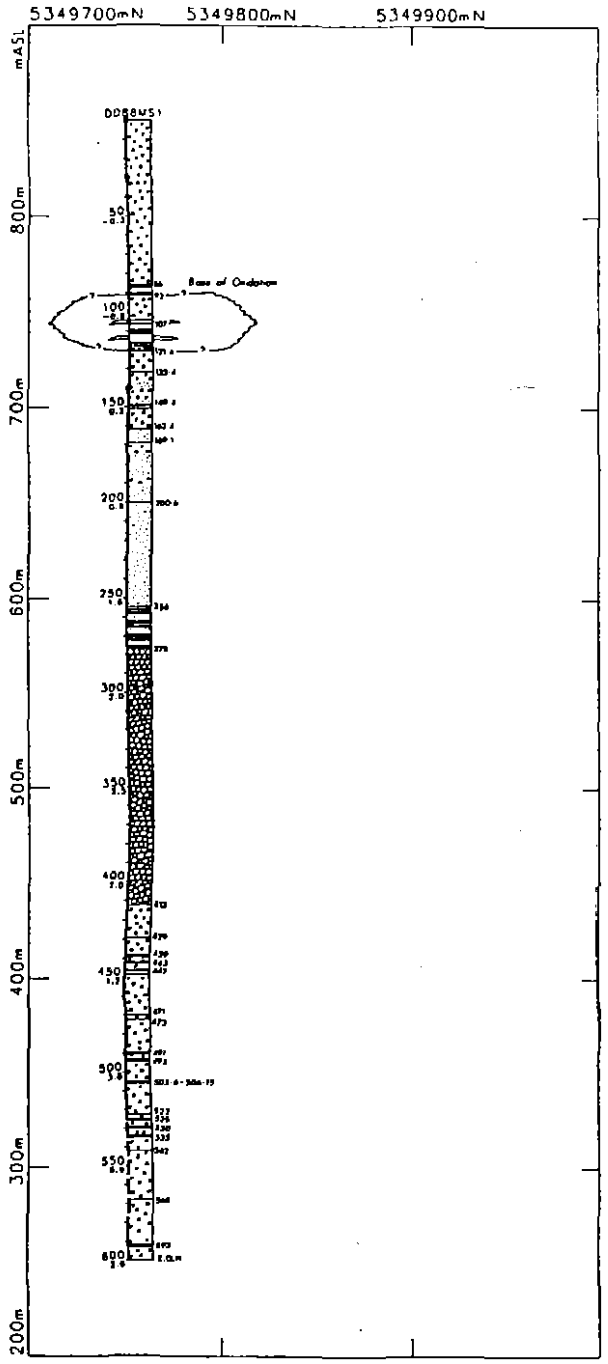
CRA Exploration Pty Ltd - EL 5/85

In 1986-87 a reconnaissance stream sediment BLEG (plus some -80# fire assay/AAS) gold survey was done primarily to test for targets in the Owen Conglomerate (Sheppard, 1986; Funnel, 1987). Maps 3 & 2 show a zone of elevated -80# gold (10 - 80 ppb) in streams draining Tyndall Group volcanics south of Mt. Sedgwick, in the northeast corner of the EL. BLEG values on the same samples are not elevated, suggesting either a concentration of gold in fines which constitute a small proportion of the sample or an ineffective assay leaching process. The survey coverage is too sparse and the samples too few to draw conclusions from. The difference in background ranges for the major rock units has not been established.

A 9 km^2 block over a strong aeromagnetic anomaly east of the Mt. Sedgwick summit was excluded from the 1988 Aberfoyle joint venture and a 600 metre vertical cored hole was drilled through the Owen Conglomerate, without reaching the prognosed underlying volcanics. Although the location is north of the EL 52/94 boundary the hole is of interest because it represents the thickest drilled section of Owen Conglomerate (Figures 7 & 8). CRAE explain the magnetic high as a zone of disseminated magnetite between

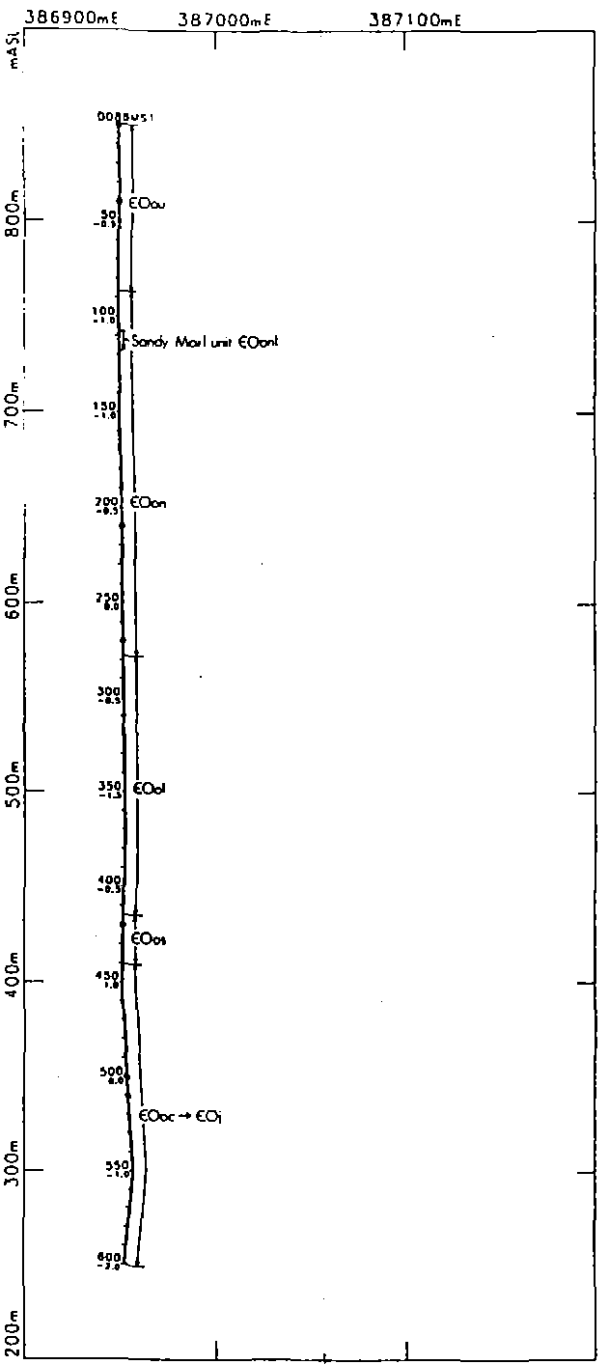
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LITHOLOGY



SECTION ALONG 386950m E

TENTATIVE STRATIGRAPHIC SUBDIVISIONS



SECTION ALONG 5349750m N

LEGEND

CAMBRIAN - ORDOVICIAN SEDIMENTS

- Cobble conglomerate - clast supported
- Pebble conglomerate - clast supported with a quartz sand matrix, some sand rich intervals
- Siliceous sandstone occasional siltstone interbeds
- Siltstone
- Combinations of the above rock types are present with the relative abundance of each component mirrored in the symbol
- Interbedded Siltstone > shale
- Pebble conglomerate > sandstone

INTRUSIVES

- Rhyolitic dyke, quartz - feldspar phyric, 10 to 110cm wide

LEGEND

ORDOVICIAN

- €Oou — Upper sequence of generally pink sandstone and granule pebble conglomerate with minor siltstone. Clasts of pink chert common.
- €Oon — Interbedded sequence of micaceous sandstone, siltstone and siliciclastic pebble conglomerate, generally grey but pink in some areas. Impure limestone and calcareous sandstone (€Oonl)
- €Ool — Dominantly thick-bedded to massive pink cobble-pebble to cobble-boulder conglomerate. Some units of grey conglomerate and sandstone.
- €Oos — Dominantly pink sandstone, pebbly sandstone and pebble conglomerate units of pebble-cobble conglomerate.

CAMBRIAN

- €Oc — Dominantly thick-bedded to massive cobble-pebble to cobble-boulder conglomerate with minor sandstone lenses. Contains volcanic clasts in some areas.
- €Oj — Volcaniclastic conglomerate and sandstone - correlate of Julia Conglomerate.

5 cm

Depth ticks at 10 metre intervals, depth annotation interval 50m

Offsets from section are negative in front of section plane, and positive behind plane.

Drill hole trace displayed as a solid line when within 5m of section plane, broken line between 5 and 15m.

Circles on drill hole trace mark points of intersection with section plane.

Reference QUEENSTOWN SK55-5 (8013)

0 100 200 metres

CRA EXPLORATION PTY. LIMITED

EL 5/85 - LAKE MARGARET
Mt. Sedgwick Prospect
DD88MS1
LITHOLOGY AND
TENTATIVE STRATIGRAPHIC SUBDIVISIONS

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Figure 7: DD88 MS1 Log (from Funnell, 1988)

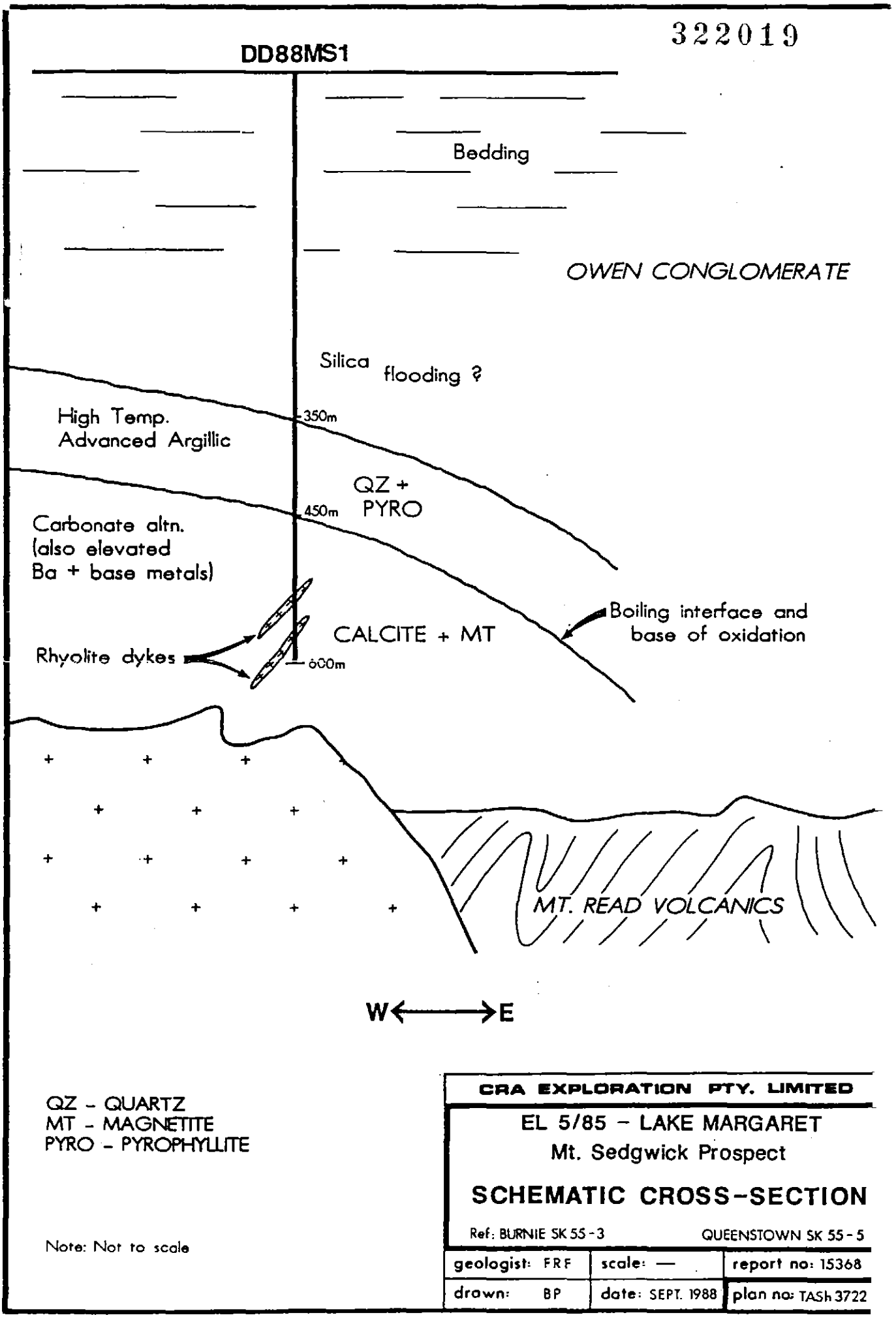


Figure 8: CRAE Interpretation of DD88 MS1 (from Funnell, 1988)

450 and 600 metres (Funnell, 1988) and note an increasing abundance of volcanic clasts in the conglomerate below 440 metres. Rhyolite dykes cut by quartz-calcite veins and acid argillic alteration overprinted by carbonate alteration were encountered and, as the carbonate phase appears to be post D2, the age of the dykes is speculated as early Ordovician to middle Devonian (Funnell, 1988).

BHP Minerals Ltd - EL 102/87

BHP explored the Mt. Sedgwick - Comstock region including compiling the previous grid based geophysics in the Comstock Valley and the three MLMRC drill holes (Figure 9). The philosophy was to blanket prospective areas with EM, which was in favour in western Tasmania during the late 1980s due to its success in discovering Hellyer. In 1989-90 BHP conducted a moving loop Sirotem survey on three lines of the old Comstock Valley grid (lines 4800E, 6200E and 7600E) which they had refurbished (Wilde and Kerr, 1990). Three conclusions followed:

1. The valley is underlain by Gordon Limestone which is faulted against Owen Conglomerate to the north and south. The limestone is widest in the valley centre and narrows to the east and west.

2. Glacial sediments overlie the limestone and reach a thickness of >140 metres in the valley centre, based on interpretation of the resistivity contrast between the limestone (200-300 ohms) and the glacials (100-200 ohms).

3. Conductive zones occur discontinuously within the limestone package and they are interpreted as carbonaceous units, consistent with the drill log from C54.

Nine further moving loop profiles and a fixed loop survey were completed, generating a strong anomaly on line 4800E and a subtle anomaly on line 4000E. The former was prognosed as a plate-like conductor dipping 45°n below 4800E/5000N and was drilled by a south dipping cored hole (Wilde and Kerr, 1990). CV1 intersected 118 metres downhole thickness of glacials and 198 metres of Gordon Limestone, including a 13 metre zone of pyrite veining with weak zinc/lead mineralisation (maximum 1 metre @ 0.26% Zn). Modelling of a downhole EM survey concluded that the target conductor

COMSTOCK VALLEY GRID

Turam (BMR 1966). Anomalies shown as 2° or 2.5° phase difference contours.

Self potential. (BHP 1966)

5 cm

TASMAN CROWN LYELL GRID

Turam (RTAE 1962). Anomalies shown as 2° or 2.5° phase difference contours.

Gravity (RTAE 1959B)

Equipotential survey (BMR 1958)

EL 102/87

Input coverage

6 channel anomaly

5 channel anomaly

4 channel anomaly

1 channel anomaly

Scale 1:10,000

N

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TASMAN CROWN LYELL GRID

COMSTOCK VALLEY GRID

C54

C51

C49

9/1·7 500'

6/0·1 560'

4/0·2 520'

K

Figure 9: Comstock Valley Geophysics (from Wilde & Kerr, 1990)

had been drilled and is a carbonaceous limestone facies containing up to 10% pyrite.

BHP interpret the four Comstock Valley holes to show a 45° northerly dip for the Gordon Limestone and that the underlying clay is either a stratigraphic unit in the Gordon Group or Quaternary glacial fill against a scarp in the limestone. In contrast at McDowells in the Linda Valley (Figure 10), the Owen Conglomerate dips south and a relogging and reassaying of G14A (Figure 11) showed that much of the clayey lithology is fine sand and mica/sericite and that an 80 metre interval carries 0.15% zinc, mainly in hematite pseudomorphs. Again it was unclear as to the origin of the mineralised unit, which Wilde and Kerr (1990) considered to be either glacials or a correlate of the Pioneer Sandstone. BHP and Gold Fields assays from Comstock holes (Table 2) show that the clay/sandstone lithology (at least in the basal part of C49) is substantially more mineralised than the limestone.

North of the Comstock Valley, on the Beatrice Grid, geophysical properties of the various rock types outcropping were recorded (Table 3) and as some of these lithologies will be encountered on EL 52/94, the data are relevant.

BHP also did some regional drainage geochemistry for gold using BLEG and fire assay checks on 10 kg -2 mm samples. On a population of 52 samples they maintain that statistically, 1 ppb is an effective BLEG anomaly threshold (Wilde and Kerr, 1990) but geological source effect on background is not considered. Sample sites inside the EL 52/94 area shown on Map 3 and two strong anomalies of 65 and 70 ppb BLEG Au occur in Cemetery Creek. These anomalies have not been explained but they were apparently not repeated by further sampling (Cameron and Read, 1991).

Aberfoyle Resources Ltd. - EL 5/95

In 1988 Aberfoyle entered a joint venture with CRAE and continued to focus on the Sedgwick area, relinquishing a mandatory half the licence in 1990. In 1993 when a further partial relinquishment was decided by the partners Aberfoyle conducted a reconnaissance mapping traverse along the old Comstock-Linda tramway, where it cuts through volcanics which in part correlate with the Tyndall Group and possibly include Comstock Tuff correlates (Map Sheets 1 & 2). They mapped factual outcrop at 1:10,000 scale concluding that a shear zone in quartz/feldspar phyric lapilli volcaniclastics, which probably correlate with the Comstock Tuff, exists in the southeast of the block but that alteration was poorly developed (Sharpe, 1993). Aberfoyle relinquished that portion of the licence in 1993.

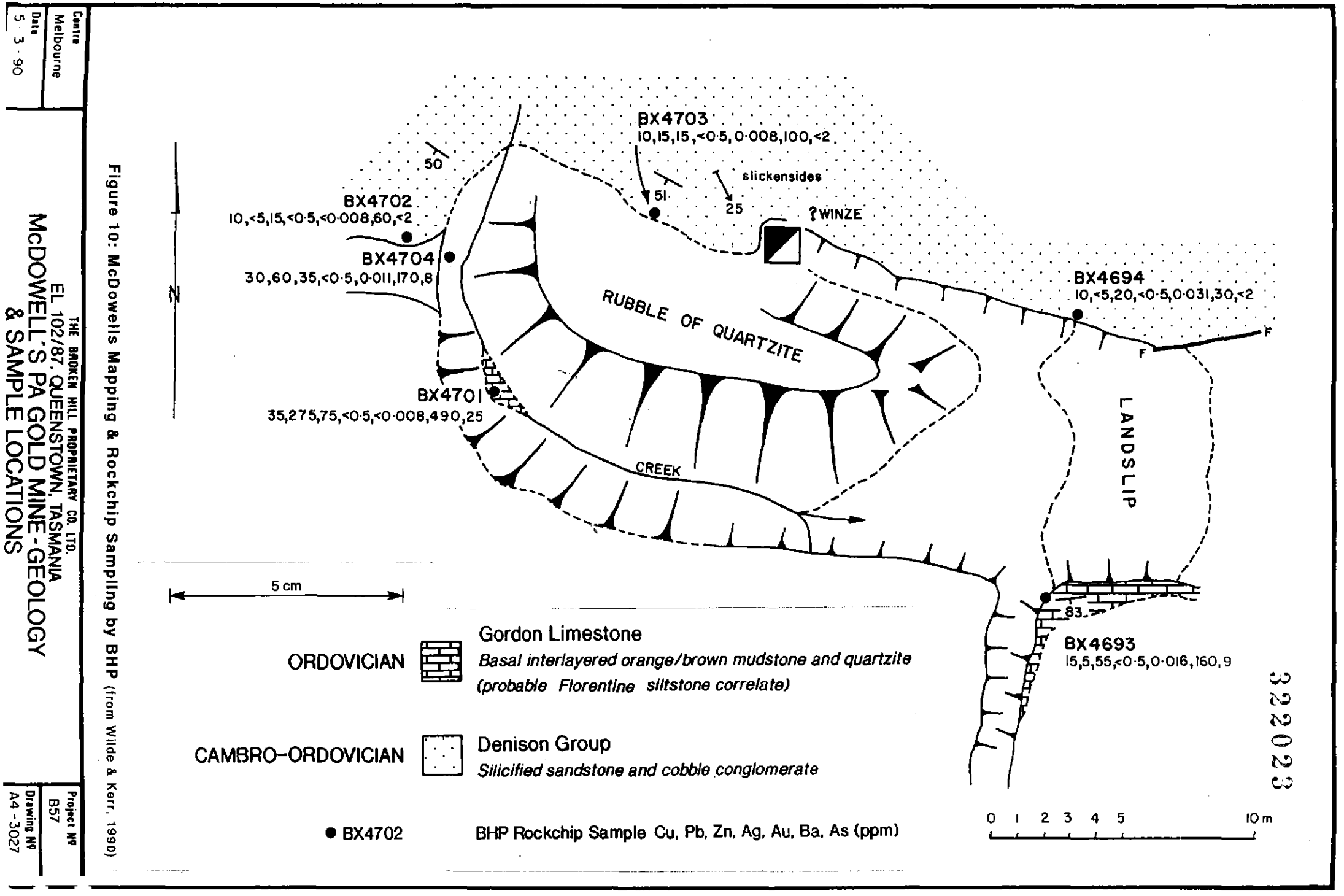
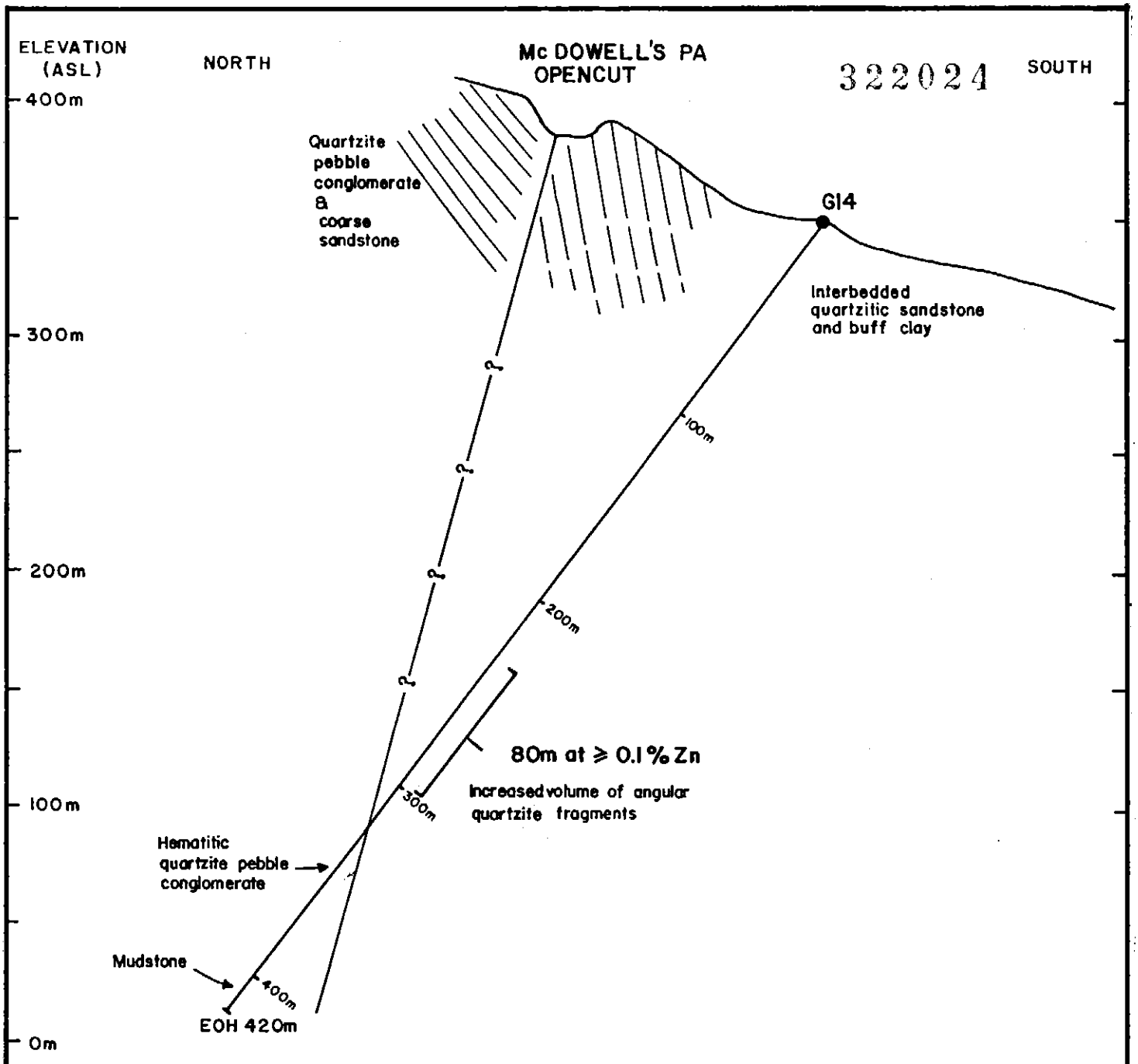


Figure 10: McDowells Mapping & Rockchip Sampling by BHP (from Wilde & Kerr, 1990)

THE BROKEN HILL PROPRIETARY CO. LTD.
EL 102/87, QUEENSTOWN, TASMANIA
McDOWELL'S PA GOLD MINE-GEOLOGY
& SAMPLE LOCATIONS

Centre: Melbourne
Date: 5 · 3 · 90
Project No: B57
Drawing No: A4 - 3027



DEPTH	Cu	Pb	Zn	As	Ba	Au
200	20	65	140	20	420	10
225	25	520	900	35	140	10
250	55	1850	1300	60	300	14
275	20	160	1450	20	320	11
300	45	560	1400	50	290	16
330	40	195	540	50	250	10
334	10	5	30	2	20	14
350	5	<5	20	<2	25	12
375	5	<5	20	<2	85	13
400	15	<5	40	<2	320	20

Cu, Pb, Zn, Ag - AAS. All Ag <0.5 ppm. As, Ba - XRF
Au - Fire Assay. Results in ppm, except Au - ppb

Prepared: A.Wilde	BHP-Utah Minerals International (Asia Pacific Division)	Proj.No.: B57
Drawn: C.Purnell	EL 102/87, QUEENSTOWN, TASMANIA	Drg No.: A4-3026
Date: March 90	McDOWELL'S PA GOLD MINE - SECTION & GEOCHEM RESULTS	
Centre: Melbourne		

Figure 11: McDowells Drilling Results (from Wilde & Kerr, 1990)

Table 2 : (from Wilde & Kerr, 1990)

Geochemical analyses of samples of Gordon Limestone and possible glacial clay (actually a fine sandstone) from the Comstock Valley. Cu, Pb, Zn, Ag AAS, Au fire assay, BA, As XRD. Additional assays are given in Appendix .*Quality of these analyses is unknown. High Cu may be due to laboratory contamination, indeed there is poor correspondence between the BHP and Mt Lyell analyses. Twenty-three samples of limestone, analysed by Goldfields yielded a mean value of 17 ppb gold (maximum 67 ppb).

SAMPLE #	LOCATION	ROCK TYPE	Cu	Pb	Zn	Ag	Au	Ba	As	COMMENTS
BX4564	C51 200-245 m	Limestone	12	10	42	<1	<0.01	-	-	Composite chip sample
BX4705	C49 411.3	Clay/"Gossan"	120	70	1850	<0.5	<0.008	70	30	
BX4559	C54 245-255 m	Limestone	7	6	7	<1	<0.01	-	-	Composite chip sample
BX4560	C54 295-305 m	Limestone	6	8	12	<1	<0.01	-	-	Composite chip sample
BX4561	C54 345-355 m	Limestone	3	5	11	<1	<0.01	-	-	Composite chip sample
BX4562	C54 375-385 m	Limestone	4	6	10	<1	0.01	-	-	Composite chip sample
BX4563	C54 385-420 m	Limestone	6	10	15	<1	<0.01	-	-	Composite chip sample
23403	C49 390 m	Clay (Sandstone)	85	50	370	<0.5	<0.008	-	25	
23404	C49 436 m	Clay (Sandstone)	70	60	470	<0.5	<0.008	-	39	
-	C49 376-383 m	Clay (Sandstone)	1,350	<500	100	-	-	-	-	Mt Lyell Co analyses (1967)*
-	C49 392-395 m	Clay (Sandstone)	500	<500	100	-	-	-	-	Mt Lyell Co analyses (1967)*
-	C49 414-414.5 m	Clay (Sandstone)	2,300	<500	300	-	-	-	-	Mt Lyell Co analyses (1967)*

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Table 3: Geophysical Properties of Rocks on Beatrice Grid (from Wilde & Kerr, 1990)

	RESISTIVITY (Ω /m)				IP (mV)				CONDUCTIVITY (S/m)			
	N	MAX	MIN	$\bar{X}$	SD	N	MAX	MIN	$\bar{X}$	SD	N	MAX	MIN	$\bar{X}$
ORDOVICIAN														
Gordon Limestone	–	–	–	–	–	–	–	–	–	–	60	4.1	0.12	0.91
CAMBRIAN META-SEDIMENTS														
Sandstone	29	10,000	794	5,534	3007	34	60.9	2.4	19.9	15.2	7	0.49	1.80	0.88
Massive Slate	100	3,000	398	981	503	132	98.7	19.0	59.5	16.7	32	8.21	0.42	2.13
Laminated Slate	11	1,950	850	1,404	297	11	68.5	38.0	51.8	11.8	4	5.68	1.03	2.37
Siltstone	25	1,800	230	1,175	341	30	68.6	27.0	46.6	12.6	1	–	–	0.86
Quartz-Chlorite-Mica Rock	135	90,000	40	3,824	8,296	134	55.0	2.0	13.4	7.8	–	–	–	–
Crystal Breccia	7	5,450	950	2,478	1,936	7	10.0	4.0	6.43	2.3	1	–	–	0.62
Lithic Breccia	23	7,250	4,800	3,876	1,514	23	26.5	1.0	9.89	7.5	–	–	–	–
Pumiceous Breccia	124	7,200	316	2,773	1,547	131	54.0	1.0	14.0	12.0	12	2.50	0.33	1.14
MISC. ROCKS														
Sedgwick Porphyry	220	50,119	850	10,021	10,689	237	56.4	-11.9	17.2	12.9	48	2.22	0.09	0.61
Fault Gouge	2	1,584	1,259	1,421	230	6	31.1	19.3	25.2	4.4	–	–	–	–
"Chert" (Hydrothermal)	18	6,309	1,900	3,625	1,410	14	27.2	8.0	15.2	5.9	–	–	–	–
Quartzite (Hydrothermal)	7	6,200	2,500	4,185	1,557	7	9.0	6.0	7.0	1.0	–	–	–	–
Schist (?Tectonic)	2	1,250	1,250	1,250	0	2	38.0	25.0	31.5	9.2	–	–	–	–

322026

RGC Exploration Pty Ltd - EL 102/87

In 1991 the remaining portion of ATP Queenstown was incorporated into EL 102/87 which was in Joint Venture between BHP and RGC Exploration Pty Ltd. RGC by then had replaced Gold Fields as the exploration company within Rension Gold Fields Consolidated Ltd.

Although no further work was conducted within the area now covered by EL 52/94, RGC, with consulting help from the Tasmanian Department of Mines (Corbett, 1989), intensively explored the Comstock mineralisation (not Comstock Valley), making important findings.

1. Trace element lithogeochemistry was used to see through the alteration and define an andesitic host unit which extends at least from Comstock to Cape Horn (Halley, 1992). Crawford et al (1992) and Crawford (1995) believe that the Comstock andesite is one of a suite of distinctive hornblende-plagioclase shoshonitic intrusives formed south of the Henty Fault Zone and which are closely related to ore deposition.

2. Interpretation of drilling is that within the Comstock andesite a probable exhalative sequence, with a distal limestone equivalent, in part stratigraphically overlies a chert and that this Comstock Chert is considered an analogue of the MQ unit at Henty, in terms of alteration style and position within the seawater-dominant hydrothermal fluid system. Halley (1994) interprets the Comstock Chert as a silicified vent with the main exhalative unit sitting above stockwork mineralisation, ie the Comstock ore bodies.

RGC drilled three holes (C070, C071, C072) into the andesite to test the interpreted exhalative sequence. A gold anomaly was detected in C072 of 90 metres @ 0.29 ppm and a conductor updip from this gold zone was modelled from down hole Sirotem EM (Halley, 1993). A drill hole was planned to test the conductive body but has not yet been drilled due to the sale of the Mount Lyell project by RGC in late 1994 (Halley, 1994).

c) Conclusions and Recommendations

1. Low density and patchy coverage by stream sediment geochemisty for gold is the only regional scale work conducted by previous explorers which can be utilised. Two anomalous BLEG values in Cemetery Creek remain unexplained and the Tyndall Group rocks south of Mt. Sedgwick appear to have sourced elevated BLEG gold stream sediment values. Major infilling and extension is required to adequately survey the drainage within EL 52/94 and it should be an effective way to screen and discriminate between the volcanics and Denison Group and Gordon Group lithologies. All sampling needs to be upslope from the glacial sediments.

2. Six grids partly or entirely locate within the EL but the geophysics and soil surveys on these grids are not adequately tied to the sub Quaternary geology and in most cases the primary data are not available to be used in ongoing exploration. Excellent data has been acquired from a high resolution helimag survey flown in 1995.

3. Records of 34 drill holes within the EL have been located. Twenty nine of these were targetting copper clays or prognosed sub Owen Conglomerate volcanics, conducted within mining leases of the time by MLMRC. Four holes were drilled on electrical geophysical targets in the Comstock Valley and one hole was drilled under McDowells gold workings in the Linda Valley. The latter five holes encountered Gordon Limestone ± Pioneer Sandstone and Owen Conglomerate, beneath Quaternary glacial sediments. Relogging of these holes together with palynology and XRD clay mineralogy is needed to discriminate the various Ordovician and Cainozoic lutites. No targets remain undrilled within the EL but the C072 anomaly near Comstock, inside 1M/95, has been prepared by RGC and requires drilling.

4. Regional Geological Survey mapping and research in areas of structure, stratigraphy, volcanology and rock chemistry have provided substantial help in the design of future exploration. Two high ranking targets exist in the EL

   i) Base metal sulphides or gold in favourable horizons stratigraphically below potential Comstock Tuff correlates in the volcanics east of Mt. Lyell .

   ii) Easterly extensions of known copper clays mineralisation, and possible associated zinc, within Gordon Group and/or Quaternary glacial host sediments in the upper Linda Valley.

   Gold potential elsewhere in the EL will be assessed by infill drainage geochemistry and the potential for fault displaced portions of Mount Lyell orebodies below thick Owen Conglomerate cover along the western edge of the EL can be assessed as part of the exploration program within 1M/95.

3 COPPER CLAYS STUDY

A comprehensive study of the known copper clays deposits at Mt Lyell was completed and is incorporated in this report as Appendix 1 in Volume 2. Of the three deposits previously mined, Lyell Consols locates inside EL 52/94, King Lyell is on the boundary and Lyell Blocks is within lease 1M/95. However, as all three will be explored as a single project and as undiscovered potential is likely to extend down plunge to the east, the copper clays work is considered part of the EL based program.

4. AEROMAGNETICS

During February 1995, UTS Geophysics of Perth conducted a detailed airborne magnetometer survey of the EL as part of a broader multi company program. A total of 473 line kilometres of data were collected using a forward stinger mounted Geometrics G-833 magnetometer mounted on a Squirrel helicopter. Flight lines were oriented east-west with a 100m line spacing, 20 to 30 metre target sensor height and along line sample spacing of 3 to 4 metres. One kilometre spaced north-south tie lines and base station dirunal readings were used to level the data.

Magnetic data has been levelled and gridded and presented as total magnetic intensity contours and stacked profiles (Appendix 2). Data is currently being reprocessed and imaged. Processing will include vertical and horizontal derivatives and presentation using various sun angles to highlight structural trends. Modelling of selected anomalies to determine source shape, orientation and depth is planned.

The aeromagnetics results have provided a new insight into the geology and structure of the area covered by the Licence and a preliminary interpretation has highlighted a number of features which will be followed up with ongoing field work. The most prominent feature is the extensive area of complex, high magnetic character which, on the eastern end of Mount Lyell and in a narrow strip along the eastern flank of Mt Owen, reflects the Tyndall Group Volcanics as shown on the Queenstown 1:25,000 geological sheet -Map 2 (now informally called the "Burbury volcanics"). The southern and western continuation of similar high (though notably less noisy) magnetics into the area mapped as Denison Group sediments suggests that the siliceous sediments on Mounts Lyell and Owen are underlain by similar volcanics. Modelling of profiles will aid in determining the thickness of Denison Group cover and may reveal major fault displacements and windows through thinner portions of the cover.

The magnetic texture of the northern exposed volcanics appears to be the result of a combination of stratigraphic variation in rock composition and possibly magnetite destructive hydrothermal alteration. A prominent northeasterly trending magnetic low near the centre of the northern complex has a nothwesterly "blowout" which coincides with mapped structures. Thumbprint magnetic highs within the low are analogous to porphyry copper style signatures, where central magnetite stable potassic (K-spar or biotite) alteration may be surrounded by magnetite destructive argillic assemblages. Biotite bearing porphyries are mapped in this area and the anomaly coincides with a relative topographic low (an alternative cause for the anomaly). The spatial relationship noted on the Mt Lyell mining field between discrete thumbprint magnetic highs and known copper-gold orebodies, which are concentrated on the adjacent high magnetic gradients in the intensely pyritised and argillised rocks, also make this anomaly worthy of follow up. Alteration and geological mapping with systematic rock and stream sediment sampling will test this area.

The magnetic complex is dissected by a conspicuous west-nothwesterly trending magnetic low which is coincident with the Linda Valley. This

graben structure contains younger Gordon Group sediments which include the limestone, marl and shale sediments found to contain significant zinc, lead, silver and gold anomalism at the Chamounix Zinc prospect. A broad, low order magnetic high is evident over this prospect and may reflect siderite alteration or sulphide concentration. Four similar magnetic highs have been identified within a corridor stretching between the Prince Lyell mine and the eastern boundary of the Exploration Licence which require attention. Further reprocessing and enhancement of the magnetics in the Linda Valley should aid in the identification of further anomalies and provide a base for geological interpretation.

Major structures are apparent from the magnetics which cut diagonally across the Licence parallel to the west-northwesterly Linda Disturbance. Many of these structures have been mapped and are shown on the Queenstown geological sheet (Map 2). The magnetics images are aiding in the location of extensions and possible jogs in major structures, such as the North Lyell Fault, where they pass under cover. These structures bound the Linda Valley graben and are known to host or control mineralisation at McDowells gold mine. Additional parallel structures are interpreted to divide the Linda Valley graben longitudinally, with the northern portion possibly having a thicker sediment pile (lower magnetic signature) relative to the southern portion. Ongoing exploration will be focussed along these structures with emphasis on interpreted structural intersections and jogs.

5. FIELD EXPLORATION

In October-November 1995 a program of sampling and outcrop mapping in the Linda Valley was undertaken to test several aspects of the geology of the targets generated by the literature review and the responses to certain exploration methods, in preparation for the 1995-96 field season (Map 5, Appendix 3).

a) Chamounix Zinc

Outcropping mineralisation was located in Cemetery Creek hosted by a weathered deformed black shale unit with minor siltstone and fine sandstone which appears to overlie Gordon Group limestone . This shale unit probably correlates with the black pugs which host the copper clays deposits at the western end of Linda Valley. Regionally these carbonaceous shales and clays may correlate with the upper most division of the Gordon Group (Ogr), described by Calver (1995 - draft explanatory notes for Lyell 1:50,000 sheet) as slightly calcareous and micaceous siltstones and mudstones.

A 5 metre wide zone of quartz veining with disseminated clots and stringers of pyrite sphalerite and galena crops out in the banks of Cemetery Creek (photo 1) some 300 metres south of the Lyell Highway. Bedding dip directions on the underlying limestone in the Linda Creek-Cemetery Creek area (photo 2) suggest that the mineralised rocks occur about the hinge line of a syncline. This structural setting is consistent with the easterly down plunge extension of the syncline which hosts the King Lyell deposit between

Gormanston Spur and Pioneer Spur (Map 2). Selective sampling of outcrop and nearby float fragments in Cemetery Creek (sample no.s 16, 18, 19, 22, 23 - Map 5, Appendix 3) assayed from 1.2 to 21.1% zinc, < 0.1 - 34.8 ppm silver and 77 - 4647 ppm lead. Copper, barium and manganese are not elevated and arsenic and molybdenum show at best subtle elevation. Sample no 23 returned 260 ppb gold, 9.8 ppm silver and 15.2% zinc from outcrop.

A -80# wet sieve sample (sample no 62) from gravel bar sediments in Cemetery Creek, 50 metres down stream from the outcropping mineralisation, assayed 4.2 ppm gold and 663 ppm zinc. Pan concentrate from the same site (sample no 37) assayed 52 ppb gold and 2011 ppm zinc. One particle of visible gold was noted in the concentrate. The origin of detrital gold in creek sdiments which in part are derived from Owen Conglomerates and the Quaternary glacial sediments is always uncertain but the anomalous zinc gold and silver values encountered to date in Cemetery Creek all will be further explored. This target is informally called the Chamounix ZincProspect.

b) Copper Clays

Previous drilling on the copper clays deposits, and also the single drill hole at McDowells gold prospect on the North Lyell Fault, all encountered difficulty in interpreting the sediments drilled, in particular, discriminating the various Quaternary facies from Gordon Group lutites and the uncertainties regarding the origin and nature of the black clays and ferricretes which host the mineralisation. Field exposures in Linda Valley show the complex small scale relationships between the Gordon Group black shales and clays and the overlying Quaternary peat and humic silts. In places Quaternary gravel and fossil wood is enclosed within ductile deformed and brecciated soft black clays derived insitu from either Gordon Group shales or partly dissolved impure limestone. It is not clear whether the brecciation and plastic deformation observed in these basement shales is due mainly to tectonics or ice stress but clearly the latter is responsible for the intermixing of basement and surficial sediments.

The application of palynology and organic carbon content to discriminate between Gordon Group and Quaternary carbonaceous lutites was trialled, with an aim to prepare logging methods for the copper clays drilling program in 1996. The results (Appendix 4) are summarised in Table 4 Microscopic examination of slides prepared from organic extract show abundant modern pollens in the Quaternary sediemnts but, except for minor contaminants, only amorphous carbon fragments in the Gordon Group lithologies, demonstrating this method as a diagnostic tool. The Quaternary humic sediments and Gordon Group shales have approximately the same organic carbon content, which is an order of magnitude higher than in the limestone. Comparison of TOC values for Gordon Group limestone and shale/clay suggests that if the black clay is a dissolution residue from relatively pure limestone then a 90% volume reduction is required. The small degree of quartz vein and joint defomation in the Cemetery Creek shales implies very little or no dissolution and is more consistent with physical deformation of a ductile argillaceous lithology.



Photo 1 Quartz veined black shale with sphalerite, pyrite, galena mineralisation, outcropping in Cemetery Creek (4890E, 1330N).



Photo 2 Deformed, weathered black shale overlying southwesterly facing micritic limestone, Linda Creek (4900E, 1680N). The outcrop is partly covered with Quaternary gravel.

Table 4

Comparative TOC and Palynology - Carbonaceous Lutites, Linda Valley

Rock Type	% Total Organic Carbon	Palynology
Gordon Group Black Shale/Clay	1.5 - 7.2 (8 samples)	Abundant amorphous carbon
Gordon Group Limestone	0.2 (1 sample)	Abundand amorphous carbon
Quaternary Humic Silt/Peat	3.4 - 4.2 (2 samples)	Abundant modern pollen

Laterite-like ferricrete and limonitic clays and sand outcrop at the copper clays deposits and in other gullies in the Linda Creek-Idaho Creek-Whites Creek area. These ferricretes are developed mainly on Gordon Group rocks near the copper clays deposits but also partly on Pioneer Sandstone and Quaternary glacial sediments, proving that at least some of the ferricrete is of Quaternary age. It is not yet clear if the lateritisation is critical to copper clays mineralisation but ore grade specimens of ferricretes and ferruginous clay breccia, marbled with native copper filling fine cracks, were recovered at the King Lyell workings. The co-existence of synclines controlling drainage into impermeable carbonaceous shales may be a prerequisite for iron and copper rich oxide formation and equivalent settings in the adjacent area require exploration for copper clays mineralisation.

Ferricrete developed on probable Gordon Group shale/sandstone outcrops immediately north of Linda township, 400 metres west of McDowells gold workings. The outcrop is a litho correlate of the rocks in the footwall of the North Lyell Fault at McDowells. Chip samples of the nodular ferricrete (sample no.s 0563, 65, 97) assayed from 0.11 - 0.38% zinc which is consistent with the zinc grade encountered in the fine sand and clay drilled under McDowells (Wilde and Kerr, 1990). The high manganese content of the north Linda occurrence is also consistent with the scavanged origin of non sulphide zinc considered by BHP at McDowells during their relogging of drill hole G14A.

c) North Lyell Fault/Burbury volcanics

Orientation stream sediment sampling was conducted in three streams draining Mt Lyell and the North Lyell Fault area (Map 5). The streams are located at the western and eastern ends and in the centre of Linda Valley and in each creek sites were sampled below and above the projected position of the North Lyell Fault. At each site stream sediments were sampled for pan concentrates, BLEG and wet sieve -40#. At some sites -80# samples were also taken (Appendix 3). Similar comparative sampling was also done in Cemetery Creek and one of its tributaries (Map 5). For each sample the process feedstock was 2 litres of wet screened -2 mm sediment.

At the time of writing, BLEG data are not available but the small number of results to date show several important points.

i) Strong gold responses in the stream draining the Burbury volcanics below the North Lyell Fault, from both pan concentrates and -80# (sample nos 54 and 56) but not from -40# (sample no 57). All three methods at this site are strongly enriched in manganese and moderately enriched in molybdenum and base metals relative to the other sites on the North Lyell Fault trend, suggesting that the fault contact of the Tyndall Group quartz feldspar porphyries against Owen Conglomerate upstream from this site requires follow up work. Quartz vein stockwork 600 metres to the south east, on The North Lyell Fault zone within Owen Conglomerate, was rock chip sampled (sample nos 586 - 595) with no sign of gold or base metal enrichment.

ii) The creek east of McDowells workings shows no indications of mineralisation or alteration below or above the North Lyell Fault position. The nugget effect in pan concentrates is demonstrated by sample no 50, in which one particle of visible gold was observed but the 50 g fire assay-AAS result is < 1 ppb gold.

This creek drains a valley filled with glacial sediment (Map 2) and the projected position of the North Lyell Fault is subsurface to the sample sites.

iii) A similar situation exists in the western most creek tested, ie the tributary of Idaho Creek. Downslope from the North Lyell Fault position the -40# fraction (sample no 43) shows a slight molybdenum elevation of 45 ppb but the pan concentrate in which 2 particles of gold were observed assayed 2 ppb (sample no 44). Upstream from the fault position, which is sub Quaternary gravel and talus, the pan concentrate (sample no 47) assayed 2.4 ppb, with no visible gold reported. Copper shows a modest elevation to 44 ppm in the -40# fraction (sample no 45).

iv) Cemetery Creek and its tributary, sampled in an area of known mineralisation, shows strong -80# and pan concentrate anomalies in gold and zinc (sample nos 37 and 62) in Cemetery Creek, and -40# anomalies in zinc and copper and strong silver and zinc anomalies from pan concentrates in the tributary creek (sample no 35). Elevated zinc from the-40# fraction (sample no 41 - 365 ppm) was also recorded from the tributary.

Four conclusions are reached, albeit based on a very small number of samples and in the absence of BLEG results.

1 Pan concentrates and both sieve fractions detected the zinc mineralisation in the Cemetery Creek area and produced gold and silver anomalies which need follow up.

2 Pan concentrate and -80# detected gold manganese anomalies below the fault contact of the Burbury volcanics and Owen

Conglomerate. -40# mesh did not respond, confirming the view that the extra effort in producing a minimum 100 g -80# sample is justified. Experiments with sieve fractions finer than -80# are recommended. This site will be further explored.

3 The problem of seeing through the Quaternary cover, particularly in relation to gold, remains unsolved. If mineralisation can be demonstrated along the fault zone then Wacka drilling and/or geophysics should be trialled on the sub Quaternary segments of the fault zone.

4 The nugget problem of gold in pan concentrates combined with the good overall correspondence of pan concentrates and -80# for base metals requires that both methods be used at each site in future.

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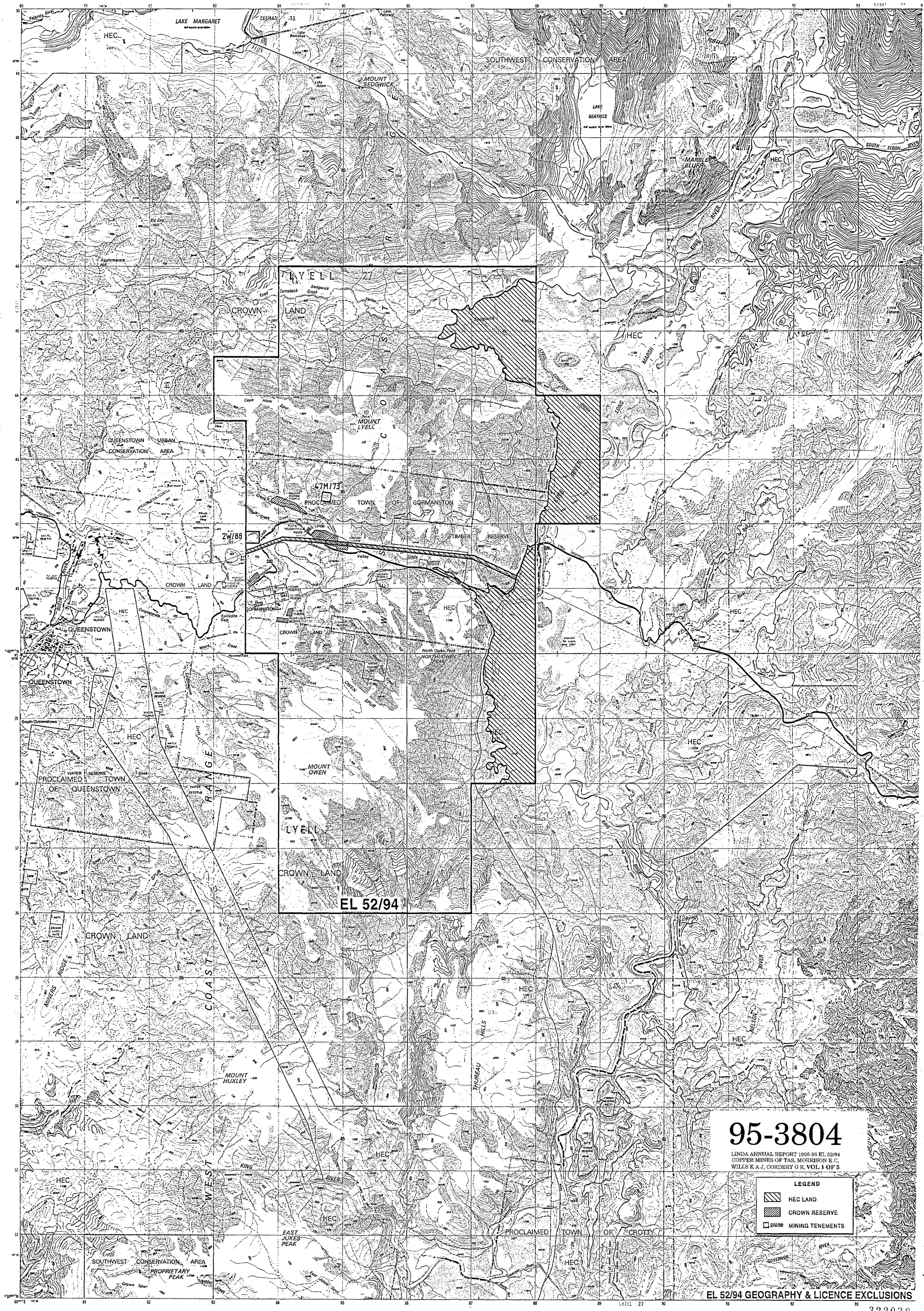
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TASMANIA 1:25 000 SERIES

GORMANSTON



95-3804

LINDA ANNUAL REPORT 1995-96 EL 52/94
COPPER MINES OF TAS, MORRISON K C,
WILLS K A J, CORDERY G R, **VOL 1 OF 5**

LEGEND

- HEC LAND
- CROWN RESERVE
- 2W/88 MINING TENEMENTS

EL 52/94 GEOGRAPHY & LICENCE EXCLUSIONS

322038

PRODUCTION: Mapping Division, Lands Department, Hobart, 1996
ACCURACY: Horizontal: 90% of well defined detail is within 12.5 metres of true position.
Vertical: 90% of elevations are within 5 metres. These accuracies may not be achieved in areas of dense vegetation
RELIABILITY: Topography compiled from aerial photography flown 1984 with field verification 1995.
NOMENCLATURE: Place names have been approved by the Nomenclature Board of Tasmania.
PUBLIC RIGHT OF WAY: Roads on this map do not necessarily indicate a public right of way.
REVISION: A five yearly revision cycle is intended for this series. Users noting errors and omissions are invited to write to the Director of Mapping, GPO Box 44A, Hobart, Tasmania, 7001.
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PROJECTION: Universal Transverse Mercator (UTM).
HORIZONTAL DATUM: Australian Geodetic Datum 1966.
VERTICAL DATUM: Australian Height Datum (Tasmania) excepting offshore islands whose datum is mean sea level.
GRID: 1000 metre intervals of the Universal Transverse Mercator Grid, Zone 55 (Australian Map Grid), Australian National Spheroid. Grid values are shown in full at the south west corner of the map.
CONTOUR INTERVAL: 80 metres with 40 metre index contours.
WORLD GEODETIC SYSTEM 1972: To convert co-ordinates from this system to Australian Geodetic Datum 1966, increase the value of latitudes by 5.2", equivalent to 160 metres, and decrease the value of longitudes by 4.4" equivalent to 102 metres. To obtain heights increase spheroid heights by 4 metres.
MAGNETIC VARIATION: True, Grid and Magnetic North are shown diagrammatically for the centre of this map. Magnetic North is correct for 1995 and moves easterly about 0.1° every two years.

GRID CONVERGENCE 03° — GRID MAGNETIC ANGLE 12.0°

- Residential area; Commercial buildings
- Roads maintained for continuous public use: Primary road with route number; Secondary road with route number; Minor road with route number; Other road
- Roads of restricted use or access: Other roads with bridge; Vehicular track with gate
- Walking track or horse trail (approximate position) with bridge
- Railway with station; Places entered in National Estate Register
- Power transmission line and pylon positions
- Building; Feature of historic or special interest; Ruin; Mine
- Post office; Police station; Fire station; School

SCALE 1:25 000
1 millimetre on this map represents 25 metres on the ground

- Caravan park; Camping ground; Public toilets
- Disposal area; Information centre; Cemetery
- Picnic area; Trig station beacon; Spot elevation
- Contour with value; Depression contour
- Quarry, pit or open cut mine
- Rock scree; Broken rocky surface
- Dense forest; Medium forest
- Low dense vegetation; Distinctive grass
- Orchard; Pine plantation
- Eucalypt plantation; Submerged trees
- Swamp
- Windbreak
- Wet area; Subject to flooding
- Waterfall; Rapids
- Indefinite shoreline or floodbank; Levee
- Tidal rocks or ledge; Offshore rock
- Navigation light or lighthouse; Exposed wreck
- Sand; Tidal reef
- Saline coastal flat; Tidal flats
- Jetty; Launching ramp

5 cm

BOUNDARIES shown on this map are NOT authoritative. General's Division, Law Department; or the Survey Di towns or less than two hectares may not be depicted. Bo to low water mark. To give a land parcel reference, pref number to own title or survey information please consult S are shown as at March 1995.

- Municipality name and number
- Municipality boundary
- Ward name
- Ward boundary
- Town boundary; Other administrative boundaries
- Reserve boundary; Vinculum or joining symbol
- Property boundary; Land parcel boundary and number
- Boundary location uncertain or indefinite

MAP 1

GEOLOGICAL SURVEY OF TASMANIA–HOBART

QUEENSTOWN

1:25 000 SERIES

SCALE 1 : 25 000

1 0.5 0 1 2 km

5 cm

EL 52/94

QUATERNARY

HOLOCENE

- Qc — Cultural features — mine dumps etc.
- Qha — Alluvium, swamp and marsh deposits. May include older alluvial deposits.
- Qt — Talus, scree and colluvial deposits.
- Qfa — Bouldery slope and fan deposits, commonly with levee channels.

PLEISTOCENE

Pleistocene glacial deposits (Qpg). Some moraine ridge crests indicated (• • • •). Some occurrences of Jurassic dolerite boulders (Δ old) and other erratics indicated. Stratigraphy of deposits from Fitzsimons (1989):

- Qpm — Mainly till deposits — unweathered or slightly weathered.
- Qmd — Outwash deposits of Dante Rivulet fan. — MARGARET GLACIATION ≤ 13 000 — ≤ 100 000 ybp
- Qmc — Outwash gravel with rare tills of 'Chamouni terrace'.
- Qtb — Weathered till and outwash gravel of Bull Rivulet Formation. — HENTY GLACIATION >130 00 ybp
- Qtd — Weathered and poorly sorted outwash gravel and till of David Formation.
- Qtc — Weathered outwash gravel and till of Cableway Formation.
- Qpl — Deeply weathered till, outwash gravel and lacustrine sediments. Reversed magnetic polarity indicate age > 730,000 ybp. — LINDA GLACIATION >730 00 ybp

TERTIARY ?

- Ts — Pre-glacial alluvial deposits with preserved tree trunks at CPR38421.

JURASSIC

- Jdl — Dolerite

PERMIAN — CARBONIFEROUS

- Pbu — Bouldery mudstone, sandstone, siltstone. — PARMEENER SUPERGROUP

- Di — Lamprophyre dyke with trend indicated.

DEVONIAN

- Db — Mudstone, siltstone, minor fine-grained sandstone and rare limestone — correlate of Bell Formation.
- Df — Fine-grained quartz sandstone with minor siltstone and mudstone — correlate of Florence Sandstone.

SILURIAN

- Sxa — Undifferentiated sandstone-mudstone-minor limestone sequence — correlates of Crotty and Amber Formations (Sca). — ELDON GROUP
- Scc — Fine to coarse-grained quartz-rich sandstone, calcareous sandstone and minor mudstone (Scc) with upper unit of siltstone and fine-grained sandstone (Scs) — correlates of Crotty Formation.
- Sgs — Mainly siltstone and fine-grained sandstone. — GORDON GROUP
- Sgl — Mainly limestone, commonly decomposed to black clay "pug".

ORDOVICIAN

- Oou — Grey to pink quartz sandstone with basal pebble-granule conglomerate; trace fossils and chromite-rich bands in upper part — Pioneer Beds and correlates. Angular unconformity on Oou and older rocks in places, elsewhere conformable on Oou.
- Oou — Thin-bedded quartz sandstone, commonly bioturbated, with interbedded siltstone and minor granule-pebble conglomerate. Chert clasts common in conglomerate beds in Mt. Lyell mines area.
- Oou — Mainly pale pink to cream coloured, thick-bedded pebble-cobble to cobble-boulder quartzite conglomerate — Middle Owen Conglomerate and correlates.
- Oou — Mainly thin-bedded pink quartzitic sandstone and pebbly sandstone with bands of pebble conglomerate; minor siltstone-correlate of Newton Creek Sandstone.
- Oou — Mainly white to pale pink conglomerate and pebbly sandstone (dOzq) — Lower Owen Conglomerate.
- dOzq — Grey pebble-cobble conglomerate and sandstone in Sedgwick Bluff area (dOzlg).
- dOou — Thick-bedded to massive cobble-boulder conglomerate. Erosional unconformity at base in some areas. — DENISON GROUP = OWEN CONGLOMERATE
- dOou — Thin-bedded grey-green siltstone and micaceous sandstone, grading laterally to pink thin-bedded sandstone.
- dOou — Thick-bedded to massive cobble-boulder conglomerate.
- dOou — Basal unit of partly volcaniclastic conglomerate and sandstone, Thureau Hills.
- dOou — Volcaniclastic conglomerate and sandstone, usually locally developed at contact with volcanic rocks — correlate of Jukes Conglomerate.
- dOch — Chert bodies, usually with hematite ↑ barite veins; conglomerate texture and bedding preserved in some places; partly of hydrothermal origin; some bodies partly derived from Owen Conglomerate.

WURAWINNA SUPERGROUP

- dOqp — Quartz-feldspar (↑ biotite) porphyry.
- dOou — Mainly volcaniclastic conglomerate and sandstone with minor mudstone and tuff.
- dOt — Mainly crystal tuff (quartz-feldspar ↑ pyroxene-phyric) and agglomerate with minor vitric ash, conglomerate, sandstone, siltstone and very rare limestone (Cht). Some bedded sandstone-siltstone units shown (Cht), and a lower unit of quartz-feldspar-phyric lava and tuff (Cv). Comstock Tuff and correlates. — TYNDALL GROUP (INCLUDING "FISH CREEK ASSOCIATION" AND "EASTERN SEQUENCE")
- dOvx — Mainly brown-weathering breccia, agglomerate, tuff and lava of andesitic composition (feldspar-pyroxene ↑ hornblende-phyric) with minor sandstone and siltstone (dOvx). Some units of andesitic lava, including pillow lava, shown (Cvx). Some mafic dykes indicated (Cdi).
- dOvx — Brown-weathering lava, breccia, and related intrusives of basaltic to andesitic composition (feldspar-pyroxene-phyric), including Lynch Creek basalts. Possibly equivalent to dOvx.
- dOvx — Quartz-rich sandstone and granule-pebble conglomerate with interbedded siltstone; trace fossils in some beds. Stichi Range Beds of Lake Beatrice area.

CAMBRIAN

- Cqp — Quartz-feldspar (↑ biotite) porphyry, intrusive and possibly partly extrusive.
- Cdb — Andesitic to basaltic intrusive bodies with minor extrusive and clastic units. Includes feldspar-hornblende-pyroxene-phyric and feldspar-pyroxene-phyric types, and small chlorite-altered dykes. May be related to dOvx and dOp. Includes Crown Hill andesite.
- Cvf — Mainly felsic pyroclastic rocks, dominantly feldspar-phyric, including pumice-bearing tuff and breccia, crystal-vitric tuff, vitric tuff and minor shale and sandstone.
- Cvx — Mainly felsic feldspar-phyric lava and intrusives; massive to flow-banded or autobrecciated, with rare columnar jointing.
- Cvs — Units of bedded siltstone, sandstone, tuff, agglomerate.
- Cvagg — Minor bedded quartzite, associated in places with tuffaceous conglomerate containing dispersed quartzite clasts.
- Cvmg — Dark green, chlorite-rich mafic to intermediate tuff and agglomerate with abundant basaltic clasts. — CENTRAL VOLCANIC COMPLEX (= KING RIVER ASSOCIATION) Partly interfingering relationship with Yolande River sequence.

MOUNT READ VOLCANICS

- Cqp — Felsic porphyry bodies, intrusive and partly extrusive, including quartz-feldspar (↑ biotite) porphyry (Cqfp), feldspar-quartz-pyroxene porphyry (Cfpqp), feldspar-quartz-hornblende porphyry (Cfqhp).
- Cdb — Andesitic to basaltic intrusive bodies with minor extrusive units. Includes feldspar-hornblende-pyroxene-phyric and feldspar-pyroxene-phyric types. May be related to dOvx and dOp.
- Cys — Dominantly greywacke and mudstone with some interbedded vitric tuff, crystal tuff and crystal-lithic tuff (Cys). Some crystal tuff units shown (Cys).
- Cys — Interbedded vitric tuff, crystal tuff, siltstone, slate, sandstone and agglomerate (Cy). Some crystal tuff units (Cyst) and siltstone-slate-sandstone units (Cys) shown.
- Cyvcr — Well bedded micaceous quartzwacke sandstone and minor mudstone — Miners Ridge Sandstone.
- Cyop — Ophitic-textured tholeiitic basalt lava, breccia and tuff with associated intrusives. — YOLANDE RIVER SEQUENCE (= "WESTERN SEQUENCE" AND "LYNCHFORD ASSOCIATION")

PRECAMBRIAN

- Pq — Massive and schistose quartzite, fine to coarse grained
- Pq — Quartz-mica schist, fine to coarse grained, commonly thinly banded
- Pp — Pelitic quartz-mica phyllite.

Ore body — projected to surface in some cases; mined out in some cases.

Orepoint indicates area of alteration in volcanic rocks: ser = sericite, chl = chlorite, py = pyrite, qtz = quartz.

Operating mine.

Prospect or abandoned mine.

Geological boundary — position accurate or approximate.

Geological boundary — transitional.

Geological boundary — inferred or concealed.

Fault — position accurate or approximate; dip shown.

Fault — inferred or concealed.

Strike and dip of bedding — right way up dipping, overturned, horizontal; facing known vertical, facing unknown vertical; dipping.

Strike and dip of compositional banding in igneous and volcanic rock, vertical banding.

Trend and plunge of columnar jointing.

Strike and dip of cleavage, vertical; synchronous cleavages (approx. strike) dipping, vertical; locally earlier cleavage dipping.

Type of cleavage — slaty; crenulation; spaced and seamed.

Strike and dip of dominant cleavage or schistosity in P rocks, vertical: cleavage later than dominant cleavage

Minor fold hinge-line with plunge; dip of axial surface shown.

Axial surface trace and plunge of major anticline, syncline.

Dominant lineation.

Field station for adjacent readings on map.

A — Queen River — MINERS RIDGE — WHIP SPUR — B — MT. OWEN — Lake — NORTH OWEN PEAK — Linda Creek — C

SECTIONS V : H = 1

Geology by K.D. Corbett, B.Sc. (Hons), Ph.D.; C.R. Calver, B.Sc. (Hons); J.L. Everard, B.Sc. (Hons) and D.B. Seymour, B.Sc. (Hons), Ph.D.
Base map adapted from 1 : 25 000 series maps produced by Lands Department, Hobart.
Geological map production by the Cartographic Section of the Geological Survey, Department of Mines, Hobart.
Cartography by P.B. Nankivell and C.A. Mosch.
Senior Geologist in charge of Queenstown 1 : 25 000 mapping K.D. Corbett, B.Sc. (Hons), Ph.D.
Compiled under the direction of M.R. Hargreaves, Deputy Director of Mines, and H. Murchie, B.Sc., Director of Mines.
Issued under the authority of the Minister for Resources and Energy.

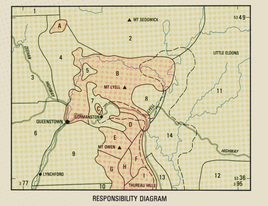
Published 1989.
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AREAS COMPILED FROM PREVIOUS MAPPING

1. Corbett, K. D. 1986. Geology of the Henty River Mt. Read Area. Mt. Read Volcanics Project Map 3, Department of Mines Tasmania.
2. Corbett, K. D. and Jackson, J. J. 1987. Geology of the Tyndall Range Area. Mt. Read Volcanics Project Map 5, Department of Mines Tasmania.
3. J. L. Everard — mapping for Leven 1 : 50 000 Sheet (1987).
4. Corbett, K. D. 1987. Geology of the Lake Margaret and associated rocks within Lake Margaret Road-Cynthia Bay area. Unpub. Rep. 1987/15, Department of Mines, Tasmania.
J. L. Everard and P. W. Baillie — mapping for Leven 1 : 50 000 Sheet (1987).
5. Gold Fields Exploration P/L — mapping by P. Kempshan.
6. P. W. Baillie — mapping for Leven 1 : 50 000 Sheet (1987).
7. E. Williams — mapping for Leven 1 : 50 000 Sheet (1987).
Gold Fields Exploration P/L — mapping by G. Arnold.
8. P. R. Williams — mapping for Leven 1 : 50 000 Sheet (1987).
Corbett, K. D. 1987b : Stratigraphy, correlation and evolution of the Mt. Read Volcanics in the Queenstown, Johns-Darwin and Mt. Sedgwick areas. Bull. Geol. Surv. Tasm. 58.
9. Corbett, K. D. 1979. Bull. Geol. Surv. Tasm. 58.
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D. B. Seymour — mapping for Leven 1 : 50 000 Sheet (1987).
10. J. L. Everard — mapping for Leven 1 : 50 000 Sheet (1987).
11. C. R. Calver — mapping for Leven 1 : 50 000 Sheet (1987).
12. Cox, R. D. 1963. Structure and petrology of the Raglan Range. Bull. Geol. Surv. Tasm. 42.
Compiled by N. J. Turner for Leven 1 : 50 000 Sheet (1987).
13. P. W. Baillie — mapping for Leven 1 : 50 000 Sheet (1987).
14. Quaternary stratigraphy and distribution from Fitzsimons, S. J. 1988. The Quaternary stratigraphy and sedimentology of the King River Valley, Western Tasmania. Ph.D. thesis (unpub.), University of Tasmania.

RE-MAPPED AREAS 1988-89

A — J. L. Everard.
B — K. D. Corbett, with reference to Leven 1 : 50 000 Sheet (P. W. Williams, E. Williams) and Gold Fields Exploration P/L (G. Arnold, P. Kempshan, Mt. Lyell Co. geologists).
C — K. D. Corbett, with reference to Leven 1 : 50 000 Sheet (E. Williams) and Gold Fields Exploration P/L (G. Arnold).
D — C. R. Calver, K. D. Corbett, D. B. Seymour, with reference to Leven 1 : 50 000 Sheet (D. B. Seymour, E. Williams).
E — C. R. Calver, K. D. Corbett, with reference to Level 1 : 50 000 Sheet (E. Williams).
F — D. B. Seymour, K. D. Corbett, with reference to Level 1 : 50 000 Sheet (D. B. Seymour).
G — K. D. Corbett, D. B. Seymour, with reference to Gold Fields Exploration P/L (P. Kempshan) and Level 1 : 50 000 Sheet (P. W. Baillie).
H — C. R. Calver, D. B. Seymour, with reference to Level 1 : 50 000 Sheet (D. B. Seymour).
I — C. R. Calver, K. D. Corbett, with reference to Level 1 : 50 000 Sheet (P. W. Baillie).



RESPONSIBILITY DIAGRAM



LOCATION MAP

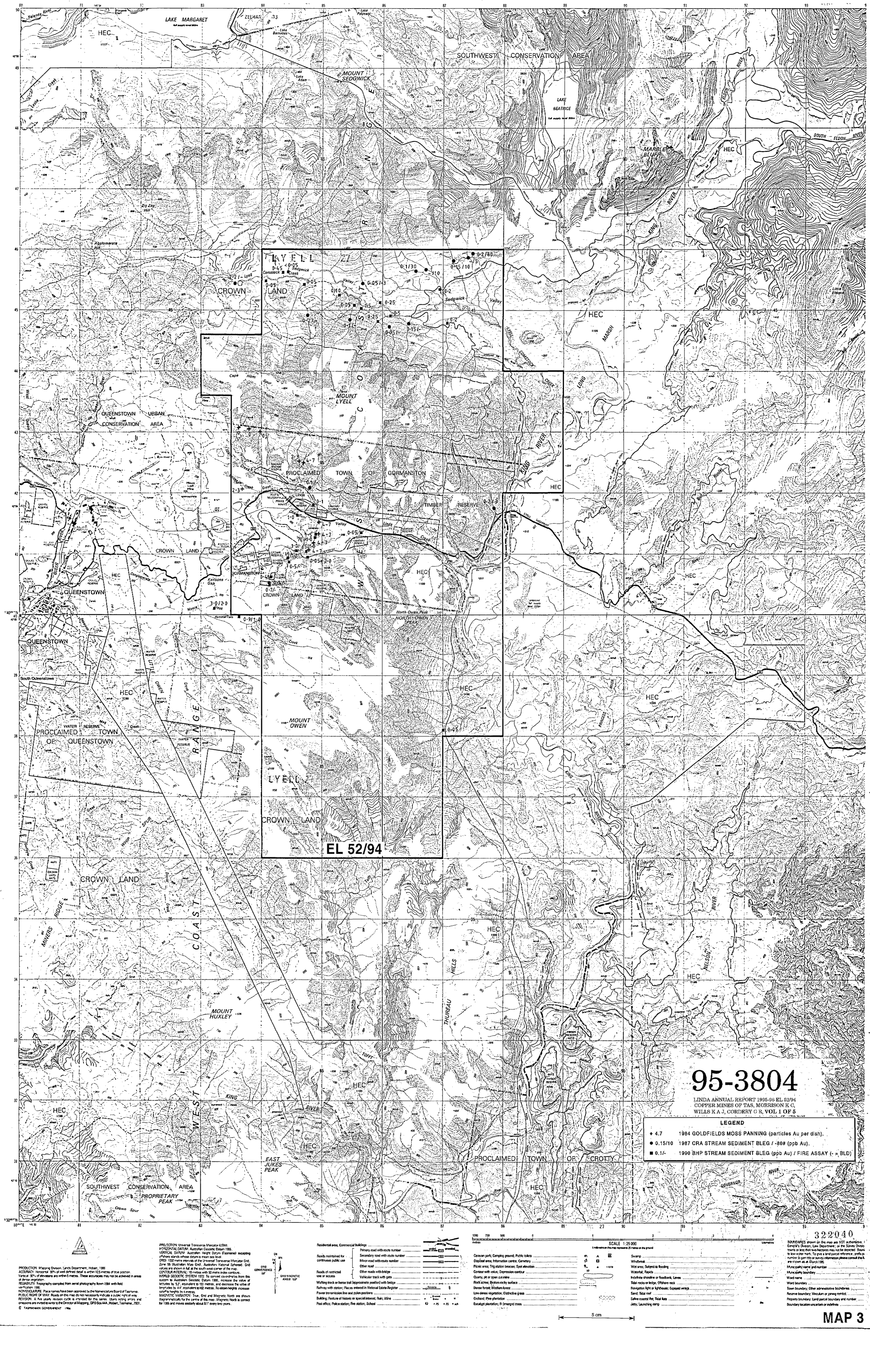
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MAP 2

QUEENSTOWN 1 : 25 000

TASMANIA 1:25 000 SERIES

GORMANSTON



95-3804

LINDA ANNUAL REPORT 1995-96 EL 52/94
COPPER MINES OF TAS, MORRISON K C,
WILLS K A J, CORDERY G R, VOL 1 OF 5

LEGEND

+ 4.7	1984 GOLDFIELDS MOSS PANNING (particles Au per dish).
● 0.15/10	1987 CRA STREAM SEDIMENT BLEG / -80# (ppb Au).
■ 0.1/-	1990 BHP STREAM SEDIMENT BLEG (ppb Au) / FIRE ASSAY (- = BLD)

PRODUCTION: Mapping Division, Lands Department, Hobart, 1996
ACCURACY: Horizontal: 90% of well defined detail is within 12.5 metres of true position. Vertical: 90% of elevations are within 5 metres. These accuracies may not be achieved in areas of dense vegetation.
RELIABILITY: Topography compiled from aerial photography flown 1984 with field verification 1996.
NOMENCLATURE: Place names have been approved by the Nomenclature Board of Tasmania.
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GRID CONVERGENCE 0.8° — GRID MAGNETIC ANGLE 12.8°

Residential area; Commercial buildings
Roads maintained for continuous public use: Primary road with route number; Secondary road with route number; Minor road with route number; Other road
Roads of restricted use or access: Other roads with bridge; Vehicular track with gate
Walking track or horse trail (approximate position) with bridge
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Caravan park; Camping ground; Public toilets
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Orchard; Pine plantation
Eucalypt plantation; Scrub/regrd trees

Swamp
Windbreak
Wet area; Subject to flooding
Waterfall; Rapids
Indefinite shoreline or floodbank; Levee
Tidal rocks or ledge; Offshore rock
Navigation light or lighthouse; Exposed wreck
Sand; Tidal reef
Saline coastal flat; Tidal flats
Jetty; Launching ramp

5 cm

322040

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Municipality name and number
Municipality boundary
Ward name
Ward boundary
Town boundary; Other administrative boundaries
Reserve boundary; Vinculum or joining symbol
Property boundary; Land parcel boundary and number
Boundary location uncertain or indefinite

MAP 3

TASMANIA 1:25 000 SERIES

GORMANSTON

LAKE MARGARET
HEC
ZEHAN
Lake Polycarp
Lake Barnabas
SOUTHWEST CONSERVATION AREA
MOUNT SEDGWICK
Lake Adam
LAKE BEATRICE
MARBLE BLUFF
SOUTH ELDON RIVER
ELDON RIVER
Yolande River
Lesley Creek
Zig Zag Hill
Agglomerate
BEATRICE GRID
MLMRC 1960's / BHP 1989
KING RIVER
Dams
Rivulet
Little Eldons
LYELL
Sedgwick Creek
Comstock Valley
CROWN LAND
TASMAN CROWN LYELL GRID
RTAE 1957
CV1
C54
C51
C49
COMSTOCK VALLEY GRID
MLMRC 1960's / BHP 1989
Sedgwick Valley
MARSH
COMSTOCK
LONG CREEK
KING RIVER
MOUNT LYELL
Cape Horn Spur
Idaho (Au)
Watsons (Au)
North Lyell Pioneer (Cu)
Lyell Consols East (Cu)
Lyell Consols (Cu)
Zeplins (Au)
Lyell Pioneer (Au)
King Lyell (Cu)
Old Gold (Au)
G14A
McDowells (Au)
PROCLAIMED TOWN OF GORMANSTON
TIMBER RESERVE
LINDA GRID
PLACER 1967
GORMANSTON GRID
MLMRC 1940's
Linda
Chamonix
Valley
Bull Run
Rivulet
LYELL HIGHWAY
Princess River
GORMANSTON
CROWN LAND
Mount Owen
North Owen Peak
NORTH OWEN PEAK
OWEN SPUR
HEC
QUEENSTOWN
South Queenstown
PROCLAIMED WATER RESERVE OF QUEENSTOWN
Roaring Creek
Lyell Hwy
MOUNT OWEN
LITTLE OWEN GRID
PICKANDS MATHER 1960's/
MLMRC 1974
LYELL
CROWN LAND
EL 52/94
Lyell Highway
Nelson River
Lyell Creek
Whip Spur
Doone Creek
MINERS RIDGE
COAST
MOUNT HUXLEY
THUREAU
TOFFT RIVER
KING RIVER
WEST
EAST JUKES PEAK
PROPRIETARY PEAK
Crown Spur
Traveller Creek
East Jukes Spur
PROCLAIMED TOWN OF CROTTY
Governor River
Bastion
GOVERNOR RIVER
Nelson River

EL52/194
Watsons (Au)
LB1
LB2
LB4

EL52/194
LB19
LB18
LB21
LB22
LB23
LB20
LB5
LB12
LB24
LB8
LB10
LB9
LB11
LB25
LB6
LB7

EL52/194
KL13
ML10
ML11
KL2
ML12
Old Gold (Au)

EL52/194
G6
G5
G12
G4
G3
G13
G2

0 100 200m
Scale 1:5000

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NOMENCLATURE: Place names have been approved by the Nomenclature Board of Tasmania.
PUBLIC RIGHT OF WAY: Roads on this map do not necessarily indicate a public right of way
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PROJECTION: Universal Transverse Mercator (UTM)
HORIZONTAL DATUM: Australian Geodetic Datum 1966
VERTICAL DATUM: Australian Height Datum (Tasmanian) excepting offshore islands whose datum is mean sea level
GRID: 1000 metre intervals of the Universal Transverse Mercator Grid, Zone 55 (Australian Map Grid). Australian National Spheroid. Grid values are shown in full at the south west corner of the map.
CONTOUR INTERVAL: 10 metres with 50 metre index contours
WORLD GEODETIC SYSTEM 1972: To convert co-ordinates from this system to Australian Geodetic Datum 1966, increase the value of latitudes by 5.2", equivalent to 161 metres, and decrease the value of longitudes by 4.4", equivalent to 102 metres. To obtain heights increase ellipsoidal heights by 4 metres.
MAGNETIC VARIATION: True, Grid and Magnetic North are shown diagrammatically for the centre of this map. Magnetic North is correct for 1986 and moves easterly about 0.1° every two years.

GRID CONVERGENCE 0.8°
GRID MAGNETIC ANGLE 12.8°

Residential area; Commercial buildings
Roads maintained for continuous public use: Primary road with route number; Secondary road with route number; Minor road with route number; Other road
Roads of restricted use or access: Other roads with bridge; Vehicular track with gate
Walking track or horse trail (approximate position) with bridge
Railway with station; Places entered in National Estate Register
Power transmission line and pylon positions
Building; Feature of historic or special interest; Ruin; Mine
Post office; Police station; Fire station; School

SCALE 1:25 000
1 millimetre on the map represents 25 metres on the ground

Caravan park; Camping ground; Public toilets
Disposal area; Information centre; Cemetery
Picnic area; Trig station beacon; Spot elevation
Contour with value; Depression contour
Quarry, pit or open cut mine
Rock scree; Broken rocky surface
Dense forest; Medium forest
Low dense vegetation; Distinctive grass
Orchard; Pine plantation
Eucalypt plantation; Submerged trees
Swamp
Windbreak
Wet area; Subject to flooding
Waterfall; Rapids
Indefinite shoreline or floodbank; Levee
Tidal rocks or ledge; Offshore rock
Navigation light or lighthouse; Exposed wreck
Sand; Tidal reef
Saline coastal flat; Tidal flats
Jetty; Launching ramp

5 cm

322041

BOUNDARIES shown on this map are NOT authoritative. General's Division, Law Department, or the Survey Divisio towns or less than two hectares may not be depicted. Bound to low water mark. To give a land parcel reference, prefix p number to gain title or survey information please consult the A are shown as at March 1986.

Municipality name and number
Municipality boundary
Ward name
Ward boundary
Town boundary; Other administrative boundaries
Reserve boundary; Vinculum or joining symbol
Property boundary; Land parcel boundary and number
Boundary location uncertain or indefinite

95-3804

LINDA ANNUAL REPORT 1995-96 EL 52/94
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WILLS K A J, CORDERY G R, **VOL 1 OF 5**

EL 52/94 PREVIOUS WORKINGS, GRIDS & DRILL HOLES

MAP 4

E 384 000

N5342 000

CROWN LAND
GORMANSTON 18

LINDA
RAILWAY STATION RESERVE 4888

TIMBER RESERVE

TIMBER RESERVE

Linda Creek

Linda Creek

Boundary between Gormanston Rhyolite Body

0045-47
0042-44
0598-600
0048-50
0051-53
0563-64
0597
0585
0010
0007-9
0012
0003-6
0001-2
0011
0598
0566-67
0048-58
0031
0030
0027-28
0025-26
0029
0014-15
0582-83
0580-81
0579
0577-78
0584
40
70
0574-76
0013
0016
0551
0017
0018, 0552-53
0037-39, 0062
0620
0035-36
0040-41
0554-56
0022-23
0560-61
0557-58
0559
40
55
0024
0058-61
0054-57
0572-73
0596
0571
0570
75
0586-95

LEGEND

- LATERITIC IRONSTONE, CLAY ON GORDON GROUP ROCKS
- GORDON GROUP BLACK SHALE / CLAY
- GORDON GROUP LIMESTONE
- QUARTZ VEIN STOCKWORK IN FAULT ZONE
- STRIKE & DIP OF BEDDING (VERTICAL DIP)
- 0045-47 LOCATION & TICKET No. - Stream sediment samples
- 0598 LOCATION & TICKET No. - Rock chip outcrop sample
- 0618 LOCATION & TICKET No. - Rock chip float sample

N

95-3804

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322042

0 250m
Scale 1:5000

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EL 52/94
LINDA VALLEY SAMPLING & MAPPING
Author: K.C.Morrison | Drafting: R.Carroll | Date: 8/12/95

MAP 5

5 cm

322043

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OPEN CUT POTENTIAL OF THE COPPER CLAYS AREA MOUNT LYELL, TASMANIA

REPORT NO: 1995-50

95-3804

LINDA ANNUAL REPORT 1995-96 EL 52/94
COPPER MINES OF TAS, MORRISON K C,
WILLS K A J, CORDERY G R, **VOL 3 OF 5**

Author	: K J A Wills
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Date	: June 1995
Distribution	: CMT Library (2 copies)
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Ref:	Reps: 1995-50

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WILLS K A J, CORDERY G R, VOL 3 OF 5

322044

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1. SUMMARY

This report synthesises 112 years of mining and exploration history at the Mt Lyell Copper Clays. These are a series of native copper in clay deposits located at the head of the Linda Valley, just below the Mt Lyell Saddle. The main deposits are Lyell Blocks, Lyell Consols and King Lyell. They occur in valleys and are generally covered by thin fluvioglacial sediments. The data on which this report is based have been available for the last 25 years but have not been previously reported or interpreted.

During the 1886 Linda gold rush, in addition to gold, up to 1 kilogram per dish of native copper could be panned from Cooney's Creek (King Lyell) and on Jimmy Watson's Claims (Lyell Blocks). Early copper production commenced with sluicing operations and in 1902 the Blocks commenced gravity treatment of underground ore. The Blocks mine had a large and rambling gravity plant that was visited by metallurgists from all over the Commonwealth, and pronounced first class.

Total production between 1892 and 1910 was 243,000 tonnes of 1.6% ore for 2,750 tonnes of copper. The Blocks and Consols underground mines had severe problems with ground stability and both were closed following collapses and flooding. During its brief life, the Blocks produced a concentrate averaging 69% copper with a recovery of 72%. The Mount Lyell Blocks Mining Company NL was one of the few companies on the field apart from the MLMRC to declare dividends. The mine was eventually sold to the MLMRC for £5,000 in 1919. Blainey summed up its history succinctly as "a courageous and enterprising company; it deserved a better fate."

Several early factual geological descriptions of the deposits have been very useful. Native copper was found outcropping in 'pug' in the form of: sheets in joints; dendritic masses coated in chalcocite; as pebbles, nuggets, shots and spangles; as masses up to 75 kgm and as limonite geode fillings of interlayered cuprite and native copper. Batchelor's original 1902 diamond drill logs provide neat and factual descriptions which showed that native copper was the main ore mineral throughout the clay hosted deposits and into the underlying unconsolidated Pioneer Sandstones.

Previous geological descriptions and genetic ideas are reviewed and it is shown that recent workers have suffered from a lack of access to good factual data. This led to unjustified theories which were tested by expensive and unsuccessful exploration programmes. The worst example was the drilling of two long diamond holes in 1984 which showed there was no ore where the Block's main shaft had previously reached the same conclusion in 1915.

Elements of previous genetic ideas have been combined to produce a new model which is factually well supported. It involves the dissolution of copper during weathering into acid oxidising drainage and the neutralisation of solutions during mass formational dissolution of Gordon Limestone. Copper is precipitated by the reducing effects of clay, carbon or humic acid in the limestone residue or pug. The process has been termed natural Cainozoic hydrometallurgy and has a predictive capacity which will hopefully aid future exploration.

A total of 46 diamond drillholes for about 4,000 metres has been drilled during exploration of the Copper Clays between 1902 and 1970. New summary logs have been produced, plotted and interpreted. A sectional resource estimate using a cut off

grade of 0.1% Cu gave a global inferred resource of 8Mt at 0.6% copper. Core recovery averaged between 56 and 70% which results in a higher than normal uncertainty on the grade of the resource. Simple pit designs lead to an estimated recoverable resource at a waste to ore ratio of 2.3 to 1 of 6.9Mt at 0.6% copper. Estimates of total resource potential including inferred resources have also been made. They suggest that 19Mt at 0.8% Cu may be present with a target of potentially recoverable copper in the order of 90,000 tonnes.

Preliminary economics are examined. For contract mining and a gravity copper separation plant, operating costs of $11.28 per tonne are estimated. This equates to a break-even head grade of 0.45% copper. To produce copper with operating costs of 50% of revenue, a head grade of 0.9% is needed, and believed achievable. This suggests that mining of the Copper Clays could be highly profitable. It also justifies an exploration programme to upgrade the status of the resource and provide information for a pre-feasibility study.

A 64-hole, 5,590m programme of vertical air core and face sampling hammer drilling is proposed. This will lead to a better understanding of the deposits and possible estimation of an indicated resource. By weighing drill samples, more reliable estimates of recoveries and tonnage factors will be obtained. It is also proposed to commence collecting metallurgical and mining information.

Finally, the long term exploration potential for the entire Copper Clays area is assessed. Four main targets are considered worthy of exploration attention. Firstly, the Copper Clay deposits as described above. Secondly, there are four locations of limited Tabberabberan quartz vein gold known. These suggest leakage from potential Henty-style gold orebodies in structures at depth. Thirdly, carbonate hosted lead-zinc mineralisation is suggested by the presence of fine-grained galena and honey-yellow sphalerite in concentrates from non cupriferous clays. Fourthly, there is the much greater prize of a continuation of the Mt Lyell Copper-Gold-Silver Field at a depth of about 1,500 metres under the Copper Clay deposits and Owen Conglomerate on the eastern side of the Great Lyell Fault.

The Copper Clays are a rare to unique type of ore deposit and their successful evaluation is a challenging task. However, potential rewards are high and it is believed that, like the impact of the 1893 Mt Lyell silver bonanza on the MLMRC, the Copper Clays have the potential to produce a significant cash injection during Copper Mines of Tasmania's ("CMT") early years at Mt Lyell.

2. INTRODUCTION

The Copper Clays at Mt Lyell are an unusual group of native copper in clay deposits at the head of the Linda Valley which have been promoted by many but with very little long term effect. The deposits are all located under modern water courses at altitudes of between 300 and 600m above sea level as shown on Figure 1. There are three previous mines and a large area of prospective ground (shown on Figure 1 as Mpc) which may be mineralised.

As part of a brief to examine the future open cut potential of the Mt Lyell area, it became clear in the initial assessment (Wills, 1995a), that excellent potential existed in the Copper Clays area. This was not difficult to conclude as estimates of 'indicated' ore of 1.99 Mt at 1.92% Cu, with an additional 6 million tonnes possible, were made by Wade (1957b). Subsequent workers appear not to have been aware of Wade's conclusions as they have not been mentioned again until Flitcroft and McKeown's (1992) report and subsequently by Newnham (1993), Snowden (1994) and Ellis (1994).

After producing a first-pass assessment of the West Lyell resource, (Wills, 1995b), and while work on an upgrade of the West Lyell resource estimation was under way, an early assessment of the Copper Clays area was requested by Gold Mines of Australia Limited's ("GMA") management so that decisions on future metallurgical and exploration work could be made.

The work for this report has taken about 5 weeks, mostly compiling data, but results have exceeded expectations. It is thought that this has resulted from a situation, particularly during the 1980's, where 'theory' based exploration had gained the upper hand and participants were either unable or unwilling to consider, or unaware of the existence of, the large amount of factual descriptive information which conflicted with their concepts.

This report has been designed to provide a comprehensive overview of the history and economic geology of the Copper Clays deposits. Very little new work other than drawing up and interpreting drill sections has been necessary.

Historical data from the 36 years of operations between 1883 and 1919 is a vital part of the story. Three operations demonstrated that production of high grade copper concentrates by gravity methods was possible. However, underground mining of unconsolidated materials has obvious dangers and after collapses and flooding, the early mines were forced to close. If the deposits are amenable to cheap open cut mining, as well as to gravity concentration, then hurdles to their larger scale development can now be successfully overcome.

3. CONCLUSIONS

3.1 Copper Clays Neglected

Information used in this report has lain dormant at Mt Lyell for 25 years. Between 1902 and 1970, 46 diamond drillholes were completed and neither the results nor their implications have been properly assessed.

3.2 History

The Copper Clays were the first producers of copper metal at Mt Lyell with a total of about 2750 tonnes of copper from 243,000 tonnes of ore averaging 1.6% between 1892 and 1910. The largest mine at Lyell Blocks was in production between 1902 and 1907

with a peak labour force of 282 men. They produced high grade native copper rich concentrate averaging 69% with a recovery of 72% by gravity separation.

3.3 Geology

The Copper Clays are a rare to unique group of mineral deposits hosted in clays formed as a residue after the mass formational dissolution of Gordon Limestone in post landscape-formation times. A natural Cainozoic hydrometallurgical model is proposed for their genesis. In this model, acid oxidised drainage is neutralised by reaction with limestone and native copper and cuprite are precipitated by reduction within the clays.

3.4 Resource

Resources for the three main deposits total 8.0 mt at a grade of 0.6% copper. Due to poor core recovery from unconsolidated sediments, this resource can only be classified as an inferred resource. Simple open cuts have been designed and an overall waste to ore ratio of 2.3 to 1 with a recoverable resource of 6.9 mt at 0.6% Cu has been derived. Due to the lack of drillholes in the central higher-grade cores of the deposits, the grade is lower than that expected after further systematic drilling.

A number of extensions are likely with a target resource potential of 19 mt at 0.8% Cu containing approximately 90,000 tonnes of recoverable copper.

3.5 Economics

Using preliminary costs for a contract mining and gravity separation type of operation, with waste to ore of 2.3:1, operating costs total $11.28 per tonne. At a copper price of $35 per % Cu this is equivalent to a break even recovered grade of 0.32% Cu and head grade of 0.45% Cu. To operate with costs at 50% of revenue a head grade of about 0.9% Cu is necessary. The clays have the potential to be a highly profitable operation and an exploration programme to upgrade the status of the resource is justified.

4. RECOMMENDATIONS

4.1 Proposed Exploration Programme

A 64-hole, 5,590m programme of mixed vertical air core and face sampling hammer drillholes is proposed. This will lead to a better understanding of the deposit and possibly enable classification as an indicated resource so that a pre-feasibility study can be undertaken.

4.2 Treatment of Drill Samples

During the programme, careful work collecting, weighing and describing drill samples should lead to more reliable estimates of recoveries, tonnage factors and mineral distribution. Several types of copper analysis such as strong acid, weak acid and gravity recoverable copper will also help in later assessments.

4.3 Metallurgical and Mining Investigations

Representative metallurgical samples can be obtained during the drilling programme. Composite samples should be collected and size analysis and gravity recoverable copper determined. Drilling techniques need to be recorded in detail for each hole to build up a model for the proportion of each orebody which is amenable to free digging, and that requiring drill and blast.

5. HISTORY

The original Mt Lyell discovery in 1883 was based on following up alluvial and eluvial gold shed from the Iron Blow. When operating capital became scarce in 1886, the Mt Lyell Prospectors Association received a boost from a very bullish report by the Government Geologist, Gustav Thureau. He claimed the deposit was phenomenally rich in gold and so large that the deposit would be practically inexhaustible (Thureau, 1886, p. 7). In 1887, the Prospectors Association engaged Sydney geologist, J R Robertson, to assess Mt Lyell. He contradicted Thureau by saying that the average ore was poor in gold and silver and rich in copper, and was similar to the Tharsis Mine in Spain (Blainey, 1993, p. 43).

Despite Robertson's assessment, the Prospectors Association was dissolved and the Mt Lyell Gold Mining Company formed in 1888. Capital was raised and an eight-head stamp battery set up to recover the gold bonanza. Both Robertson and Thureau protested that abundant barite in the ore would severely hinder gold recovery. The battery operation was not viable and in 1891 the company was put up for sale. It was purchased by Bowes Kelly who then floated the Mt Lyell Mining Company in January 1892.

After another bullish, though this time reasonably accurate report by Peters (1893), the Mt Lyell Mining and Railway Company was formed in March 1893. The company did flourish in its early years from a bonanza; but from silver rather than gold or copper. A rich vein of stromeyerite [(Cu, Ag)S] containing 862 tonnes at 3.1% produced 24.4 tonnes of silver and provided the young company with a windfall gain of some £106,000, and some very credible publicity.

From reports by Peters (1893) and Thureau (1886), early gold production of about 4000 ounces can be estimated in the 1880's. This included some 2,200 ounces from the Blow and 1,800 ounces from the Upper Linda Valley alluvials. Thureau (1886, p.8) also noted that native copper was abundant in creeks about 200m east of the Blow (King Lyell) and from Watson's Claim (Lyell Blocks). He noted that: "besides gold, copper is found in its pure malleable state embedded in a kind of hard brown clay. Lumps of pure copper weighing between 1 and 3 kg could be found and up to 1 kg of native copper could be washed in a dish." No records of copper production for the 1883-1897 period have yet been located, but it seems clear that the first significant copper production from the Mt Lyell Field was not from sulphide deposits, but actually from the Copper Clays.

Power (1891, p. 32) also examined the alluvial deposits and provided a useful early description of them: "On tracing the alluvial copper to its source we are led to a zone of

decomposed schists forming a pug; grey, yellow and red, some hundred feet broad ..... the copper is found in sheets as if occupying the joints and cleavage planes of the original rock. These sheets of metal which at times are fairly thick, get broken up into small nuggets, shots and spangles which are more or less coated with the black oxide of copper (chalcocite). Below the native copper we come across cuprite which occurs in beautiful crystals, mostly octahedrons. No doubt the native copper has been reduced from this by the agency of the peaty waters. Still deeper than the cuprite, we come across copper pyrites and/or iron pyrites."

Another useful early description from underground observations at Lyell Blocks is by Gregory (1905, p. 140). "From observation it would appear as if the deposition of the ores had taken place subsequent to some of the transverse faulting as is evidenced by the fact that these smaller dislocations intersect the impregnated areas without any apparent alteration in the peripheral walls (such as they are) of the ore occurrences .....(Later, p. 142) the 'eastern orebody' within the North Mt Lyell property ..... is quite different from any other in the mine, and is made up of quartzitic boulders and decomposed matter carrying chalcopyrite and bornite. The soft dark decomposed matter is by far the richer in metallic contents, probably being enriched through decomposition of the original ore."

There are also some useful descriptions in W T Batchelor's 1902 drill logs of holes ML8-12 at the King Lyell deposit. Holes 9 and 10 passed through native copper bearing clay over their entire lengths and bottomed in native copper bearing conglomerates. 'Pebbles' of native copper as well as associated 'fossil wood' were also described.

It is clear that the early geologists, some of whose valuable observations are cited, had recognised many features of the Copper Clay deposits which appear to have been overlooked in more recent times.

The early history of the Mt Lyell Field was fiercely competitive and, after discovery of rich ironstone-hosted gold at the Blow in June 1886, news spread fast and sparked a gold rush. By September, over 200 diggers were working in the upper Linda Valley and any remaining ground was blanket pegged. In the years to about 1910, the cumulative effect of hundreds of miners and prospectors working for 40 different companies putting in exploration adits and shafts is thought to have been far more effective than the modern era exploration.

Only four companies have ever paid dividends from activities on the Mt Lyell Field. Of these, MLMRC, Lyell Tharsis and South Tharsis were all dependent on the financial success of the MLMRC for their production. The only other company to pay a dividend from its own efforts was the Lyell Blocks Company in 1906. The combination of the first copper production and an ability to generate dividends are the two most notable features of the early history of the Copper Clay deposits.

More detailed descriptions of the mining and production history of the main deposits are given below.

5.1 Lyell Blocks

Native copper mineralisation at the Blocks is mentioned in the first known geological report on the Mt Lyell Field by Thureau (1886). At this time, title was held by Jimmy Watson whose partners had located alluvial copper and gold. This included the largest gold nugget from the Goldfield which was located near the topographically highest part of the diggings. This 6.5 ounce nugget contained 4.5 ounces of gold associated with well-formed quartz crystals. Two creeks draining the southern slopes of Mt Lyell were named Gold and Copper Creeks after their alluvial contents (Figures 1 and 26). To the writer's knowledge, a primary source for the gold in Gold Creek has never been identified and could lie under scree cover along the North Lyell Fault near grid position 6100N-6350E.

Some early workers, for example Power (1891, p. 30) thought that the source of the gold was the conglomerates surrounding the upper Linda Valley. Power noted that where gold still clings to its matrix, it is sometimes in contact with hematite and sometimes with quartz. He also mentioned that he and local miners Jack Fehey and Steve Karlson had obtained gold from the products of decomposing conglomerate boulders.

After the 1886 rush, Watson's six claims were floated into the North Mt Lyell Prospecting Association who unfortunately found nothing to develop (Blainey, 1993, p. 102). In 1889, the leases came into the possession of a Sydney syndicate known as the Stanley Company (Mining Standard, 1898). They spent £3,000 but were unable to make the property pay. However, they did prove the existence of a large lode of auriferous copper clay. They also held the ground without working it for a long time. Some time before 1892, the leases became owned by the Idaho Copper Mining Company. Two reports by Thureau (1892; 1893) give information on this period. Twenty tonnes of concentrate were sent to Newcastle (NSW) where they yielded 90% copper.

Some time before 1897 (Russell, 1898), the ground was renamed the Blocks and ownership passed to the Melbourne-based Mt Lyell Blocks Copper Corporation. The new manager was Robert Schloesser who placed an emphasis on underground exploration for which he was congratulated by the Press (Mining Standard, 1898). During the period 1897-99 significant sulphide and native Cu ore was discovered and production was said to be imminent (PMIT).

Production did commence during the September 1900 quarter when 3,583 tonnes of bornite ore, said to average 10% Cu, were produced. About the first 10,000 tonnes of bornite ore produced came from the North Lyell orebody on the Blocks leases. However, about the last 8,000 tonnes were stolen from the North Mt Lyell company's ground. The MLMRC were the main benefactors (Blainey, 1993, p. 143). A total of 18,568 tonnes averaging 7.6% copper with similar gold and silver contents to the North Lyell orebody grades were sold to MLMRC between the September 1900 and December 1901 quarters. This production has been included with statistics on the North Lyell Orebody and is not listed in Table 1. Before the end of 1901, probably to avoid legal prosecution, the Mt Lyell Blocks Copper Corporation was dissolved and reformed as the Mt Lyell Blocks Mining Company NL.

Table 1

Copper Clays, Historic Production Details

Mine	Period	Data Source	Tonnes Treated	*Head Grade % Cu	Recovered Grade % Cu	Tonnes Produced Cu
Lyell Blocks	pre-1892	T	20.3	Cons	90.0	18.3
	1902	P	7,500	2.81	2.02	151.7
	1903	P	No production			
	1904	P	17,429	1.72	1.24	215.4
	1905	P	64,410	1.80	1.28	823.2
	1906	P	71,926	1.51	1.09	781.6
	1907	P	45,089	1.14	0.82	368.3
Total Lyell Blocks			206,354	1.58	1.13	2,385.5
Lyell Consols	1909	P	8,700	1.11	0.80	69.4
	1910	P	14,906	1.07	0.77	115.3
Total Lyell Consols			23,606	1.09	0.78	184.7
King Lyell	pre 1897	R	10,000	2.08	1.5	150
	1898	P	2,760	2.08	1.5	41.4
	1899	P	273	2.08	1.5	4.1
	pre 1903	B1	21	56.1	40.4	8.5
	1904	B2	2	1.53	1.1	0.02
	1906	B2	4	2.36	1.7	0.07
Total King Lyell			13,060	2.17	1.56	204.1
Total Copper Clays 1883-1910 (28 years)			243,020	1.56	1.12	2.747.3

* Head grades estimated assuming 72% Recovery from Table 2.

Data Source Abbreviations

T = Thureau (1892)

P = Progress of the mineral industry of Tasmania quarterly reports 1897-1913.

B = Record of Mining and Treatment operations. "The Black Book" CMT Ref T1991-008. B1 purchased prior to Mt Lyell - North Lyell amalgamation in 1903. B2 during MLMRC ownership.

R = Reid (1970) from G W Blainey's personal records.

During the period of bornite mining, a significant amount of development work had been carried out (Figure 27). Therefore, as early as the March quarter of 1902, the new company was able to commence underground production for the first time on copper-clay ore. In this quarter, 592 tonnes of ore was treated by two puddling machines and blanket tables for 34.4 tonnes of concentrates grading 49% copper (Table 2). Over the next two quarters, concentrate grade increased initially to 58.1 and then to 64.3% copper. The entire 1902 production was 7,500 tonnes of ore for 267.3 tonnes of concentrates averaging 57% copper (Tables 1 and 2).

Production was halted in late 1902 by a strike over wages. Eventually, work was resumed with no changes to pay, but with falling copper prices the result was a loss making situation, so the mine was closed and most workers dismissed (Blainey, 1993, p. 201). The copper price from April to December 1901 averaged £71 per tonne and from January to September 1902, it averaged £54 per tonne.

The period to August 1904 was spent reconstructing the company, carrying out underground exploration and development and in constructing a new mill. The mill construction is described in detail by Grayson (1903). The clay was initially desegregated in puddlers and oversize material separated. This was hand sorted and any copper-bearing materials put through a Chillian mill. The fines and crushed material were then passed over a hydraulic classifier and treated on Wilfley and Ferraris tables. Grayson predicted an 80% recovery and concentrates grading 75% Cu. A second product, largely composed of ironstone, assaying 20% Cu was also produced. The plant was planned to treat 1,500 tonnes per week and for three years from August 1909 to July 1907, it averaged 1,305 tonnes per 50-week year.

The mill was described by Blainey (1993, p. 187) as 'large and rambling' and was visited by metallurgists from all over the Commonwealth and pronounced 'first class'.

During peak production, a maximum of 284 men and an average of 242 men per quarter were employed at the Lyell Blocks Mine. The company recovered at least 70% of the copper and successfully treated about 200,000 tonnes of ore producing concentrates averaging 69% Cu for about 2,200 tonnes of copper (PMIT statistics, listed in Tables 1 and 2). Concentrates were railed to the Kelly Basin and shipped to the Wallaroo smelters. The stock was popular and in 1906 the Blocks paid £15,000 in dividends as well as spending additional funds on exploration properties at Mt Darwin and Zeehan (Blainey, op. cit.).

Unfortunately, the clay in the mine tended to swell and smash the heavy timber supports. In July 1907 the timber, clay and slurry caved in over a wide area and buried two men; only one survived. Officially, the mine was closed due to the low copper price and the low ore grade. The recovered grade had gradually dropped from 3.09 to 0.87% Cu between 1902 and 1907. By December 1907, the mine was idle (PMIT, 1907).

The mine remained closed for some time and there was consideration of a merger with the adjacent Consols mine which was preparing for production in 1908. The Blocks was re-opened in December 1909, but copper clay production did not recommence.

Table 2

Available Details of Gravity Concentrates

2.1 Lyell Blocks

Note:
Plain numbers are as reported or calculated from reported numbers.
Numbers with superscript [e] are estimates based on averages of other reported numbers.

Quarter Ending	Ore Tonnes T	Head Grade % Cu	Recovered Grade % Cu	Conct. Produced T	Conc. Ratio	Con Grade % Cu	Cu Metal Produced	Recovery %
31.03.02	592	4.29[e]	3.09	37.4	15.8	48.9	18.3	72[e]
30.06.02	3,587	2.90[e]	2.09	129.0	27.8	58.1	75.0	72[e]
30.09.02	2,399	3.19[e]	2.30	85.7[e]	28.0[e]	64.3[e]	55.1	72[e]
31.12.02	908	0.51[e]	0.37	15.2	59.7	22.4	3.4	72[e]
30.09.05	14,242	1.90	1.37[e]	267.0	53.3	73.0[e]	195.1[e]	72[e]
31.12.05	19,203	1.90	1.39	335.3	57.3	79.4	266.2	73
31.03.06	12,371	1.58[e]	1.13	196.1	63.1	71.5	140.2	72[e]
30.09.06	17,927	1.50	1.05	301.2[e]	59.5[e]	62.0[e]	188.2	70
Totals	**71,229**	**1.84**	**1.32**	**1,366.9**	**52.1**	**68.9**	**941.5**	**72**

2.2 Lyell Consols

30.09.09	4,267	1.02[e]	0.73	46.7	91.3	67.0	31.3	72[e]
31.12.09	4,433	1.19[e]	0.86	66.7	66.5	57.2	38.1	72[e]
31.03.10	3,338	1.33[e]	0.96	49.7	67.2	64.4	32.0	72[e]
30.06.10	7,302	1.74[e]	1.25	78.7	92.7	61.8	48.7	72[e]
30.09.10	4,267	1.13[e]	0.81	58.8	72.5	58.8	34.7	72[e]
Totals	**23,607**	**1.09**	**0.78**	**300.6**	**78.5**	**61.5**	**184.8**	**72**

Data from Progress of the Mineral Industry of Tasmania (PMIT).

Between late 1909 and 1915, the Blocks carried out development work in the search for more bornite ore. This was largely by sinking of the 414m deep Blocks shaft. This was located only 10m from the North Mount Lyell Company's lease boundary. The search for bornite ore was unsuccessful, as were the two diamond drillholes NL1101 and 1102, which tested the same target area in 1984 (Bird, 1984; 1985). The Blocks Mine was inactive until 1919 when it was sold to the MLMRC for £5,000. Blainey (1993, p. 193) summed up the Blocks Mining Company's history succinctly: "A courageous and enterprising company, it deserved a better fate."

The MLMRC have done little with the ground except for the Corridor mining activities which impinge on the Blocks western boundary and the drilling of 16 diamond drillholes between 1963 and 1984, most of which were neither plotted up nor reported on. In contrast, a very useful report on the Copper Clays which concentrates on the Blocks was completed by Wade (1957b), but this appears to have been temporarily mislaid until it was mentioned by Flitcroft and McKeown (1992). The MLMRC's work is described in later sections of this report.

5.2 Lyell Consols

The Mt Lyell Blocks Mining Company was the most successful company on the field after the MLMRC. Other Copper Clay mining companies fared badly by comparison with the Blocks and much less information is available.

The first mention located of the Lyell Consols Mining Company NL is by Russell (1898). This was one of James Crotty's companies and preliminary work was being undertaken in 1897. It appears from early publicity that Crotty expected to find additional North Lyell type rich bornite ore on the leases, but despite tunnelling, this was unsuccessful.

Schloesser (1900) reported that hematite and gossan carrying native copper were found in the Consols tunnel under the Linda Valley Creek but the value bulked under 2% Cu. Location is shown on Figures 1 and 8 and the extent of underground workings on Figure 24. There were rumours of a production start from early 1906 and a similar mill to that at Lyell Blocks was built during 1907.

The Consols Plant consisted of puddling machines, a 5-head battery and Wilfley concentrating tables. Commissioning began in the September quarter of 1907, but alterations were necessary and underground development continued until production commenced in the September quarter of 1909. The mine remained in production for two years until 10 September 1910. A total of 23,600 tonnes of ore for 185 tonnes of copper was produced. Production statistics are shown in Table 1 and the concentrate information in Table 2.

The average treatment rate of 236 tonnes per week is significantly less than the 1,250 predicted which must have made the operation a financial failure. It is of interest that actual concentrate grades averaged 61.5% and that the Consols did not show a similar gradually declining grade trend to the Blocks. It is thought that problems with ore supply or plant performance were the main reasons for their financial position.

Mine closure was again caused by ground weakness. One day in August 1910, the miners heard the ground creeping and the timbers groaning so they promptly left the mine. A few hours later, creek water broke into the workings which were so badly damaged that the mine had to be abandoned (Blainey, 1993, p. 193). Development including diamond drilling for which we have no records was continued until about June 1911, after which there are no entries in the PMIT records.

Reserves at closure were estimated to be 95,600 tonnes at 3.0% Cu (Wade 1957b). The grade is thought to be over-stated, and a much larger area was mineralised than the reserves suggest.

5.3 King Lyell

The history of King Lyell is also not very well covered by available documents. The presence of Native Copper was mentioned by Thureau in 1886 and the ground was probably pegged soon after the discovery of the Iron Blow in 1883. The Blow is located only 200 metres uphill to the southwest (Figure 1). Reid (1970) mentions that the King Lyell company was sluicing copper from Cooney's Creek as early as June 1895. The deposit was well described geologically by Power (1891, p. 32), and Schloesser (1900) mentioned that the deposit had been mined by hydraulic sluicing by the King Lyell Gold and Copper Mining Company NL for the previous 3 years.

The main areas sluiced to shallow depth were on the Southern Slopes of Pioneer Spur (Figure 30). Reid (1970) comments that Blainey's personal records amount to a total of at least 150 tonnes of copper on a very conservative reckoning. Like the Blocks, King Lyell was also probably selling copper before the MLMRC commenced production on 25 June 1896 (though they had produced Ag-Cu-Au concentrates from the Mt Lyell Bonanza in 1893/5).

In November 1901, King Lyell was purchased by the MLMRC for £2,600 as a prospective overburden dump. They set about exploration by the diamond drilling of four holes, ML8-12, in 1902 and the development of the No. 5 Adit for the Iron Blow Mine (Figure 15).

Apart from the diamond drillholes, trenches, sluicing, 2 tunnels and several shafts help to define the mineralised area. There was also Mr Batchelor's prospecting shaft, recommended by Thureau (1899; 1900), put down in 1903 and collapsed soon after. Thureau (1900) also suggested that "the boys in the district might be induced to collect scrap iron for copper precipitation from the mineral waters impregnated with dissolved copper."

Production statistics are recorded in Table 1 from which it can be seen that King Lyell has been the second largest copper clay producer, despite its lack of underground mining. Reid (1970) wrote a comprehensive review of King Lyell in which he recognised the potential and recommended an initial programme of 10 vertical diamond drillholes on 122m centres for a total of 945 metres. If encouragement was obtained, the second phase was to consist of 61m spaced holes. Four of these holes were drilled in 1970/71 (KL1, 2, 13 and 16) but the results were disappointing and have never been written up.

Reid (1970) was aware of problems of high core loss in the 1902 drillholes and also of contamination by material falling down the holes. He concluded that with unrepresentative sampling and errors in assay techniques, the information should not be used for evaluation purposes. Despite the unreconcilable factors, Reid thought that the results were of considerable interest.

5.4 Balance Shaft

The Balance Shaft is shown as a separate deposit on the Queenstown 1:25,000 geology map and receives some separate comments in PMIT. However, it was really part of the Lyell Blocks orebody to which it may be connected by undiscovered ore.

5.5 McDowell's Prospect

This prospect has been included with the Copper Clays Group for geographic rather than geological reasons. The old open cut is located just east of Figure 1 at about 5600N/7500E. The prospect is shown on the Queenstown 1:25,000 sheet as lying on the North Lyell Fault and is similarly described by Sillitoe (1984, p. 21).

The prospect was explored by Bird (1985), who decided that the North Lyell Fault was really 400m further up the hill. He suggested the epithermal mineralisation was associated with a hydrothermal explosion crater which created free-standing Owen Cliffs perhaps 1,000m high. Together with Bird's other explosion crater at Gormonston, these rocks were thought more likely to be glacial sediments by Arnold (1985), Sillitoe (1985) and Flitcroft and McKeown (1992).

Sillitoe's (1984) description of McDowell's appears realistic, that the gold mineralisation is associated with quartz vein stockworks parallel to the North Lyell Fault. There have also been suggestions that similar features are present on the south boundary faults of the Linda Graben. Together with the Gold Creek alluvials, there appears to be a gold source in the area related to the North Lyell Fault Zone, which is an important aspect of the metallogenic history of the area.

5.6 Lyell Pioneer

Until a recent discovery of old reports, virtually nothing was known about this prospect. It's location was known from Figure 24, but it seemed to be more an alluvial gold working than anything else. The report by Cundy (1901a) included a very useful map which has been redrawn as Figure 23. Cundy explained that there was no major mineralisation in either the main or in Calligan's Tunnel. However, he did report quartz veins with traces of gold near the contact of the Owen Conglomerate with the Lyell Schists.

Also Cundy reported a gossan zone near the entrance to the main Tunnel (Figure 23) which he compared with the mineralisation at the Lyell Blocks. A shaft had been sunk to 100 feet on the eastern part of the property through surface clay, pug and loose boulders, but the ground proved too heavy for the timbering and collapsed.

In this area, the clays have been washed off the Spurs (Wade, 1957a) and the flanking valley to the north which may turn out to be as prospective as that to the south (which hosts the King Lyell deposit). The Lyell Pioneer area is an exploration target, particularly along the Zeplin Fault zone as shown in Figure 1.

5.7 Mt Lyell Extended

This area has been named as a separate prospect, mainly by virtue of it's tenure history, being in James Crotty's stable at the turn of the century (Russell, 1898). The property contained two prospecting tunnels. Location is shown on Figure 23, but no detailed map of the workings has yet been found.

Cundy (1901b) mentions that in the 183m long lower tunnel, minor chalcopyrite in schist and a 2 foot wide vein with galena were located but did not persist more than a few feet. A gossan is present at the entrance to the lower tunnel containing shows of native copper but the workings had collapsed by 1901. PMIT makes mention of Lyell Extended in 1901, 1908 and 1909, but apart from suggestions of appreciable native copper, no production is known.

6. GEOLOGY

Some previous geological descriptions have suffered from being a mixture of fact and theory. The most useful descriptive accounts found are by Thureau (1886), Power (1891), Batchelor (1902; 1904), Gregory (1905), Wade (1975b), Solomon (1969) and Reid (1970). It is thought vital to distinguish between observation and deduction so sections 6.1 on host rocks and 6.2 on mineralisation are as factual as possible and any deductions are made in section 6.3 on ore genesis. The writer has studied any information available, visited the deposits, looked at drill core and produced summary drill logs and drill sections for most of the holes drilled. In this section, the Copper Clays are treated as a group as similar features have been observed at many deposits and the report would otherwise be too repetitive.

6.1 Host Rocks

Regional

The known Copper Clay deposits are restricted to altitudes of between 200 and 600m at the Western end of the Linda Valley or against the eastern flank of the Lyell Saddle. They are located in the Western Linda Graben, east of the Great Lyell Fault, south of the North Lyell Fault and north of the Owen Spur Fault. The deposits are located under water courses in valleys coincident with synclines and WNW trending Tabberabberan faults.

Ore Host

The immediate host to ore is clay, thought to be remnant clay after the dissolution of the calcium carbonate component of the Gordon Limestone. To test this assumption a series of XRD mineral determinations were made on samples of mineralised clay and on a residue after weak sulphuric acid leaching of Halls Creek Limestone. This was

prepared by Rob Gregory at GMA's Perth laboratory from samples collected by Morrison (1995). Mineralised clays were found to be mineralogically similar to the Gordon Limestone residue being composed of quartz, muscovite and kaolinite (Appendix 8) as was also found by Solomon (1969, p. 44).

There are references to mineralisation in the Gordon Limestone itself, but these do not form a large part of the mineralisation in sight. There is a tendency, best seen in the long sections of Figures 14 and 19, for the better grade clays and undissolved Gordon Limestone to be incompatible.

Gordon Limestone

Regionally, the Gordon Limestone commonly contains a sequence of basal interbedded limestone and sandstone followed by 300-500m of micritic impure limestone (Banks and Baillie, 1989; Calver, 1995). Recent work by Morrison (1995) at the Halls Creek Quarry has shown that the limestone typically consists of about 40-70% calcium carbonate and 25-50% clay. The formation is not typically pyritic. Also, the sequence is mainly massive with few shaley interbeds. A middle Ordovician age has recently been established for the Pioneer Sandstone (Calver, pers. comm., 1995) which is similar to the Gordon Limestone. This suggests a time gap of some 10-20 Ma associated with the Haulage unconformity.

Ore Footwall

Assays of interest normally cut out in the Pioneer Sandstone which acts as a footwall to copper clay mineralisation. Often, the sands are poorly consolidated. Anomalous chromium to 0.43% has been recorded, for instance, in LB09 at the Consols. In the vicinity of the Copper Clays, the Pioneer Sandstone is generally only 10-15m thick with a basal conglomerate. This passes unconformably into either conglomerates or sandstones of the Owen Conglomerate which are usually strongly hematitic.

Ore Hanging Wall

In the mineralised positions, upper parts of the Gordon Limestone are not seen. If present, the overlying stratigraphic unit is the Crotty Quartzite of the Silurian Eldon Group, but this has not been mapped in the Linda Valley.

There is often no hanging wall or only recent fluvioglacial sediments present. This makes it possible that part of the copper clay mineralisation was eroded during Pleistocene glaciation.

6.2 Mineralisation

Ore Minerals

From the drill logs and mining history, it is concluded that there is one dominant ore mineral, namely native copper and two minor ore minerals, namely cuprite and chalcocite. No thorough work has been undertaken to quantify the various minerals present and this will be a difficult process as the ore is not homogenous. Although the

sulphides covellite, bornite and chalcopyrite are present, they are often contained in variably sized sub-angular to sub-rounded clasts suggesting they represent detrital material from the orebodies up slope.

Markham (1966; 1968) made heavy mineral concentrates from drillholes LB13, 26, 28 and 31 as it was impossible to prepare polished sections. The concentrates included the following minerals:

> ***Pyrite*** was the most abundant sulphide mineral occurring as discrete euhedral crystals averaging 0.03mm in size. They may show partial replacement by chalcocite, digenite or covellite. The textural features suggest a process whereby copper in solution is precipitated by reaction with sulphides. Markham thought the pyrite was authigenic (grew in situ).
>
> ***Chalcocite*** occurs as marginal replacements to pyrite and as framboidal aggregates of spherical, oval and crescent-shaped grains. Digenite, covellite and bornite are also present in the framboidal aggregates.
>
> ***Native Copper and Cuprite*** are claimed by Markham to be more typically observed in the near surface portions of the deposits and grade into sulphides at depth. This was also suggested by Power (1891). However, this is neither true from the drill logs nor from the Lyell Blocks production concentrate grades. In his own samples from depth, Markham observed native copper and cuprite and assumed that they have formed by oxidation of primary copper sulphides.
>
> ***Sphalerite and Galena***; a few isolated grains occur which are not associated with copper sulphides. The sphalerite is typically a honey-yellow colour. Wade (1957b) also noted black clays derived from the Gordon Limestone containing fine, widely disseminated grains of galena.

Other mineralogical descriptions by Edwards (1939, 1958) are also useful. During a field visit in March 1958, Edwards collected some limonite nodules (geode like) from King Lyell with internal cavities up to 2cm across encrusted with interlayered seams of native copper and cuprite up to 0.5mm wide. Open or filled cracks lined with these minerals lead into the cavities. There are also sheets of native copper filmed by malachite. Another group of specimens from the Blocks consisted of porous sheet-like slightly colloform bands of cuprite studded with minute inclusions of native copper.

Other relevant previously-mentioned descriptions include native copper occurring as films infilling joints and cleavages, including joints in the footwall Pioneer Sandstone and as chalcocite encrusted dendritic masses. Massive nuggets of native copper of up to 75kg were encountered at the Blocks (Blainey, 1993, p. 187). In his drill logs, Batchelor (1902) records pebbles of native copper and in hole ML12, the only mineralised Gordon Limestone interval with no associated clay mineralisation, fine pyrite-chalcopyrite and native copper are disseminated in silicified limestone.

Determination of the relative quantities of each mineral is difficult as they are not spread homogenously through the deposits. The best evidence is from the deposit's

metallurgical history. To be able to produce concentrates averaging 69% Cu with 72% recovery, the minerals involved must be high copper species.

Since chalcocite is very fine and hard to recover, this indicates that native copper and cuprite are the main minerals present which agrees with the drill logs. An educated guess at the overall proportions would be 70-90% native copper, 5-20% cuprite and 5-10% chalcocite.

Associated Lithologies

Not all of the Copper Clays consist of clay. There are two other major components which both tend to be unmineralised. These are limestone and detrital sediments. The limestone may be massive or vughy limestone or limestone gravels. Dolomite has been logged, but this may include ironstained limestone. Various unconsolidated detrital sediments are mixed with the clays. They vary from silt to sand, grit, pebbles, cobbles and boulders. Examples of all major local lithologies have been seen, including sub-angular to rounded clasts of cleaved and mineralised Lyell Schists, hematite, quartzite, quartz, conglomerate, sandstone, bornite and gossan. These lithologies may occur as wide intervals, eg: up to 100m of hematitic sand in LB37 or as isolated boulders in clay.

Where limestone is present, there are no descriptions of any typical skarn mineral assemblages or any clay mineral hydrothermal alteration. Occasional quartz veins containing sulphides are present under the Gordon Limestone. For instance, in hole NL1102, in a zone of altered Owen Conglomerate under Lyell Blocks, an interval of 46m at 30% $BaSO_4$ contains narrow quartz-barite-galena veins assaying up to 0.37% Pb and 9 g/t Ag over 2m. These assays are diluted by non-vein material in the assay interval. Separate galena and chalcopyrite bearing quartz veins are present in Owen Conglomerate at Mt Lyell Extended. Gold is present in quartz veins at Lyell Pioneer.

There is insufficient Gordon Limestone core available to be sure if the fresh limestone normally carries sulphide minerals. There are several holes with long lengths of unmineralised limestone, eg: LB6, 7, 32, 33, 34, 35 and NL1101.

Of the 48 holes drilled at the Blocks, Consols and King Lyell only 16 have intersected limestone and clay. Of these, only 5 have some mineralisation in limestone, whereas 15 contain mineralised clay. Only one hole, ML12 (Batchelor, 1902), near the eastern margin of the King Lyell deposit, had mineralised limestone with no associated mineralised clay (Figure 19).

Relationship to Structure and Metamorphism

The deposits are hosted predominantly by poorly lithified to plastic clay (cf. history of ground support collapse). No descriptions of any effects of metamorphism such as schistocity or metamorphic mineral development in the deposits themselves have been sighted.

The limestone precursors were present in synclines with common axial planar faults which have similar orientations to the S_2 schistocity in Lyell Schists and Owen

Conglomerate; where it can be determined (Figure 1). These synclines have acted as hosts for topographic lows which have allowed limestone and clay to be preserved.

It is thought, for instance by Wade (1957b), that former limestone on the Whaleback, Linda, Pioneer and Gormanston Spurs has been converted to clay by carbonate dissolution and then either scraped off by ice or washed off by the heavy rainfall. This process has left unusual exposed fold surfaces as if they had been carefully excavated.

6.3 Ore Genesis

Review of Previous Ideas

Various theories have been advanced to account for the copper clay mineralisation. Gregory (1905, p. 140) pointed out that the ore deposition at the Blocks was subsequent to the main transverse faulting. At the turn of the century, Power, Batchelor and Cundy promoted the view that the deposits were products of in situ decomposition. There was a long gap before anyone even commented on the Copper Clays until Alexander (1953) claimed that their relationship to structure indicated a hypogene origin. Wade (1957a) and Wade and Solomon (1958) thought that the deposits occurred in shales of the Gordon Formation that had been mineralised by hypogene hydrothermal activity and then oxidised. However, Wade (1957b) noted that native copper is forming at the present time, particularly after rain by adsorption of copper on the clay from acid solution.

Markham (1966) suggested that the textural features strongly suggested the precipitation of iron and copper sulphides in a low temperature environment. He said that in view of their proximity to major sulphide deposits, it was reasonable to assume that they were the source of the iron and copper. The primary orebodies could have contributed metals to the Ordovician clay sediments by processes of leaching and transportation as soluble iron and copper sulphates. Markham thought it was difficult to decide when the process occurred, either syngenetically in the Ordovician or epigenetically in present day climatic and topographic conditions. A syngenetic Ordovician genesis was his preferred model.

Solomon (1967) suggested that the Iron Blow and associated hematite were gossans formed by oxidation during the early Ordovician. His descriptive paper on the Copper Clays (Solomon, 1969) is, in the writer's opinion, the best available summary; though Solomon seems unaware of the results of the 1963-65 drilling of holes LB1-37. Solomon's genetic views were multifaceted and included an enrichment of copper and iron sulphides during sedimentation. He thought a Tabberabberan age via hydrothermal remobilisation could not be ruled out. Solomon also considered that modern low-temperature precipitation and exchange with iron and/or limestone from copper in groundwaters derived from the deposits uphill was possible. In summary, he concluded that "the Copper Clay deposits are a combination of indigenous and transported gossans."

Reid (1970; 1975) followed the views of Markham (1968) and Solomon (1969).

In the early 1980's, a group of geologists from the new mine owner, RGC, soon dispensed with many of the views established after years of careful mapping, research and debate.

Bird (1982a; b), Brook (1984), Sillitoe (1984; 1985) and Arnold (1985) resurrected many dormant Tabberabberan epigenetic ideas and applied them to most of the orebodies on the field; including the Copper Clays. Sillitoe asserted that much of the mineralisation was structurally controlled by faults and that the Lyell Blocks mine exploited a steep 10-15m wide structure. If the mineralisation was structurally controlled, then Markham's (1968) syngenetic limestone-shale concentration model was unlikely. Also, any Tertiary supergene addition presupposed pre-existing sulphides. Sillitoe concluded that the Copper Clay deposits support hydrothermal sulphide mineralisation at Mt Lyell in post Gordon Limestone, probably Tabberabberan, times.

Bird (1984) stated that recent work at Mt Lyell had shown that volcanogenic models were erroneous and that the mineralisation is related to hydrothermal events that post-date the Gordon Limestone and Crotty Quartzite and is therefore of probable Devonian age. The two main styles of deposit likely in the Gordon Limestone were vein or replacement mineralisation. Vein deposits were likely to be of native copper-silver type with 2-4% Cu, 30-100 g/t Ag and possibly 1-2 g/t Au. Potential for up to 20 million tonnes of this style of material was recognised. Bird tested his model by drilling diamond holes NL1101 and 1102, totalling 1,024 metres, under Lyell Blocks. Apart from retesting the zone where the Lyell Blocks main shaft had terminated in 1915, the holes intersected very little mineralisation. The Copper Clays sections were not assayed and the best results were from the 46m of 30% barite section reported above.

Arnold (1985) recognised that the puggy ex-Gordon Limestone clays are clearly much modified from Paleozoic precursor limestones. He recognised, as did Sillitoe (1985), that pre-glacial deep weathering and periglacial and fluvioglacial processes have caused additional complications in the area. Arnold commented that the 'black pug' showed evidence of slumping, mixing and resedimentation with the glacial sediments. He provides a concise review of various models, but, apart from supporting Bird's ideas, he makes no firm conclusions.

Conclusions from Previous Ideas

Previous workers' ideas can be grouped into the four most popular models:

1. Decomposition
2. Syngenetic
3. Epigenetic - Hydrothermal
4. Natural Hydrometallurgy

1. In Situ Decomposition of Lyell Schists

The decomposition model was accepted by most of the early workers, including Power (1891), Cundy (1901) and Batchelor (1904). The model involved in situ decomposition of schist to pug and near surface oxidation of chalcopyrite to native copper. This process is untenable because Lyell Schists do not

decompose; stable detrital schist clasts are present in the copper clays. Pug is now widely accepted as a residue after weak acid dissolution of Gordon Limestone calcite.

2. Ordovician Syngenetic Deposition with Gordon Limestone

Markham (1966; 1968) and Reid (1970; 1975) were the main protagonists of this model which was also considered possible by Solomon (1969). The syngenetic model involved sulphide deposition during sedimentation in a shaley or mudstone horizon at the base of the Gordon Limestone. Metal-bearing solutions are in part derived by low-temperature leaching from the adjacent large deposits (Blow, West Lyell, Corridor). Flitcroft and McKeown (1992, section 6.4) wanted to carry out lead isotopic work to determine if the ores were Cambrian in age, ie: older than their host rocks.

This model is based on several misconceptions on the nature of the deposits:

(a) that the surface native copper grades into primary sulphide mineralisation at depth (drilling and mining have shown that it does not);

(b) that there was a shaley zone at the base of the Gordon Limestone. This is unsupported by regional stratigraphic evidence and the 'clays' are thought to be residues from mass formational dissolution; and

(c) the ore has formed in a zone which is of post landscape, probably Cainozoic, age.

3. Devonian Epigenetic Hydrothermal Models

The epigenetic model was mentioned by Alexander (1953), Wade (1957a; b), Wade and Solomon (1958), but principally developed by Bird (1982a; b; 1984), Brook (1984) Angus (1984) and Sillitoe (1984; 1985). The model proposes primary epigenetic vein-type mineralisation associated with strong barite-hematite metasomatism during late stages of the Devonian Tabberabberan Orogeny. The model also predicts vein mineralisation in structural zones cutting the Owen Conglomerate. Later, in situ oxidation has produced native copper at surface.

This model also fails to take account of the drill log and mining evidence of predominant native copper. Furthermore, there is little evidence for the associated veins. Practically all the Gordon Limestone drilled is unmineralised and the barite-galena veins discovered under the Blocks and Mt Lyell Extended can hardly be responsible for copper mineralisation.

With the process suggested, either some skarn or clay mineral hydrothermal alteration would be expected, but has not yet been identified. Also, Cainozoic mass limestone dissolution is not compatible with the Tabberabberan timing of this model. Markham's (1966) recognition of low temperature framboidal textures is another problem. In fact, there is so much conflicting evidence that

this model is regarded as unacceptable. If the model is invalid, ore potential in the Owen Conglomerate is also downgraded.

4. Natural Cainozoic Hydrometallurgy

Elements of this model have been suggested as a possibility by Wade (1957b), Markham (1966), Solomon (1969), Arnold (1985) and Hills (1990), though none of these authors chose recent concentration as their preferred option. The model proposed here involves a source of copper and acid solutions from oxidation of primary deposits such as the Blow, West Lyell and the Corridor on the Lyell Saddle. The solutions are then transported downhill until they meet carbonate from the Gordon Limestone which neutralises the solutions. This makes the dissolved copper unstable and it is readily precipitated by reducing agents in the clay such as carbon, kerogen, bacteria, iron oxides or humic acid.

Objections to this model have been based on presumed structural control, the presence of sulphides at depth and difficulties with low temperature copper precipitation mechanisms.

Evidence for the hydrometallurgical model is the distribution of native copper throughout the clay formed by Cainozoic mass dissolution of Gordon Limestone. This process chemically aids copper precipitation at low temperatures, producing minerals and textures consistent with the model and observations. Precious metal contents in the Copper Clays are generally low (see Tables 4 and 5) which would be expected in the low temperature model, but not in the higher temperature syngenetic or epigenetic models. The lack of associated mineralised limestone, veins and metamorphic features are all also consistent with the natural hydrometallurgical model which is considered the most acceptable current theory.

Several chemists, geochemists and metallurgists have been asked if they can suggest a likely precipitation mechanism consistent with the geological evidence. At one stage it was thought that the cation exchange capacity of montmorillonite clays (Bush and others, 1993) could explain the mechanism. However, XRD work on samples of mineralised clay (Appendix 8) found no smectite group clays, so a cation exchange process is unlikely. Current thoughts on possible mechanisms include the reaction between humic acid and copper sulphate precipitating copper metal (Baker, pers. comm, 1995), or a type of natural electrowinning process where copper is forced out of dilute turbulent solution by weak natural electric charges. The subject warrants further research.

Timing of Mineralisation

The sheets of copper in joints, dendritic copper nuggets and pebbles of native copper all suggest copper deposition in a vadose zone post landscape formation. The mass dissolution of calcium carbonate of the Gordon Limestone is also likely to have occurred after the formation of the landscape. The process would be much slower, if at all possible, if the limestone was in the phreatic zone below a poorly oxygenated fresh water table.

The abundant oxidising sulphides on the Lyell Saddle are naturally producing both surface and groundwater solution flow which is acid, oxygenated and cupriferous. The reaction of pyrite, chalcopyrite, water and oxygen produce goethite (gossan with residual precious metals), sulphuric acid, copper sulphate and iron sulphate. The recent CMT environmental management report showed that a daily mean of over two tonnes of copper is being transported downstream from Mt Lyell (Thompson and Brett, 1994, Figure 4.22). Mining has caused accelerated copper transport rates, but even at 0.1 tonnes per day and only a 5% of total copper precipitation rate, it would only take some 27,000 years to accumulate the 50,000 tonnes of copper identified in the three main deposits to date (Appendix 3).

Since glacial deposits of up to 0.8 Ma age overlie but do not contain interesting copper intersections (Appendix 1), the mineralising process is thought to be mainly of pre-Quaternary age. As the current landscape is thought to have developed during the Cainozoic, it is likely that the Gordon Limestone dissolution and copper deposition took place during this period, and is probably currently continuing.

Limestone Dissolution Process

While trying to understand the dissolution process, the writer contacted Dr Armstrong Osborne of Sydney University who is an expert on limestone caves. He is currently working on a model for major cave system formation which suggests the rate of dissolution is exponentially increased if oxidising sulphides (generally pyrite) are present in the groundwater catchment (Osborne, 1994). The mass dissolution of Gordon Limestone at Mt Lyell is clearly an extreme example of this process.

According to Osborne (1984; 1986) cave sediments are very common, and although an areally minor depositional environment, they are among the most complex in terms of range of processes and geometry of products. Cave sediments in Eastern Australia are generally of Cainozoic Age with sediments generally derived from outside the cave. A number of unusual sedimentary features can develop such as:

- high initial dips
- diamictites with angular and rounded clasts
- results of floor and/or roof collapse
- lateral facies changes
- circular and vertical unconformities
- stratigraphic reversals
- non metamorphosed sediments unconformably underlying older bedrock

Such features help explain the complex sequence of interbedded clay, limestone and sediments seen in copper clay diamond drill core.

In fact, it is surprising there is any limestone left in the Linda Valley. This can be explained by the channelling effect of groundwater flow through established open space. It is highly likely that during the dissolution process a complex and constantly-evolving cave system developed which included major collapse and breccia formation. Another common feature of cave systems is their sediment content, including boulder beds if a

source and access are present. During Pleistocene glaciation, it is even likely that diamictic sediments were squeezed through subterranean cave systems under pressure (K Kiernan, pers. comm., 1995).

The gradual dissolution of limestone can be likened to the gradual melting of ice during a glacial retreat. Examples of the complex types of sedimentary accumulations developed are illustrated by Fitzsimmons and others (1993, Figure 32).

Implications of the Model

As the deposits occur in faulted synclines, some may claim they exhibit structural control, though this is an inherited control on valley position. The important control on mineralisation is thought to be by natural hydrometallurgy, ie: the dissolution, transport and precipitation mechanisms that have allowed the economic concentrations to be formed.

The model has a predictive capacity for orebody location, shape and grade variation. The deposits will have an overall synclinal chute-like geometry with major variations in grade caused by the copper nugget effect and paleofluid channelling zones. The highest grades may be expected near source with a gradual tapering off in grade with depth. Zones of potential mineralisation are present all along the western limit of clays as shown on Figure 1.

The deposits will be very complex in detail having evolved through a cave stage where irregular channels and collapse followed by dissolution have occurred. Before and during glacial stages, rounded sediments of varying grainsize will have been transported through caves and mixed up with angular collapsing limestone debris.

Ore fluid channelling will have led to adjacent high and low grade zones. Correlation between adjacent drillholes will be very difficult and numerous voids are still likely to be present. Isolated boulders in clay and porous gravel zones will present severe drilling difficulties.

6.4 Comparisons With Other Native Copper Deposits

Although copper is one of the commonest native elements, it generally occurs as a supergene oxidation product rather than as the major mineral in ore deposits. In order to gain helpful insights from other native copper deposits, a search was made on the main international computer data bases at the AMF.

The most common deposits of native copper are associated with low-grade metamorphism of basic volcanics. The best example is the Michigan Native Copper District on the Keweenaw Peninsula, USA (Lindegren, 1913). Since 1845, over 5 million tonnes of copper have been produced from the 1095 Ma Portage Volcanics and interbedded sediments. Hosts for this production are approximately 58% volcanics, 40 conglomerates and 2% veins with 96% coming from a 45km long, 3km wide zone. Ore is principally mined underground, historically at grades of up to 4% copper, but more recently at grades of between 0.5 and 1.0% copper.

Most authors have concluded that the deposits formed at about 1050 Ma during prehnite-pumpellyite regional metamorphism at 250°C and depths up to 3.5km. Copper has been leached from basic volcanics containing about 70 ppm Cu during dehydration reactions and transported as chloride complexes containing 1500 to 2000 ppm Cu. Solutions have percolated upwards towards lower temperature levels where hydration was dominant. Open space in both amygdaloidal basalts and porous conglomerates has been filled to produce 'pseudo' stratiform 'manto' (blanket) type orebodies. The deposits are silver rich and contain some native silver. Where constrictions have concentrated fluid flow through, grades are higher.

Other native copper locations with geological similarities to the Keweenawan deposits are:

- Victorian district of Zimbabwe (King, 1989)
- Carboniferous Clyde Plateau lavas of the Midland Valley of Scotland (King, op. cit.)
- Seachondong basalt flows of southern Korea (Lee and Kim, 1970).

Additional occurrences of native copper are known in serpentinised peridotite from central Japan (Kahehira and others, 1975) and also from central Sweden and at the Franklin Mine, New Jersey, USA (Burke and Dunn, 1988). A paragenesis of low temperature (300°C) alkaline hydrothermal alteration under very low sulphur fugacity conditions has been suggested to control precipitation.

Neither the Keweenawan deposits, nor any others for which descriptions have been located, seem similar to the Mt Lyell Copper Clays. They are therefore thought to be a very rare to unique type of ore deposit.

7. RESOURCE ESTIMATES

It is surprising that with 48 diamond drillholes completed, and many significant intersections (Table 3), that nobody appears to have yet carried out a resource estimate. In the most recent detailed Copper Clays MLMRC report, Reid (1970, p.7) claims that as the data is unrepresentative and contains errors, it should not be used for evaluation purposes. While there are certainly problems with the data quality, this is the case with most resource estimations. The writer believes that geologists have a responsibility to make the most of the information available while reporting concerns caused by deficiencies in the data. Since 1970, the AIMM resource reporting code has been developed and this gives guidelines for dealing with Copper Clay type situations.

The procedure adopted here is to analyse resource assessment criteria with a view to suggesting improvements. Detailed results for each main deposit are then reported in sections 7.1 to 7.3.

Estimation Technique and Interpretation

A total of 48 diamond drillholes for 4,900 metres have been completed between September 1902 and July 1984. Drill logs are stored in the Lyell Blocks blue book in the

geology office safe. Summary logs have been produced for this work (Appendix 1) and lists of intersections compiled as Table 3 and Appendix 2.

These logs have been plotted on a series of 13 sections at the most appropriate intervals to reduce the length of projection onto each section. Intersections have been bulked as much as possible and a low cut off grade of 0.1% Cu has been used to simplify the interpretation. Cross sections have been interpreted and areas of mineralisation on each section measured by planimeter. Average grade assigned is a length weighted average of the intersections inside each perimeter. A tonnage factor of 2.1 tonnes/m^3 has been used to account for the low density clays and voids. Tonnages for each section have then been added. Resources obtained are detailed in Appendix 3 and summarised on Table 7.

The orebodies have been defined by clustering of holes with significant drill intersections and orebody perimeters drawn to divide ore bearing holes from barren holes. All holes within the mineralised perimeter for each orebody have been included in the estimate.

If it were not for the problems of core recovery, the resource might be able to be classified as indicated. However, the recovery is so poor that classification as an inferred resource is preferred. In the writer's experience, poor core recovery seldom 'makes' or 'breaks' an orebody. In detail, the recovery is quite variable and available estimates for each intersection are given in Appendix 2.

Drill Hole Density

Currently, a total of 36 holes and various underground workings define the three resources. Spacing is somewhat irregular, possibly due to difficulties of site access, but from the sections and workings, a high confidence in ore continuity is achieved. This is also because there are no examples of unmineralised holes within ore perimeters. Holes KL16 at King Lyell and LB37 at the Blocks are closest to being negative. There are sufficient holes and continuity for an inferred resource.

Hole Location Accuracy

For all but the old ML holes, locations have been surveyed. The five Mt Lyell holes drilled in 1902 are probably only accurate to ±5m, but this will not affect the current conclusions.

Drilling Techniques and Recovery

All holes, except the five 1902 holes, have been drilled since 1963 with modern types of diamond drill equipment. There is probably no ideal rig to drill the difficult mixture of limestone, clay, running sand, gravel and boulder clay that is present. In observing the core that has been recovered, it is surprising to see how much unconsolidated sand, gravel and some cored boulders has been recovered. Overall recoveries over mineralised intervals vary from 20 to 100% with an average from Appendix 2 of 56%. A void space of 20% has been assumed to reduce the tonnage factors so that the real recovery may be 56/80, ie: up to about 70%.

Table 3

List of Significant Drill Intersections

Deposit	Hole No	Intersection			Cu	Au	Ag	Recovery
		From (m)	To (m)	Length (m)	%	g/t	g/t	% Est
Lyell Blocks	LB28	16.5	181.4	164.9	0.64	0.13	4.1	50
	including	74.8	143.3	68.5	1.33	0.08	6.7	50
	including	77.0	85.5	8.5	2.20	0.07	1.2	67
	LB30	0.0	48.8	48.8	0.37	Tr	3.1	50
	including	32.3	39.6	7.3	0.80*	Tr	3.2	36
Lyell Consols	LB18	10.7	41.7	31.0	1.56	nd	Tr	60
	including	27.1	29.9	2.8	10.5	nd	Tr	84
	LB23	55.0	90.0	45.0	0.62	nd	Tr	80
	including	59.4	70.1	10.7	1.38	nd	Tr	91
King Lyell	ML09	2.4	43.0	40.6	2.16	nr	nr	low
	including	2.4	6.1	3.7	9.5	nr	nr	low
	ML11	48.8	85.3	36.5	0.67	bld	bld	poor
	ML12	62.5	111.3	48.8	0.52	bld	bld	poor
	including	94.5	106.7	12.2	1.05	bld	bld	poor
	KL01	30.5	38.1	7.6	1.69	nd	nd	37
	KL13	42.7	70.1	27.4	1.08	nd	nd	46

* = Includes 3.1m of office tunnel void - otherwise probably 1.5% Cu
Tr = Trace
nd = not determined
nr = not recorded in logs, existence unknown
bld = below limit of detection
= detection limits for Au and Ag
= for ML holes - Au 0.3 g/t Ag 15 g/t
= for other holes - Au 0.15 g/t Ag 0.3 g/t

Such a recovery could still give a good representation of what is in the ground, depending on whether the 30% lost core was of lower, similar or higher grade than the material recovered. In the general absence of sludge assays, there is no way of knowing whether the lost core is of consistently higher or lower grade.

The only sludge assays located were from the 1902 drilling of hole ML09; these are reported in Table 4. Surprisingly, these sludge assays are significantly higher grade than the recovered core. However, it is doubtful if the sludge assays are representative – so they do not really help.

The writer believes the most likely lost material is unconsolidated sediment; which is generally unmineralised. This would have the effect of increasing the average grade of material recovered. Because of the difficulties of drilling copper clay type mineralisation, it is unlikely the problem will be eradicated. However, it should be possible to do better and quantify the errors so that risk can be reduced.

Sampling Techniques

These are not well documented. From drill core remaining, it can be seen that it was not always cut in half, even if it was possible to do so. As much of the core is unconsolidated, it can only be assumed that the samplers attempted to select representative material for analysis.

Assay Techniques

These were similar to others in use at Mt Lyell. It is clear from the logs that if native copper is present, it can often be visually seen down to very low levels of 0.1% Cu, though for some intervals of plus 0.5% Cu, no copper minerals are mentioned. This could be caused by the problem of identifying chalcocite which is hard to distinguish from black clay, carbon and manganese staining.

The main problem, illustrated on Table 4, is reproduceability due to difficulties in preparing a homogenous pulp from malleable native copper. The only data available are from the 1970 King Lyell drilling. They show poor comparability, so it is concluded that there is an assay reliability problem. It is not known whether this would lead to generally higher or lower results. This would depend on how the assay charge was taken. It is thought most likely that with unpulverised native copper present, the charges would be generally of lower grade than the bulk pulp.

Tonnage Factor

Tonnage factors will vary from 0 for voids to 8.9 for native copper. The SG of the clay is probably about 2.6, but with the possibility of up to 20% voids an SG of 80% of 2.6, that is 2.1 tonnes/m^3 has been used in the estimation. Wade (1957b) reports work by Batchelor in 1902 who measured the SG of King Lyell clay at 2.08. However, Wade used a figure of 2.4 in his estimations. If he was right, the current estimate is up to 15% or 1.2 million tonnes low on tonnes.

Table 4

Details of Sludge Assays and Re-Assays

Sludges

From 1902 drilling recorded in drill logs for Hole ML09

Interval (m)			Core Assay	Sludge Assay	Difference
From	To	Length	% Cu	% Cu	%
19.8	21.3	1.5	1.9	8.7	+ 358
21.3	22.9	1.5	2.4	15.0	+ 525
22.9	24.4	1.5	2.9	12.9	+ 345

No details on core recovery available.
No details of sludge collection method available.

Note That from 13.7 to 16.8m in Batchelor's Prospecting shaft located 15m to the northeast of ML09, a gossan zone was recorded and was estimated to contain 20% copper!

Re-Assays

Only carried out on 1970/71 King Lyell drilling

Hole No	Interval (m)			Original Cu Assays	Re-Assays	Difference
	From	To	Length	% Cu	% Cu	%
KL01	30.5	38.1	7.6	1.69	0.85	- 50
KL02	74.5	78.5	4.0	0.86	1.60	+ 86
KL16	19.8	42.7	22.9	0.049	0.042	- 14

Note These are bulked intervals. Individual assays may show more variation.

SG Weighted Assay Averaging

Another factor which can have a major influence on contained copper is whether composite assays are SG and length weighted rather than the normal length only weighting which has been used here. For instance, one meter of native copper and 1 meter of barren clay average 77% (8.9/8.9+2.6)not 50% Cu.

A more realistic example is to average 4m of clay at 0.1% Cu with an SG of 2.6 and 1m of mineralisation at 10% Cu with an SG of 3.3. Normal length weighted averaging gives 5m at 2.08% Cu, but the correct average is 5m at 2.48% Cu; which is a 16% increase in grade. It is thought likely that the average grade would be increased from 10-15% if SG weighted averaging were used.

Nugget Effect

Another effect which is difficult to evaluate is the nugget effect. It is likely that, as in gold deposits, a large proportion of contained copper is present in a small proportion of the volume. To properly evaluate this would require geostatistical knowledge of the range and nugget effect from a much higher drill density. This is not likely to be available. The factor is important if there is a desire to maximise copper production in the short term.

From the model developed, it is anticipated that high-grade fluid channelling zones of plus 3% copper are likely to be present. Deposits with high nugget effects are difficult to evaluate and some cutting of high grades may be appropriate.

Cut-Off Grade

A cut-off grade of 0.1% copper was initially chosen arbitrarily. The decision can be justified as follows: At a revenue of $35 per % Cu recovered, if treatment cost is $1.0 to $1.5 per tonne, then in an open cut situation, recovered copper needs to be over 0.03 to 0.04% to justify treatment as ore rather than waste. At this grade, recovery can be expected to be only 30 to 50%, so a cut-off head grade of 0.08 to 0.1% Cu is appropriate.

Quality of Data Description

Unfortunately, this leaves a lot to be desired as hardly any information or reports describing what has been done are available. The blue drill log books are vital, and do systematically record the most important data. However, logging has been carried out by many geologists and a degree of inconsistency is inevitable.

On check logging, the only problem found was an interval in the most recent King Lyell holes logged as quartzite which was found to be silicified vughy limestone with a fizzy reaction to 10% HCL. It is hoped that by simplification to only a few lithologies, the summary logs are as reliable as possible.

As no reports on drilling of 46 of the 48 holes were produced (or have not been referred to or located), it is thought that the MLMRC were not impressed by the results. When

they did carry out metallurgical testing, it is suspected they were considering treating the copper clays through their normal flotation process. As the flotation test results were disappointing, it is easy to see how they became disenchanted with the copper clays and did not regard a resource assessment as necessary.

7.1 Lyell Blocks

Blocks mining history is reasonably documented, but more detailed period reports are probably available through State Archives. Previous stoping history suggests a zone of higher grade mineralisation parallel to and under the gossan zone which was exposed in Copper Creek (Figure 26). Assuming mineralisation between the Blocks and Balance Shaft area is really continuous, the Blocks orebody is up to 400m long, 140m wide and 160m deep. Strike is NW which is not parallel to either the North Lyell Fault or the set of WNW trending Tabberabberan D_2 faults to the south. The body appears to be controlled by the topography and the natural hydrometallurgy model previously described.

Nine of the 16 holes drilled (for 2569m) outline the orebody. Of the 7 remaining, 2 were abandoned (LB3 and 36), 2 were not assayed (NL1101 and 1102) and 3 are some distance to the southeast of the orebody (LB1, 2 and 4). Of the 9 holes defining the orebody, only one, LB28, was drilled in the central higher grade zone. It achieved an intersection of 165m at 0.6% Cu which is the highest m% accumulation in all clays holes. The other 8 holes intersected significantly less mineralisation (Appendix 2.1).

There is good evidence for strong mineralisation on the old long projections (Figures 28 and 29) and from the complexity of the underground workings (Figure 27). It is anticipated that despite the ore extracted, after more holes are drilled, the average grade will be increased by relatively more strong intersections from the central core.

The Blocks resource of 4.7 mt at 0.5% Cu contains 23,700 tonnes of copper which is 48% of the inferred resource recognised in this report. Without the benefit of the 1960's drilling, Wade (1957b) estimated probable reserves of 1.63 mt at 1.75% Cu containing 28,500 tonnes of copper. He also recognised potential for an additional six million tonnes of ore above the Crown Lyell Quarry. Since this is largely outside the current inferred resource mineralisation, total resource potential of 10 mt at 1% Cu is recognised.

The few mildly anomalous silver and gold assays from copper clays are mainly from Lyell Blocks (Tables 5 and 6). There is a suggestion, at least with the anomalous Ag, that it correlates with higher sulphur assays. This implies that detrital clasts of bornite and chalcopyrite ore from North Lyell form a part of the Blocks mineralisation as recognised by Batchelor (1904).

Table 5

Gold and Silver Contents of Copper Clays ore from Production Records

Ore Source	Period	Tonnes	% Cu	g/t Au	g/t Ag	Note
North Lyell	Pre 1903	101,978	7.8	0.32	85	1
Lyell Blocks	1900/01	18,537	7.6	0.29	47	2
King Lyell	1903	21	40.42	bld	19	
	1904	2.0	1.09	Tr	3.4	
	1906	3.6	1.68	bld	Tr	
North Lyell	1904	59.1	0.50	bld	13.8	3
	1906	34.6	0.34	bld	11.0	3

Notes:

Tr	= Trace.
bld	= below limit of analytical detection.
1	Bornite-rich ore mined by the North Lyell Company.
2	Bornite-rich ore mined from Lyell Blocks - see Blainey (1993, p. 143).
3	Probably Blocks ore sold to MLMRC, possibly from the Copper Clays north of Lyell Blocks.

Table 6

Copper Clays Mineralisation, Copper, Pyrite, Gold and Silver Contents
from Drill Intersections

Deposit	Hole No	Intersection (m)			Cu	FeS_2	Au	Ag	Description of Interval
		From	To	Interval	%	%	g/t	g/t	from drill logs
Blocks	LB28	16.5	30.8	14.3	0.15	1.07	0.15	1.4	sand, clay, py cubes
Blocks	LB28	30.8	45.7	14.9	0.13	1.14	0.30	2.6	clay
Blocks	LB28	45.7	65.2	19.5	0.21	1.36	0.30	4.3	hematitic schist
Blocks	LB28	65.2	72.9	7.6	0.11	0.23	Tr	0.8	decomposed schist
Blocks	LB28	72.9	76.7	3.8	0.59	0.51	0.15	1.4	clay
Blocks	LB28	76.7	85.5	8.7	2.94	0.64	Tr	1.2	clay, fine diss NCu
Blocks	LB28	85.5	100.6	15.4	0.27	1.41	Tr	2.1	clay, limestone, py cubes
Blocks	LB28	100.6	112.8	12.2	1.09	1.17	Tr	1.2	clay, NCu
Blocks	LB28	112.8	121.9	9.1	2.37	1.63	Tr	12.4	clay, NCu
Blocks	LB28	121.9	129.5	7.6	1.06	0.78	0.15	27.7	coloured clay, NCu
Blocks	LB28	129.5	139.0	9.5	1.81	1.56	Tr	2.9	grey clay fine NCu
Blocks	LB28	139.0	152.4	13.4	0.35	2.05	Tr	3.5	grey clay NCu & py
Blocks	LB28	152.4	167.3	14.9	0.15	1.33	Tr	1.2	(clay with fine py in darker
Blocks	LB28	167.3	181.1	13.7	0.10	1.74	Tr	Tr	(layers
Blocks	LB30	9.0	21.3	12.3	0.21	0.20	Tr	2.9	clay
Blocks	LB30	21.3	35.1	13.8	0.34	0.45	Tr	3.1	clay with NCu
Blocks	LB30	35.1	45.7	10.6	0.45	2.67	Tr	3.4	clay with NCu
Blocks	LB30	45.7	54.5	8.8	0.30	3.58	Tr	2.8	clay with py
Blocks	LB32	12.5	24.4	11.9	0.16	0.01	Tr	1.2	clay with NCu
Consols	LB13	5.5	17.4	11.9	0.10	2.46	Tr	2.5	coloured clays, diss py
Consols	LB13	58.5	75.9	17.4	0.68	bld	0.15	3.1	clay, limestone, py, NCu
Consols	LB18	27.1	29.9	2.8	10.5	bld	Tr	Tr	grey clay, NCu
Consols	LB23	53.3	59.4	6.1	0.27	4.0	Tr	0.9	clay with fine diss NCu
Consols	LB23	59.4	67.1	7.7	1.54	bld	bld	Tr	clay with fine NCu

Abbreviations:

Tr = Trace
bld = below limit of detection
py = pyrite
diss = disseminated
NCu = Native Copper
FeS_2 is as recorded on logs and probably an under-estimate as some of the determined sulphur has been alloted to chalcopyrite.

The main problem with the Blocks, particularly during the exploration stage, is the presence of waste dumps from the various Corridor pits. These comprise Crown 3 and North Lyell waste dumps which together cover the northwestern part of the orebody.

7.2 Lyell Consols

Mining history is not well documented, but ore was developed on several levels and over a considerable strike length (Figure 24). In 1907, reserves were estimated at 95,627 tonnes at 3% copper (Wade, 1957b). The orebody trends approximately east-west at a similar orientation to the Consols and Whaleback Faults. It is up to 400m long, 160m wide and 70m deep and opportunities for immediate extensions are not obvious.

Lyell Consols is the most densely drilled of the three deposits, with 23 holes for 1646m (Appendix 2.2). Again, one hole, LB18, had by far the best intersection of 31m at 1.56% Cu and the mineralised body appears to be strongly zoned around a high-grade core. The total resource of 1.9 mt at 0.5% Cu contains 8,700 tonnes of copper which is 18% of the global resource. It is again predicted that after a more representative drilling pattern is established, a higher grade though lower tonnage resource of about 1.5 mt at 1% Cu will be established.

The long section view of Lyell Consols (Figure 14) is remarkably similar to that at King Lyell (Figure 19). It is expected that the overall geology is also very similar. The higher grade predicted for King Lyell may be a function of hole location to date, or if it is real, it is probably caused by King Lyell's closer proximity to a source of high grade solutions derived from the Iron Blow.

There are no known mine dumps overlying the Consols deposit which, apart from general site access difficulties, should be the easiest of the three main deposits to develop.

7.3 King Lyell

Although the mining history of King Lyell is different, with all previous production coming from sluicing operations, there are still sufficient shafts and tunnels to again be confident of ore continuity. These workings are shown on a beautiful plan from about 1903 (Figure 30). In plan view, King Lyell is the most erratic of the three deposits and although it is the smallest, it is also the highest grade containing 16,500 tonnes of copper or 34% of the current resource. The orebody as defined is up to 300m long, 180m wide and 45m deep, containing 1.5 mt of 1.1% Cu. There is a good chance that mineralisation will be found over an area of up to 400m long, 260m wide and 45m deep. This could lead to a doubling of the current resource to about 3 mt of 1.0% Cu.

The King Lyell resource is defined by only 7 holes of the total of 9 drilled. Of the other two, KL1 was not a good intersection, but it was not assayed over the whole hole and ML12 achieved an intersection at 62.5m depth of 49m at 0.52% Cu. This hole is near the Lyell Highway (Figure 19) and has been previously mentioned as the only hole to have a significant intersection in Gordon Limestone and not in clay. Further drilling in this area is recommended.

The 9 holes drilled are not well sighted to outline the entire deposit. Reid (1970) proposed a more extensive programme, but for some unknown reason, the 4 holes completed only achieved an average 44% recovery and Reid may have given up in disgust. Despite the poor recovery and poor assay reproduceability (Table 4), hole KL13 located 75m from Batchelor's Shaft achieved a good intersection of 27m at 1.10% Cu.

The other holes were disappointing, but the logger did not recognise some of the copper and the holes were not assayed over their entire length. Core condition has deteriorated since they were drilled and many core trays are missing, so it is not thought possible to correct this problem.

Strong zones of native copper rich mineralisation were intersected in the 1898/9 adit (55m at 4.6% Cu), in hole ML09 (40m at 2.2% Cu) and in Batchelor's Shaft (45m at 1.1% Cu; "excluding a zone between 45 feet and 50 feet which probably went 20% Cu"). At the base of Batchelor's Shaft, cross cuts were driven. The north cross cut passed through 0.2-0.3% copper before reaching the conglomerate contact and the south cross cut averaged 1.98% Cu over 26m (Reid, 1970).

King Lyell has a problem from two of the Iron Blow waste dumps (Figure 15) though these are only thought to be up to about 10m thick and may contain grades of interest. King Lyell is likely to be the second easiest mining proposition once the current aggregate operation is terminated. It contains a large area of prospective untested clay on its southern side between Cooney's Creek and the Gormanston Fault (Figure 15).

8. OPEN CUT POTENTIAL

The aim of this section is to take a preliminary look at economic factors to make sure that an exploration programme can be justified. This also encourages foresight during the exploration programme so that logging and assaying is suitable for future needs, and samples can be collected for metallurgical assessment. As the clays have been classified as an inferred resource, there is an "implication that there are reasonable prospects for eventual economic exploitation."

8.1 Waste to Ore Ratios

An exercise was undertaken where simple pit outlines were drawn on photocopies of each resource cross section. That is on Figures 3-6, 9-13 and 16-19. To avoid an extra 13 figures in this report, these are kept on file at Mt Lyell if required. In these simplistic pits, walls were drawn at 45° if in clay and at 50° if in conglomerate. Floors are not at the same RL, as all pits slope downhill parallel to the topography, but they are geometrically sensible. Deep or isolated ore was excluded to give figures for in pit resources. No adjustment has been made for end effects, so the volume of waste is probably slightly high. No dilution has been applied.

Results are summarised in Table 7 and detailed in Appendix 4. Waste to ore ratios on individual sections vary widely from 0.61 to 1 to 5.5 to 1, but overall ratios from each

orebody are more consistent in varying from 1.9 to 1 to 2.8 to 1, with an overall average of 2.3 to 1. The waste was higher than expected due to deposit location in valleys. In Appendix 5, the proportion of copper in resources recovered is listed. On individual sections, this varies from 66 to 100% and averages 83%.

Since more control is possible via detailed pit planning, the degree of waste removal is not thought to be a major hurdle to development. In fact, it presents an opportunity to develop a considerable production of construction aggregate materials for on mine use and off mine sale.

8.2 Metallurgy

Since the copper clays have been previously profitably treated, there is good reason to believe that as long as a substantial resource is outlined, it should be economically viable to treat. Grayson's (1903) description of the Blocks plant is given in section 5.1. There is sufficient information on mineral distribution from the existing 48 drill holes to believe that a gravity concentration plant would again be most appropriate. However, all options need to be considered during any feasibility study as follows:

1. Gravity concentration
2. Flotation
3. Solvent extraction and electrowinning

Previous gravity treatment at the Blocks and Consols gave recoveries of 72% with concentrate grades of 69% copper. This should be able to be improved with modern experience and technology. As the ore contains some gossan and some mineralised clasts, crushing and grinding for the estimated 20-25% that is not clay would be necessary. The Blocks also produced a secondary iron-rich product averaging about 20% copper.

Some metallurgical testwork was carried out by MLMRC from the 1964/65 Blocks and Consols drilling. As only the work sheets could be located, John Geoghegan, MLMRC's final Mill Superintendent, kindly provided a commentary on the work which is given in Appendix 6. He concluded that high slime contents would probably preclude flotation treatment and that fine chalcocite is likely to be the most troublesome component.

If a drilling technique such as air core/hammer be utilised, then for the mineralised sections, gravity recoverable copper as well as total chemical copper should be determined. Such work could be carried out in a diamond indicator mineral laboratory. It is thought that this type of analysis would be of great value in assessing the deposit. Five meter, ten meter or longer composites could be treated so the metallurgical response of the whole deposit can be determined.

Table 7

Summary of Copper Clays Resources

Deposit	Global Resource			In Pit Resource		
	Mt	% Cu	Tonnes Cu	Mt	% Cu	Tonnes Cu
Lyell Blocks	4.71	0.50	23,757	4.18	0.49	20,590
Lyell Consols	1.86	0.47	8,698	1.69	0.48	8,084
King Lyell	1.47	1.13	16,570	1.05	1.12	11,810
Totals	**8.04**	**0.61**	**49,025**	**6.92**	**0.59**	**40,484**

Deposit	Waste Mt	In Pit Resource Mt	Waste to Ore Ratio	Recovered % of	
				Tonnes	Cu
Lyell Blocks	7.92	4.18	1.89	89	87
Lyell Consols	4.77	1.69	2.82	91	93
King Lyell	3.00	1.05	2.86	71	71
Totals	**15.69**	**6.92**	**2.27**	**86**	**83**

Collection of metallurgical samples by near surface sampling is not recommended as it would be very hard to ensure representativeness. Regular size fraction analysis of uncrushed materials would also be necessary to determine the proportion of oversize that would need crushing. A small heavy-media plant could also be considered as this would effectively separate mineralised oversize and create a useful aggregate by-product.

8.3 Preliminary Economics

A brief and simplistic look at the economics of a copper clay operation is considered necessary to allow debate on the project's relative importance. Ball park cost figures have been obtained after discussions with Richard Winby and Hamish Bohannan. If contract earthmoving and an alluvial type concentration are utilised, capital cost is not expected to be a major hurdle. The type of operating cost scenario envisaged is as follows:

	per tonne ore
	$
• Mining (earthmoving) at $2.25/tonne and 2.3:1 waste to ore (3.3 tonnes per tonne ore)	7.43
• Cu recovery by gravity, including comminution	1.50
• Cu transport and recovery	2.10
• Administration	0.25
Total	**$11.28**

Thus, to break even, recovered grade at a revenue of $35 per % Cu would be 0.32% Cu. This equates to a head grade of 0.45% Cu at a recovery of 72%. For current resources, with an average grade of 0.61% Cu, an operating surplus of about $4 per tonne could be expected. However, the current grades at the Blocks and Consols would be marginal. To have operating costs as 50% of revenue with a 2.3 to 1 waste to ore ratio, a recovered grade of 0.64% Cu and head grade of 0.9% Cu would be required. This is thought to be possible by modification of pit designs.

For the King Lyell orebody (1.5 mt at 1.13% Cu) and a 2.9 to 1 waste to ore ratio, the figures are:

	per tonne ore
	$
• Mining per tonne of ore treated (3.9 x 2.25)	8.78
• Concentrate production	1.50
• Cu recovery and transport	3.95
• Administration	0.25
Total	**$14.48**
Revenue from 1.13% head grade is 0.81% recovered grade at $35 per % Cu	28.48
Surplus	**$14.00**

or for 1.5 mt, a total surplus of $21.0m

From these figures, it is concluded that a copper clays operation has the potential to be highly profitable. An exploration programme designed to increase confidence in resource knowledge is therefore justified.

9. EXPLORATION PROPOSALS

In order to enable a pre-feasibility study to be carried out, it is necessary to upgrade the resource classification to an indicated resource. Due to the unconsolidated nature of the Copper Clays, the resource estimation has similar problems to those evaluating alluvials and it may never be possible to estimate a measured resource. Any development may have to proceed on the basis of an indicated resource and probable reserve. This is possible with a two-stage drilling programme, the first stage of which is proposed here.

The main improvements to resource assessment factors which are necessary are:

1. Greater drillhole density.
2. Significantly improved recovery.
3. Minor improvements in assays, tonnage factor, size fraction analysis, quantitative mineralogy and documentation.
4. Commencement of systematic metallurgical investigations.
5. Commencement of mining investigations.

1. Greater Drillhole Density

A 64 hole, 5590m drilling programme is proposed as illustrated in Figures 20, 21 and 22 and tabulated in Appendix 7. A nominal spacing of 40m along lines 80m apart is proposed. This is slightly more dense than the 122 x 61m pattern proposed by Reid (1970) for an imperial grid. Holes average 87m in length which is similar to the historical average for the 46 holes to 1971 for 3876m at 84m per hole.

Hole depths have been predicted by reference to the cross section interpretations and are expected to be reasonably reliable. Only 8 holes (7 at the Blocks, 1 at King Lyell) are expected to be between 120 and 200m in length so their may have to be some compromise on these by leaving all difficult holes for a second phase.

It is important to complete holes to the Pioneer-Owen contact if possible as the Pioneer Sandstone is generally only about 10m thick and often carries good native copper grades.

Some holes will have to be drilled through Blow and North Lyell waste dumps, but this is unlikely to be more difficult than drilling through unconsolidated boulder beds. For best cross section interpretation, hole collars should be reasonably close to those planned.

This will involve considerable time and earthmoving cost for site preparation.

The grids at King Lyell and the Consols are the mine grid, whereas at the Blocks, a new local grid may be necessary. Holes on each traverse have been sighted so that at least one hole is outside the presumed orebody. If follow-up drilling is carried out it may be necessary to vary the hole spacing so there are more holes in the higher grade-width zones.

If drilling funds are scarce, holes could be drilled on the current cross sections. However, it would be necessary to redrill most holes for better recovery so the new pattern might as well be used. Another alternative is that one deposit, such as King Lyell, could be drilled first to check that objectives are being met.

2. Significantly Improved Recovery

Improved recovery is so important that a drill contractor and drillers with patience to experiment and a desire to improve will be necessary. It is likely that no one technique will be suitable for every situation and a combination of air core for clay and sand and a face sampling hammer for waste dumps, gossan, boulders and limestone may be necessary. A technique with casing advancing behind the bit may also be worth trialing.

It may be worth bringing in one or more experienced drilling consultants, showing them a selection of available clays core, and seeing what they recommend.

The air core technique is likely to create a big improvement in recovery in all unconsolidated zones with pebble size or less. A large diameter system may recover cobble size materials too and would create larger samples for metallurgical testing. It should be possible to retain 1 or 2m samples in large porous bags so that they can be drained and weighed. This will enable more reliable estimates of recovery and tonnage factor to be derived.

3. Minor Improvements

Assays: more duplicate work and screening of pulps to see if there is a copper smearing problem should be carried out.

Tonnage factor: weighing dry materials recovered from each meter should enable better data to be obtained. Clay samples are unlikely to dry and would have to be weighed damp and a water content estimated.

Size fraction analysis: this is necessary to make an estimate of the proportion of oversize that will be generated and hence crushed to liberate its copper.

Mineralogy: more quantitative estimates of the proportions of each copper mineral are necessary. A combination of whole rock and XRD analysis of concentrates on a suite of representative composites

should enable a reliable modal analysis. The previous practice of estimating pyrite contents from sulphur assays when the main mineral is native copper, not chalcopyrite, needs to be discontinued.

Drill logging: drill logging by a competent mineral observer with a binocular microscope on panned concentrates is thought to be desirable for semi-quantitative determinations.

Documentation:
it is taken for granted that CMT would not recreate the problems MLMRC have by lack of documentation of work for 25 years.

4. Metallurgical Investigations

As long as samples are kept in porous bags, loose water will drain out and the samples can be retained until assays are available. Composites for metallurgical or any other analysis can then be produced. In the next exploration stage, an attempt to determine total copper and gravity recoverable copper should be made. Some leaching and flotation tests can also be carried out so that a likely treatment route is known. This will influence later exploration.

5. Mining Investigations

There are not thought to be great problems here, but the proportion of the resource which can be freely dug or scraped compared to that requiring drilling and blasting needs to be known for an improvement in the quality of mining cost estimates. If a driller, an engineer and a geologist discuss the problem, it should be possible to devise a method of recording the ground type during drilling. For instance, air core drillable could indicate free digging and hammer drillable could indicate a need for drill and blast. Some work on suitable pit wall angles also needs to be carried out.

The Copper Clays evaluation is a challenging task on the boundary between alluvial, soft and hard rock evaluations. There will be many opportunities to improve evaluation techniques.

10. EXPLORATION POTENTIAL

In this section, the exploration potential of the whole Copper Clay's area is considered. This includes the head of the Linda Valley to AMG easterly co-ordinate 384000mE which is the eastern boundary of 1M/95 and ELA5/95. It can be sub-divided into four main possibilities:

1. Copper Clays and extensions.
2. Tabberabberan quartz vein gold.
3. Carbonate hosted lead-zinc.
4. Volcanic hosted copper-gold-silver.

10.1 Copper Clays and Extensions

The three deposits identified are not closed off by drilling and are likely to have extensions. Such opportunities have been termed Mpc or mineralisation-potential copper clays on Figure 1.

This includes the potential identified by the author of Figure 24 (probably Wade) in 1957. These areas are listed from north to south below with estimates of resource potential (rp) or inferred resource (ir) mineralisation at an average grade of between 0.6 and 1.2%, say 0.8% copper.

Area	Category	Resource Mt
North of Blocks (Wade, 1957b)	rp	6.0
Lyell Blocks (this work)	ir	4.7
Gap between Blocks and Balance Shaft	rp	1.0
North of Consols (Fig 24)	rp	0.5
West of Consols (Fig 24)	rp	0.5
Lyell Consols (this work)	ir	1.9
Lyell Extended/Pioneer (Fig 24)	rp	1.5
King Lyell (this work)	ir	1.5
South of and surrounding King Lyell	rp	1.5
Total	**rp**	**19.1**

If 83% of this potential is converted to a reserve and 72% of this is recovered, then potential copper production is about 91,000 tonnes.

10.2 Tabberabberan Quartz Vein Gold

The gold potential of the Linda Valley area has been addressed by Sillitoe (1984; 1985), Angus (1984) and Jones (1984; 1985). Evidence has been given in section 5.5 of gold-bearing quartz vein stockworks at McDowels, parallel to the North Lyell Fault. There are four areas currently known and possibly worthy of evaluation. These are:

1. McDowell's PA.
2. North flank of Mt Owen, Moore's and Gormanston Gold Mines.
3. Lyell Pioneer Gold workings.
4. Source of Jimmy Watson's old creek alluvials.

There is thus sufficient evidence to believe that Tabberabberan quartz vein stockworks, and associated processes, represent an important part of the metallogenic history of the area. However, to date, none have been large enough to warrant long-term exploitation. If larger deposits were present near the surface, we could expect to see some evidence in the distribution of alluvial workings.

Geoff Cordery (pers. comm., 1995) has suggested that these systems may develop into silica or sulphide-rich gold systems, such as the Henty deposit, at depth. This is a much more attractive target. As Tabberabberan D_2 veins show evidence of local derivation (Cox, 1979, p. 63), the most likely location for pyritic veins is in the Lyell Schists at depth and for siliceous veins adjacent to the Owen Conglomerate.

10.3 Carbonate Hosted Lead-Zinc

Markham (1966) recovered small isolated grains of honey-yellow sphalerite and galena from his copper clays drill composites. The minerals were not associated with the copper sulphides. Since the Owen Conglomerate hosted galena-barite veins reported by Bird (1984) do not contain anomalous zinc, the Markham Pb/Zn is thought to be from carbonate hosted mineralisation developed in the Gordon Limestone. A reward claim for zinc was granted over the Gormanston Cemetery area in 1902.

Banks and Baillie (1989) and Calver (1995) both report common secondary dolomitisation processes in Gordon Limestone Micrites. Therefore, given the regional linears indicating long-term deep fractures, an anomalous metal basement and the observed galena and sphalerite, it is likely that carbonate hosted Pb-Zn mineralisation of unknown dimensions and grade is developed.

Discovery of such deposits will be difficult. If a geophysical signature is present, it could be targeted. This is unlikely and mapping and sampling followed by reconnaissance drilling would be a favoured exploration strategy. As sulphides are stable in pug derived from Gordon Limestone, a search for galena and sphalerite in heavy mineral concentrates from shallow pug could be a very sensitive technique.

10.4 Volcanic Hosted Copper-Gold-Silver

The gold mineralisation mentioned above may be a leakage indication from a much greater prize; namely an extension of the Mt Lyell Field on the east side of the Great Lyell Fault (GLF). This idea will be more fully developed in a later report. The GLF is thought to be a Tabberabberan D_1 reverse fault generated at a depositional/lithological/rheological boundary due to overturned folding generated by the structurally weak hydrothermal alteration zone in the Central Volcanic Complex.

Orebodies such as the Blow, A Lens, Prince Lyell, Lyell Tharsis and North Lyell appear to be truncated by the GLF. Due to the reverse movement on the GLF, the extensions of these orebodies can be expected on the east side of the GLF under the Lyell Saddle - Western Linda Valley area. Unfortunately, depths are likely to be in the -1000 to -1500 RL range, so any orebodies here are probably propositions for the second half of the 21st Century. However, if their existence was confirmed, it would surely have a positive long-term effect on the Company's market profile.

The time to execute such a programme would be when Prince Lyell development is down to the 90 or 100 series. A 1km easterly cross-cut at say, -600 RL and a drilling development drive parallel to and approximately 1.5 km beneath the Copper Clays may be necessary.

11. KEYWORDS

Literature Review; Mine History; Open Cut Potential; Native Copper; Clay; Limestone; Ordovician; Devonian; Cainozoic; Glaciation; Ore Fluids; Mineralisation; Diamond Drilling; Mineralogy; Metallurgy; Mining; Economic Evaluation; Resources; Exploration Potential.

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APPENDIX 1

Copper Clays Summary Diamond Drill Logs

1.1 Lyell Blocks Holes

	Drilled		
LB 1- 4	From 16 October 1963	to	17 July 1964
LB 28-37	From 26 October 1965	to	10 June 1966
NL 1101-2	From 10 March 1984	to	18 July 1984

1.2 Lyell Consols Holes

LB 5-27	From 21 July 1964	to	24 September 1965

1.3 King Lyell Holes

ML 8-12	From 17 September 1902	to	28 November 1902
KL 1-2, 13 & 16	From 21 October 1970	to	25 November 1970

Total: 40 holes

1.1 Lyell Blocks Summary Drill Logs

Hole No	From (m)	To (m)	Abr	Summary Log
NL1101	0	39.1	QM	Clay, sand, pebbles and boulders – moraine.
	39.1	73.5	Ogc	Clay, sand and pebbles, ex-limestone.
	73.5	151.8	Ogl	Limestone and clay, some 'rubble' zones.
	151.8	211.2	Ogc	Clay, sandy clay, concretions, generally soft.
	211.2	226.3	Ogs	Sandstone, probably Pioneer Sandstone.
	226.3	554.4	Ous	Altered sandstone, brecciated, variably siliceous and/or hematitic, siderite veined, siltstone, conglomerate; quartz-carbonate-chlorite-barite siderite-galena veins over interval 246-451m. Pyrophyllite with veins and galena. Mylonitic zones over interval 482-546: Altered Owen Conglomerate. EOH.
Cu				No assays.
NL1102	0	2.0	-	Waste dump.
	2.0	75.2	-	Zone of high silica alteration of Owen Conglomerate.
	75.2	176.3	Ous	Quartz sandstone and conglomerate, fractured throughout with quartz-hematite-barite-sericite-pyrophyllite alteration: Altered Owen Conglomerate.
	176.3	195.5	Ogs	Green-pink quartz conglomerate, sandstone and siltstone, weak schistocity.
	195.5	217.5	Ogc	Grey and green sandstone and clay, ex Gordon Limestone.
	217.5	221.3	Ogs	Similar to 176.3 - 195.5m.
	221.3	269.4	Ous	Hematite-barite altered quartz sandstone.
	269.4	300.5	Ogs	Grey-green quartz sandstone.
	300.5	470.0	Ous	Purple hematitic sandstone and conglomerate, chert, jasper; altered Owen Conglomerate. EOH.
Cu				Cu assays 333-353m all <0.02%, anomalous BaSO4, 333-379m average 46m at 30% BaSO4. Anomalous Pb & Ag 333-335, 2m at 0.37% Pb, 9ppm Ag, 0.01% Cu, <0.05 g/t Au, 33% BaSO4.
LB1	0	63.1	Qm	Clay, sand, pebbles and boulders, unconsolidated moraine.
	63.1	71.0	Ogc	Sandy clay.
	71.0	95.1	Ogl	Limestone grey and brown with grit, limonite cubes, cavities.
	95.1	101.7	Ogs	Chromite-bearing quartzite (0.27% Cr): Pioneer Sandstone assays low 63-95m all Cu <0.1%, Au:Tr, Ag <2ppm.
Cu	85.0	95.0	Mcc	10m at 0.1% Cu.
LB2	0	64.2	Qm	Pebbles, sand, clay; probably moraine or scree.
	64.2	70.3	Ogc	Clay.
	70.3	101.2	Ogl	Grey limestone and clay.
	101.2	117.8	Ogc	Variegated clays.
	117.8	122.1	Ogs	Cr anomalous (0.27%) conglomerate: Pioneer edit.
Cu	106.4	117.8	Mcc	11.4m at 0.13% Cu.
LB3				Abandoned.
LB4	0	31.4	Qm	Boulders and clay: moraine
	31.4	110.2	Ogl	Limestone and fawn limestone, clay, some limonite and manganese staining, native Cu at 99m.
	110.2	147.7	Ogc	Variegated clays very weakly mineralised, small flakes of native Cu at 120m. Can see native Cu at 0.15% Cu.
	147.7	158.8	Ogs	Apple green quartzite (0.24% Cr): Pioneer Sandstone.
	158.8	161.2	Ous	Purple hematitic conglomerate-sandstone; Owen.
Cu	99.1	101.2	Mcc	2.1m at 0.26% Cu, spotty weak mineralisation 95-148m.
LB28	0	16.5	Qm	Boulders, clay, schist, wood – moraine.
	16.5	74.8	Ogc	Weakly mineralised variegated clay with sand, pyrite cubes, decomposed schist 58.3m Av 0.16% Cu.
	74.8	143.3	Ogc	Variegated mineralised clay, core/bedding 50°, pyritic, native Cu with red clay.
	143.3	193.5	Ogc	Dark grey clay, some sand, pyrite layers & veins parallel to bedding.

LB (2)

Hole No	From (m)	To (m)	Abr	Summary Log
LB28 cont	193.5	201.2	Ogs	Pebbly quartzite. Pioneer Sandstone EOH.
Cu	74.8	143.3	Mcc	1.33% Cu for 68.5m. 113-122m, 9m for metallurgy averages 2.4% Cu. Comment: A very good hole, most of Cu seems to be native Cu associated with red clay - NB steep layering. NB: 16.5 - 74.8m = 58.3m of 0.16% Cu and 143.3 - 181.4m = 38.1m of 0.12% Cu ie: 16.5 to 181.4 = 165m at 0.64% Cu.
LB29	0	9.1	Qm	Sand and boulders.
	9.1	73.0	Ogc	Variegated clays weakly mineralised to 73m then moderately mineralised.
	73.0	92.7	Ogc	Mineralised clays with traces of native Cu (BCA-90%)
	92.7	103.3	Ogs	Green tinged quartzite and sandstone: Pioneer EOH.
Cu	73.0	92.7	Mcc	0.25% Cu over 19.7m.
LB30	0	57.6	Ogc	Mineralised clays from surface with native Cu in first 2m. Bedding 90° to core axis. Office tunnel workings filled with white clay from 54.9 to 57.6m.
	57.6	71.6	Ogs	Pale green quartzite then pink conglomerate BCA 45° contrast to clays - could be a faulted contact. EOH.
Cu	0	48.8	Mcc	48.8m of 0.37% Cu - long mineralised interval.
LB31	0	4.7	Qm	Sand and boulders.
	4.7	27.7	Ogc	Variegated clays with sand, flat bedded.
	27.7	38.1	Ogs	Chromite-bearing pebbly quartzite; BCA 35°; Pioneer EOH.
Cu	5.0	25.0	Mcc	20m of 0.44% Cu.
LB32	0	12.5	Qm	Clay and boulders; boulder clay – moraine.
	12.5	22.3	Ogc	Weakly mineralised clay.
	22.3	32.9	Ogl	Sand, limestone; some with magnesite-lined vughs.
	32.9	64.0	Ogc	Clay, sand, pyritic clay.
	64.0	81.1	Ogs	Sand then quartzite and pebbly quartzite; Pioneer EOH.
Cu	14.0	22.0	Mcc	8.0m of 0.2% Cu - disappointing weak mineralisation.
LB33	0	12.2	Qm	Gravel, clay, pebbles, sand: moraine-outwash.
	12.2	49.1	Ogc	Variegated clays, flecks of native Cu but only up to 0.2% Cu - bedding 50-90° to core axis. Av 70°. 46.6 to 48.8 logged as a drive but not near workings!
	49.1	86.3	Ogl	Fawn limestone and clay.
	86.3	121.0	Ogc	Light grey and white clays only traces of mineralisation. 2m cavity at 118m.
	121.0	128.3	Ogs	Grey-green pebbly quartzite; Pioneer ODH.
Cu	38.1	45.7	Mcc	7.6m of 0.30% Cu.
LB34	0	24.4	Qm	Sand and gravel.
	24.4	48.8	Ogc	Clay, minor gravel, pyritic schist.
	48.8	56.4	Ogl	Clay with limestone fragments.
	56.4	86.6	Ogc	Grey and yellow clays some sandy limonite.
	86.6	105.5	Ogs	Chromite-bearing quartzite and conglomerate: Pioneer EOH.
Cu	24.4	39.6	Mcc	15.1m of 0.16% Cu.
LB35	0	12.5	Qm	Clay, sand and pebbles.
	12.5	54.9	Ogc	Yellow sandy clay with limonite.
	54.9	92.0	Ogl	Limestone and clay.
	92.0	162.5	Ogc	Brown to khaki clay with laminae of pyritic clay BCA 90° throughout.
	162.5	178.9	Ogs	Pebbly quartzite; Pioneer Sandstone EOH.
Cu	13.8	25.8	Mcc	12.0m of 0.20% Cu.
LB36				Abandoned.
LB37	0	44.2	Qm	Unconsolidated quartz sand with pebbles & boulders.
	44.2	140.2	Ogc	Hematitic sands.
	140.2	182.9	Ogc	Variegated clays red-orange-grey-black-yellow.
	182.9	193.9	Ogs	Pebbly chromititic quartzite EOH.
Cu	149.4	182.9	Mcc	33.5m of 0.2% Cu - also 23.2 - 85.3, 12.1m at 0.42% Cu.

1.2 Lyell Consols Summary Drill Logs

Hole No	From (m)	To (m)	Abr	Summary Log
LB5	0	2.0	Qm	Moraine.
	2.0	84.1	Ogc	Clay and sand.
	84.1	95.0	Ogs	Quartzite and conglomerate to EOH.
Cu	76.5	92.7	Mcc	16.2m at 0.32% Cu
LB6	0	17.7	Qm	Clay-moraine.
	17.7	33.0	Ogc	Clay - pug.
	33.0	75.3	Ogl	Limestone, sand and clay.
	75.3	147.5	Ogc	Black puggy clay and cavities.
	147.5	157	Ogs	Quartzite and conglomerate with chromite to EOH.
Cu				All assays less than 0.1% Cu.
LB7	0	78.6	Qm	Pebbles and sand, probably from moraine.
	78.6	82.4	Ogc	Black clay with minor fine pyrite.
	82.4	141.7	Ogl	Grey limestone with black shaley bands, limestone pebbles, calcite veins parallel to bedding.
	141.7	157.0	Ogs	Quartzite and conglomerate, chromite stain. EOH.
Cu				All assays less than 0.1% Cu.
LB8	0	8.5	Qm	Moraine with sand and pebbles.
	8.5	22.9	Ogc	Carbonaceous clays with some pyrite layers.
	22.9	32.0	Ogl	Dolomite, sand and clay.
	32.0	34.4	Mw	Timber and cavity - Consols workings?
	34.4	47.2	Ogc	Coloured clay with native Cu, sand.
	47.2	54.6	Ogs	Chromitic quartzite, some native Cu on joints, EOH.
Cu	30.8	48.5	Mcc	17.7m at 0.63% Cu.
LB9	0	3.0	Qm	Clay, sand and pebbles, probably moraine.
	3.0	27.4	Ogc/Mw	Clay and sand, bedded. (7-6-9.1 Consols Drive).
	27.4	40.2	Ogl	Mixture of clay, limestone, pyritic shale, limonite and goethite.
	40.2	53.0	Ogc	Clay, sand, limonite and goethite, quartzite, unconsolidated sand and conglomerate.
	53.0	64.9	Ogs	Native Cu on joint planes, green colouration after chromite. Up to 0.43% Cr.
Cu	18.3	57.2	Mcc	38.9m at 0.23% Cu.
LB10	0	4.3	Qm	Unconsolidated gravel and clay; moraine.
	4.3	14.9	Ogc	Clay, limonite, goethite and sand.
	14.9	46.2	Ogl	Dolomite, sand and clay, dolomitic remnants.
	46.2	58.5	Ogs	Quartzite and conglomerate with chromite. EOH.
Cu	3.2	50	Mcc	18m at 0.30%.
LB11	0	7.3	Qm	Boulders, pebbles, sand and clay; moraine.
	7.3	35.1	Ogc	Variegated clays, limonite, sand.
	35.1	42.4	Ogs	Chromititic conglomerate, quartzite and sand, EOH.
Cu	27.6	35.1	Mcc	7.5m at 0.22% Cu.
LB12	0	3.4	Qm	Clay with pebbles; moraine.
	3.4	19.2	Ogc	Clay, sand, limonite.
	19.2	44.2	Ogl	Mixture of clay, fragments of dolomite and sand.
	44.2	46.3	Mw	Timber and cavity - Consols No. 1 level drive.
	46.3	56.2	Ogc	Clay, sand, limonite with fine native copper.
	56.2	64.6	Ogs	Quartzite and conglomerate, EOH.
Cu	42.1	56.5	Mcc	14.4m at 0.46% Cu.
LB13	0	5.5	Qm	Brown sand and pebbles - moraine.
	5.5	20.1	Ogc	Clay with fragments of quartz, fine disseminated euhedral pyrite in black carbonaceous layers, sand.
	20.1	35.7	Ogl	Mixture of dark clays, sand and dolomite mostly less than 0.1% Cu.
	35.7	74.4	Ogc/Mw	Variegated clays with limonite-hematite and native Cu. Slivers of timber at 43.6m. Angular fragments of quartzite at 50m.
	74.4	93.0	Ogs	Brown unconsolidated and then pink quartzite with native Cu on joint and cleavage planes. EOH.
Cu	34.1	75.9	Mcc	42m at 0.71% Cu.

LC (2)

Hole No	From (m)	To (m)	Abr	Summary Log
LB14	0	7.0	Qm	Pebbles in clay – moraine.
	7.0	19.5	Ogl	Clay and sand with dolomite.
	19.5	41.1	Ogc	Clay with sandy bands and fine grained native Cu.
	41.1	52.1	Ogs	Pink quartzite with small-scale faulting. EOH.
Cu	15.2	45.7	Mcc	30.5m of 0.30% Cu.
LB15	0	10.4	Qm	White/grey sandy clay with pebbles – moraine.
	10.4	21.9	Ogc	Grey to black clay with disseminated euhedral pyrite.
	21.9	25.0	Ogl	Dolomite (muddy) with magnesite-lined cavities.
	25.0	36.0	Ogc	Clay and sand.
	36.0	38.7	Ogs	Pink chromitic quartzite. EOH (Pioneer Sandstone).
Cu	13.4	31.1	Mcc	18m of 0.2% Cu.
LB16	0	2.4	Qm	Clay, gravel, sand; probably moraine.
	2.4	57.0	Ogc	Variegated clay, hematitic and limonitic sand, gravelly clay towards base of unit.
	57.0	77.1	Ogs	Sand then conglomerate and quartzite with chromite-Pioneer Sandstone. EOH.
Cu	40.5	58.2	Mcc	17.7m at 0.12%, very weak.
LB17	0	6.1	Qm	Sand and pebbles – moraine.
	6.1	39.0	Ogc	Variegated clay with hematite and veins of native Cu. Native Cu finely disseminated from 8m to EOH.
	39.0	55.8	Ous	Pink quartzite and conglomerate, no chromite mentioned, probably Owen Conglomerate. EOH.
Cu	9.4	40.5	Mcc	31.1m of 0.26% Cu.
LB18	0	21.3	Ogc	Clay with cellular limonite and goethite.
	21.3	36.9	Ogc	Cellular limonite to gossan with pyrolusite and patchy native Cu (2.7m of 10.5% Cu from 27.1m).
	36.9	48.2	Ogc	Grey sandy clay.
	48.2	76.2	Ogs	Pink to purple sandstone and conglomerate.
	76.2	93.3	Ous	Native Cu on joints to 93m.
Cu	10.7	41.7	Mcc	31.0m at 1.56% Cu (29.9 to 36.0 sent for metallurgy).
LB19	0	5.0	Qm	Pale grey sandy clay with pebbles and pyrite pebbles – moraine.
	5.0	32.6	Ogc	Variegated clay, sand (some unconsolidated).
	32.6	47.2	Ogs	Quartzite with pebbles and chromite, EOH.
Cu	19.8	37.5	Mcc	17.7m at 0.1% Cu (adjacent hole 18 and very weak).
LB20	0	4.5	Qm	Sand, clay, pebbles – moraine.
	4.5	25.0	Ogc	Variegated clay, with quartzite boulders (ex Owen), unconsolidated sand, limonite gravel, cuprite at 22m and native Cu 22-25m.
	25.0	49.8	Ogs	Sand, quartzite and conglomerate with chromite layers.
Cu	18.1	23.8	Mcc	5.7m of 0.31% Cu.
LB21	0	3.7	Qm	Sand and gravel: moraine.
	3.7	28.0	Ogc	Variegated clays with limonite, goethite, hematite and pyrolusite. Unconsolidated cross-bedded sand. Native Cu 24.1 - 24.4m.
	28.0	40.1	Ogs	Conglomerate and quartzite. EOH.
Cu	18.3	28.0	Mcc	9.7m of 0.43% Cu.
LB22	0	8.8	Qm	Grey and black clay.
	8.8	18.6	Ogc	Variegated clay with limonite-goethite gravel.
	18.6	29.3	Ogl	Caverns, dolomite and grey clay.
	29.3	31.1	Ogc	Limonitic yellow clay with native copper.
	31.1	44.5	Ogs	Quartzite and conglomerate with chromite EOH.
Cu	23.2	36.0	Mcc	12.8m at 0.35% Cu.
LB23	0	9.8	Qm	Pale grey clay, sand and pebbles; moraine.
	9.8	54.7	Ogc	Sand, quartzite, boulders.
	54.7	90.2	Ogc	Brown and black clay with fine native copper visible after panning. (59.4-65.5 suitable for metallurgical testing).
	90.2	100.3	Ogs	Sand, quartzite then chromititic conglomerate, joint smears of native Cu at 94m EOH.
Cu	55.0	90.0	Mcc	35.0m at 0.62% Cu.

LC (3)

Hole No	From (m)	To (m)	Abr	Summary Log
LB24	0	4.6	Qm	Sand and pebbles: moraine.
	4.6	14.3	Ogc	Clay and sand.
	14.3	17.2	Mw	Timber and clay : collapsed stope.
	17.2	38.1	Ogc	Clay and sand.
	38.1	46.3	Ogs	Quartz, conglomerate, dolomite; chromite-bearing. EOH.
Cu	22.6	39.6	Mcc	17.0m of 0.2% Cu - very weak.
LB25	0	6.7	Qm	Sand and pebbles - moraine.
	6.7	43.7	Ogc	Variegated clay with sand, cellular limonite and goethite.
	43.7	50.3	Ogs	Conglomerate-pink, Pioneer sandstone type. EOH.
Cu				All <0.1% Cu.
LB26	0	6.1	Qm	Clays and cobbles; moraine.
	6.1	37.2	Ogc	Variegated clays and pyrite crystals up to 2mm. Fine native copper throughout visible after panning.
	37.2	37.8	Ogl	Dolomite (cavernous with magnesite-lined cavities) and limonitic clay.
	37.8	67.4	Ogc	Variegated clay, sand, mud.
	67.4	78.3	Ogs	Sand, quartzite and conglomerate. EOH.
Cu	33.5	70.7	Mc	37.2m 0.31% Cu.
LB27	0	4.0	Qm	Sand and gravel; moraine.
	4.0	77.1	Ogc	Variegated clays with decomposed hematite, sand, cobbles of black hematite.
	77.1	84.7	Ogs	Sand and conglomerate - Pioneer Sandstone EOH.
Cu	15.2	79.2	Mcc	64m at 0.26% Cu.

1.3 King Lyell Summary Drill Logs

Hole No	From (m)	To (m)	Abr	Summary Log
ML8	0	21.3	Lss	Weathered schist, pyritic, some quartz sand; could be glacial.
	21.3	76.2	Ogc	Variegated clay, ironstone pebbles, gossanous clay, blue pug with pyrite nodules.
	76.2	86.9	Ogs	Quartzite then conglomerate.
Cu	24.4	38.1	Mcc	13.7m of 0.3% Cu
ML9	0	42.7	Ogc	Variegated clays with quartz, ironstone and pyrite pebbles. Strong native Cu over whole hole.
	42.7	44.8	Ogs	Conglomerate impregnated with native Cu. NB: Three sludge assays are higher than core assays: From To Sludge Assay Core Assay 65' 70' 8.7 1.9 (60' to 70') 70' 75' 15.0) 2.4 75' 80' 12.9)
Cu	3.0	43.0	Mcc	40m of 2.16% Cu (Best intersection in Cu clays).
ML10	0	21.3	Ogc	Black pug with pebbles of quartz, pyrite, conglomerate and schist, small cubes of pyrite, siderite pebbles, occasional grains of native Cu, sand.
	21.3	42.7	Ogc	Mainly sand with pebbles as above and native Cu.
	42.7	48.5	Ogc	Brown, blue and grey clays.
	48.5	51.2	Ogs	Conglomerate.
Cu	30.5	38.1	Mcc	7.6m of 0.44% Cu - Native Cu in sand.
ML11	0	13.7	Qm	Blue-black clay with quartz and pyrite pebbles, wood at 9m, grit, probably moraine – fluvoglacial.
	13.7	45.4	Ogl	Limestone, ironstained, not mineralised.
	45.4	83.8	Ogc	Yellow clay intermixed with 'black and blue' clay, limestone remnants. Native Cu from 56-85m, including octahedral crystals of Cu at 64m, also brown clay. Clay colour not related to native Cu content. Native Cu with yellow (64m), blue (69m), brown (82m) and black (83m) clays.
	83.8	87.8	Ogs	Conglomerate. EOH.
Cu	48.8	85.3	Mcc	36.5m of 0.67% Cu.
ML12	0	27.4	Qm	Black clay, gravel and sand, minor limestone, pyrite and native Cu, gradual increase in limestone content.
	27.4	114.9	Ogl	Gradational contact with limestone and quartz sand. Siliceous limestone, clay, quartz sand, pyrite, chalcopyrite and native Cu. Not clear from Batchelor's 1902 log if the Cu minerals are disseminated in silicified limestone or are detrital particles associated with the quartz sand. I think the py-cpy-Cu is disseminated in some silicified limestone. Cf comment at 84m - limestone showing specks of native Cu (Assay 0.5% Cu) from 86-93 6m of full core of solid limestone. No Cu is mentioned and assay is <0.1% Cu. From 94.5 to 102.1 7.6m averages 1.3% Cu and is logged as yellow sand with more clay and native Cu, pyrite and chalcopyrite.
	114.9	128.0	Ogc	Clay rich zone but still limestone remnants, also pyrite, native Cu and chalcopyrite.
	128.0	134.7	Ogs	Sand then conglomerate. EOH.
Cu	62.5	111.3	Mcc	48.8m of 0.52% Cu - mainly in limestone zone.

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Hole No	From (m)	To (m)	Abr	Summary Log
KL1	0	2.4	Qm	Sand and clay.
	2.4	40.4	Ogc	Clay and sand, minor limestone pebbles. 0-19.8 not assayed but hole 9 only 10m away - had 2.4 to 21.3m, 18.9m averaged 3.05% Cu. Also from 32.0 to 38.6 is described as very little visible Cu mineralisation and no visible mineralisation apart from rare 1mm crystals of pyrite. This section assays 30.5 to 38.1m 7.6m at 1.7% Cu. Seems like poor logging and insufficient assays in KL1 (P G Burgdorf). Repeat assays do not compare very well either.
	40.4	43.1	Ogs	Conglomerate. EOH.
Cu	30.5	38.1	Mcc	7.6m of 1.69% Cu.
KL2	0	16.2	Qm	Sandy clay with schist and quartz fragments – moraine.
	16.2	30.3	Ogc	Black 'puggy' clay with 10% (by assay) fine disseminated pyrite, no copper.
	30.3	73.0	Ogl	Clay and sand with limestone remnants.
	73.0	98.5	Ogc	Dark grey and black clay with no visible copper except minor native Cu at 78.5m. EOH. Do not know if hole hit Pioneer Sandstone. 0-13, 34-73, 78.5-79.2, 86.1-92.7m, all not assayed and Cu would be expected. Last assay has 0.28% Cu. Adjacent hole ML11 intersected 36m of 0.67% Cu from 49-85m!
Cu	74.7	78.5	Mcc	3.8m average 0.86% (but 34-73m not assayed).
KL13	0	6.1	Qm	Sand and clay, probable moraine.
	6.1	18.9	Ogc	Grey; brown and black 'pug'.
	18.9	40.7	Ogl	Limestone with sand and disseminated pyrite interval not assayed but was mineralised in holes ML11 and ML12.
	40.7	70.7	Ogc	Brown pug, sandy in part, fine native Cu from 56.4 to 64.0 and pebbles of native Cu from 68.6 to 70.7m.
	70.7	73.2	Ogs	White to purple sandstone with numerous quartz veins. EOH.
Cu	42.7	70.1	Mcc	27.4m (open at both ends) averages 1.08% Cu.
KL16	0	44.7	Ogc	Red brown clay with gossanous siliceous ironstone fragments, quartz fragments. Visible native Cu from 25.8m to 29.7m but not reflected in Cu assays.
	44.7	58.2	Ogs	Pink and brown sandstone and conglomerate. EOH.
Cu	38.1	39.6	Mcc	1.5m of 0.13% Cu - does not match the other holes in the area or the description in the log, may have been a sample prep or assay mix-up.

APPENDIX 2

List of Drill Intersections In Each Hole

DRILL INTERSECTIONS

2.1 Lyell Blocks

Hole No	Year Drilled	Hole Depth (m)	Clay Length (m)	Best Intersections In Clays				Estimated Recovery %
				From (m)	To (m)	Length (m)	Cu %	
LB01	1963	101.7	32	85.0	95.0	10.0	0.10	40
LB02	1963/4	122.1	53	106.4	117.8	11.4	0.13	40
LB03	1964	16.5	-	-	-	-	-	Abandoned
LB04	1964	161.2	119	99.1	101.2	2.1	0.27	50
LB28	1965	201.2	128	16.5	181.4	164.9	0.64	50
Including		-		74.8	143.3	68.5	1.33	50
Including		-		77.0	85.5	8.5	2.20	67
Including		-		114.0	137.0	23.0	1.80	75
LB29	1965/6	103.3	58	73.0	92.5	19.5	0.25	50
LB30	1966	71.6	57	0.0	48.8	48.8	0.37	50
LB31	1966	38.1	23	5.0	25.0	20.0	0.44	50
LB32	1966	81.1	53	14.0	22.0	8.0	0.20	75
LB33	1966	128.3	97	38.1	45.7	7.6	0.30	100
LB34	1966	105.5	56	24.4	39.6	15.1	0.16	50
LB35	1966	178.9	160	13.8	25.8	12.0	0.20	77
LB36	1966	41.2	-					Abandoned
LB37	1966	193.9	52	149.4	182.9	33.5	0.20	50
Total m		1,544.6						

DRILL INTERSECTIONS

2.2 Lyell Consols

Hole No	Year Drilled	Hole Depth (m)	Clay Length (m)	Best Intersections In Clays				Estimated Recovery %
				From (m)	To (m)	Length (m)	Cu %	
LB05	1964	95.0	84	76.5	92.7	16.2	0.32	60
LB06	1964	157.0	148			all	<0.1	30
LB07	1964	157.0	63			all	<0.1	70
LB08	1964	54.6	39	30.8	48.5	17.7	0.63	60
Including				30.8	31.1	0.3	5.60	30
LB09	1964	64.9	56	18.3	57.2	38.9	0.23	65
LB10	1964	58.5	20	32.0	50.0	18.0	0.30	60
LB11	1964	42.4	28	27.6	35.1	7.5	0.22	22
LB12	1964	64.6	45	42.1	56.5	14.4	0.46	75
LB13	1965	93.0	70	34.1	75.9	41.8	0.71	50
LB14	1965	52.1	34	15.2	45.7	30.5	0.30	50
LB15	1965	38.7	33	13.4	31.1	17.7	0.25	55
LB16	1965	77.1	55	40.5	58.2	17.7	0.12	60
LB17	1965	55.8	31	9.4	40.5	31.1	0.26	80
LB18	1965	93.3	48	10.7	41.7	31.0	1.56	60
Including		-		27.1	29.9	2.8	10.50	84
LB19	1965	47.2	33	19.8	37.5	17.7	0.10	75
LB20	1965	49.8	24	18.1	23.8	5.7	0.31	65
LB21	1965	40.1	30	18.3	28.0	9.7	0.43	70
LB22	1965	44.5	39.	23.2	36.0	12.8	0.35	50
LB23	1965	100.3	90	55.0	90.0	45.0	0.62	80
Including		-		59.4	70.1	10.7	1.38	91
LB24	1965	46.3	34	22.6	39.6	17.0	0.20	20
LB25	1965	50.3	34			all	<0.1	50
LB26	1965	78.3	67	33.5	70.7	37.2	0.30	70
LB27	1965	84.7	73	15.2	79.2	64.0	0.26	80
Including		-		53.3	59.4	6.1	0.78	100
Total m		**1,645.5**						

DRILL INTERSECTIONS

2.3 King Lyell

Hole No	Year Drilled	Hole Depth (m)	Clay Length (m)	Best Intersections In Clays				Estimated Recovery %
				From (m)	To (m)	Length (m)	Cu %	
ML08	1902	86.9	53	24.4	38.1	13.7	0.3	poor
ML09	1902	44.8	43	2.4	43.0	40.6	2.16	low
Including				2.4	6.1	3.7	9.5	low
ML10	1902	51.2	47	30.5	38.1	7.6	0.44	low
ML11	1902	87.8	85	48.8	85.3	36.5	0.67	poor
ML12	1902	134.7	127	62.5	111.3	48.8	0.52	poor
Including				94.5	106.7	12.2	1.05	poor
*B.Shaft	1902/3	-	45	0.0	45.1	45.1	1.06	good
KL01	1970	43.1	40	30.5	38.1	7.6	1.69	37
KL02	1970/1	98.5	98	74.7	78.5	3.8	0.86	44
KL13	1971	73.2	70	42.7	70.1	27.4	1.08	46
KL16	1970	58.2	43	38.1	39.6	1.5	0.13	50
Total m		**685.6**						

* Batchelor's Prospecting Shaft November 1902-1903.
Excluding a gossan zone between 13.7 and 16.8m estimated at 20% Cu.
If included, the whole 45.1m averages 2.41% Cu.

Cumulative metres

Lyell Blocks	1,544.6
Lyell Consols	1,645.5
King Lyell	685.6
	3,876m
NL 1101 & 1102	025
Total:	**490/m**

322109

APPENDIX 3

Global Resource Estimations

322110

Appendix 3

LIST OF GLOBAL RESOURCES

3.1 LYELL BLOCKS

Section No	Area m²	Projection m	Tonnes (SG=2.1)	Grade % Cu	Contained Cu T
IN	8750	100	1,837,500	0.65	11,944
IS	8750	39	716,625	0.65	4,658
2N	4520	39	370,188	0.26	962
2S	4520	42.5	403,410	0.26	1,049
3N	4850	42.5	432,863	0.37	1,602
3S	4850	65	662,025	0.37	2,450
4N	2280	40	191,520	0.38	728
4S	2280	20	95,760	0.38	364
Totals		**388**	**4,709,891**	**0.50**	**23,757**

3.2 LYELL CONSOLS

Section No	Area m²	Projection m	Tonnes (SG=2.1)	Grade % Cu	Contained Cu T
1	1810	64	243,264	0.26	633
2	2340	100	491,400	0.43	2,113
3N	1525	64	204,960	1.37	3,808
3S	1410	80	236,880	0.34	805
4	2070	49	213,000	0.52	1,108
5	3005	75	473,288	0.26	1,231
Totals		**432**	**1,862,792**	**0.47**	**8,698**

3.3 KING LYELL

Section No	Area m²	Projection m	Tonnes (SG=2.1)	Grade % Cu	Contained Cu T
1	4815	80	808,920	1.37	11,082
2	2415	74	375,291	0.94	3,528
3	1630	83	284,109	0.69	1,960
Totals		**237**	**1,468,320**	**1.13**	**16,570**

Global Total

Deposit	Tonnes SG=2.1	Grade % Cu	Contained Cu T
Lyell Blocks	4,709,891	0.50	23,757
Lyell Consols	1,862,792	0.47	8,698
King Lyell	1,468,320	1.13	16,570
Totals	**8,041,003**	**0.61**	**49,025**

APPENDIX 4

In Pit Resources and Waste to Ore Ratios

Appendix 4

In Pit Resources and Waste to Ore Ratios

Section	Areas m²		Projection Length (m)	M. Tonnes		Waste Ore Ratio	Grade % Cu	Tonnes Cu
	Waste	Ore		Waste	Ore			
LYELL BLOCKS				***2.2**	**2.1**			
1	15,755	7,235	139	4.82	2.11	2.28	0.65	13,727
2	12,890	4,530	81.5	2.32	0.76	3.05	0.26	2,016
3	2,545	4,600	107.5	0.60	1.04	0.58	0.37	3,822
4	1,385	2,140	60	0.18	0.27	0.67	0.38	1,025
Totals				**7.92**	**4.18**	**1.89**	**0.49**	**20,590**
LYELL CONSOLS				**2.4 / 2.2**	**2.1**			
1	3,550	1,205	64	0.55	0.16	3.44	0.26	421
2	3,440	2,265	100	0.83	0.48	1.73	0.43	2,045
3N	1,535	1,475	64	0.34	0.20	1.70	1.37	2,716
3S	3,160	1,165	80	0.61	0.20	3.05	0.34	665
4	8,090	2,045	49	0.83	0.21	3.95	0.52	1,094
5	10,240	2,790	75	1.61	0.44	3.66	0.26	1,143
Totals				**4.77**	**1.69**	**2.82**	**0.48**	**8,084**
KING LYELL				**2.2**	**2.1**			
1	3,905	3,445	80	0.66	0.58	1.14	1.37	7,929
2	7,030	1,620	74	1.14	0.25	4.34	0.94	2,366
3	6,890	1,260	83	1.20	0.22	5.47	0.69	1,515
Totals				**3.00**	**1.05**	**2.86**	**1.12**	**11,810**
GRAND TOTALS				**15.69**	**6.92**	**2.27**	**0.59**	**40,484**

* These numbers are the Tonnage Factors utilised.

APPENDIX 5

Proportion of Resources Recoverable

Appendix 5

Proportions of Resources Recoverable

Section	In Pit Resource MT	Grade % Cu	Global Res. MT	Grade % Cu	Recovered % Tonnes	Recovered % Cu
B1	2.11	0.65	2.56	0.65	83	83
B2	0.76	0.26	0.77	0.26	99	99
B3	1.04	0.37	1.09	0.37	95	95
B4	0.27	0.38	0.29	0.38	93	93
Totals	**4.18**	**0.49**	**4.71**	**0.50**	**89**	**87**
C1	0.16	0.26	0.24	0.26	67	67
C2	0.48	0.43	0.49	0.43	98	98
C3N	0.20	1.37	0.20	1.37	100	100
C3S	0.20	0.34	0.24	0.34	83	83
C4	0.21	0.52	0.21	0.52	100	100
C5	0.44	0.26	0.48	0.26	94	94
Totals	**1.69**	**0.48**	**1.86**	**0.47**	**91**	**93**
K1	0.58	1.37	0.81	1.37	72	72
K2	0.25	0.94	0.38	0.94	66	66
K3	0.22	0.69	0.28	0.69	79	79
Totals	**1.05**	**1.12**	**1.47**	**1.13**	**71**	**71**
GRAND TOTAL	**6.92**	**0.58**	**8.04**	**0.61**	**86**	**83**

APPENDIX 6

1966 Metallurgical Testwork

322116

MEMORANDUM

To: Kevin Wills
From: John Geoghegan
Subject: Copper Clays testwork
Date: 24th. May, 1995

The testwork carried out in 1966 was apparently aimed at evaluating the possibility of including the clays in the mill feed of the day, hence the limited scope and lack of perserverance when the results were not encouraging.

Five samples were subjected to laboratory flotation and, as there is no information regarding pre-treatment or sieve analyses,I suspect that the samples were simply repulped.The fraction referred to as "slime" probably consists of decanted colloidal material which would have been excluded from flotation because of the problems such material usually causes. The slime flotation test on sample #2 shows typical lack of response, 50% recovery with a concentrate grade similar to the feed grade. On the other hand, flotation of the "sand" fraction generally gave good recoveries (up to 90%) and reasonable concentration ratios.

As you point out poor core recovery may have resulted in non-representative samples, but in all samples tested the slime fraction represents a large percentage of the total, and only in sample #1 is the slime assay significantly lower than the head. This condition would probably preclude flotation as a treatment option but some further testwork may be warranted once the mineralogy is known.

Conventional treatment of native copper bearing material would comprise comminution, if necessary, followed by gravity treatment to recover the coarse copper and flotation to recover the fine material.
The developmemt of high "g" force gravity separators may provide an alternative to flotation for the fine fraction treatment of materials such as this.The Kelsey Centrifugal Jig and the Moseley Multigravity Separator are examples of these.

If a drilling program is undertaken, the mineralogy and physical variations can be assessed and an appropriate metallurgical evaluation program can be designed. Native copper and un-oxidised sulphides will be recovered in the existing circuit, fine secondary chalcocite is likely to be the most troublesome component.

322117

THE MOUNT LYELL MINING AND RAILWAY CO. LTD.

21/1/66

Form 423

METALLURGICAL RESEARCH DEPARTMENT

TEST NO ... 1 .... NAME Native Copper Ckys.

PRODUCT	Weight	% Weight	ASSAY Cu	ASSAY S	Cu Units Cu	Cu Units	Cu Units S	DISTRIBUTION Cu		DISTRIBUTION S
Conc	181	6.03	26.81	6.92	162		42	71.0	65	71.1
Tail	615	20.5	0.73	0.15	15		3	6.6	6	5.1
Sand Float	796	26.53	6.67	1.7	177		45	77.6	71	76.2
Slimes	2204	73.47	0.70	0.19	51	73.9	14	22.4	29	23.8
Head	3000	100.0	2.28	0.59	228	250	59	100.0		100.0

LBS PER TON

OPERATION	
TIME	
MACHINE	
R. P. M.	
pH	
% SOLIDS	
TEMPERATURE	

GRINDING

Mesh	Product %	%
+ 10		
+ 14		
+ 20		
+ 28		
+ 35		
+ 48		
+ 65		
+ 100		
+ 150		
+ 200		
+ 325		
- 325		

REMARKS : 7.

322118

THE MOUNT LYELL MINING AND RAILWAY CO. LTD.

23/4/66 Form 423

METALLURGICAL RESEARCH DEPARTMENT

Cu Blocks

Float II

~~TEST~~ NO . . . . . NAME . . . . . .

PRODUCT	Weight	% Weight	ASSAYS Cu	Fe		Cu Units	Cu DISTRIBUTION
Sand Con	84.7	3.9	0.86	13.9	2.45	3.35	30.2
Mid	42.3	2.0	.073	13.4	0.12	.15	1.4
Tail	957.0	44.4	.064	9.4	.07	2.84	25.8
Slime	500	23.2	.102	10.0	.28	2.36	21.8
Sludge Con	213.0	9.9	.128	9.3	.26	1.26	11.3
Mid	113.2	5.2	.088	9.7	.15	.46	4.2
Tail	2452	11.4	.058	8.4	.22	.66	6.0
Total Weight = 2156.4		100.0	0.11			11.02	100.0
Sand Head		50.3	0.126			6.34	57.3
Sludge Head		26.5	0.090			2.38	21.5
Total Head		100.0	0.11			11.02	

LBS PER TON

OPERATION

TIME

MACHINE

R. P. M.

pH

% SOLIDS

TEMPERATURE

GRINDING

Mesh	Product %	%
+ 10		
+ 14		
+ 20		
+ 28		
+ 35		
+ 48		
+ 65		
+ 100		
+ 150		
+ 200		
+ 325		
− 325		

REMARKS :

Slime at grade similar to head and coarse grade amounts to 50% by weight, and little beneficiation is possible by flotation.

Sulphidized mid gives little extra recovery.

322119

THE MOUNT LYELL MINING AND RAILWAY CO. LTD.

29/4/66. Form 423

METALLURGICAL RESEARCH DEPARTMENT

Cu Clays

TEST NO Head No III NAME Research

PRODUCT	Weight	% Weight	~~Cu~~ ASSAY Cu	S	Cu Units	Cu DISTRIBUTION
Slimes	1409	47.3	~~.027~~ .053	.07	2.51	43.5
Con	70	2.4	.55	2.27	1.32	23.0
Mid	135	4.5	.036	.21	.16	2.8
Tail	1366	45.8	.039	—	1.78	30.7
Total Weight	2980.5	100.0	.058		5.77	100.0
Sand Head		54.2	~~.060~~		~~3.29~~ 3.26	56.5

LBS PER TON

OPERATION	GRINDING		
TIME		Product	
	Mesh	%	%
	+ 10		
	+ 14		
	+ 20		
	+ 28		
	+ 35		
	+ 48		
	+ 65		
	+ 100		
	+ 150		
MACHINE	+ 200		
R. P. M.	+ 325		
pH	— 325		
% SOLIDS			
TEMPERATURE			

REMARKS : Decant.

322120

THE MOUNT LYELL MINING AND RAILWAY CO. LTD.

Form 423

METALLURGICAL RESEARCH DEPARTMENT

TEST NO Cu Blocks IV NAME . Conals No. 3.

PRODUCT	Weight	% Weight	ASSAY Cu	Units	ASSAY S	Units	DISTRIBUTION Cu	
Con	57	2·1	17·3	36·3	11·13	23·4	41·6	40·4
Tail	601	20·6	0·204	4·2	0·14	2·9	49	49
Slime	2246	77·3	0·605	46·7	041	31·7	53·5	54·7
				87·2		58·9	100·0	100·0
Total	2904	100·0						
Tail.								
+ 100		0·8						
+ 150		8·2	0·196	1·96			10·0	
+ 200		10·3	0·122	1·26			6·6	
+ 325		20·4	0·182	3·72			19·0	
- 325		60·3	0·209	12·60			64·4	
		100·0		19·54			100·0	

LBS PER TON

OPERATION

TIME

MACHINE

R. P. M.

pH

% SOLIDS

TEMPERATURE

GRINDING

Mesh	Product %	%
+ 10		
+ 14		
+ 20		
+ 28		
+ 35		
+ 48		
+ 65		
+ 100		
+ 150		
+ 200		
+ 325		
- 325		

REMARKS : Calculated Head 0·87

Overall Recovery 41·6%

Calculated Tail 0·195

Assayed " 0·204

89% rec. on conals.

322121

THE MOUNT LYELL MINING AND RAILWAY CO. LTD.

Form 423

METALLURGICAL RESEARCH DEPARTMENT

TEST NO Cu Blocks V NAME .....

PRODUCT	Weight	% Weight	ASSAYS Cu	Cu units	ASSAYS S	S units	DISTRIBUTION Cu	DISTRIBUTION S
Con	57	1.9	10.48	19.9	1.93	3.7	77.4	33.3
Tail	1919	62.9	0.030	1.9	0.04	2.5	7.4	22.6
Slime	1074	35.2	0.112	3.9	0.14	4.9	15.2	44.1
				25.7		11.1	100.0	100.0
Total	3050	100.0						

Tail			Cu Units		Cu	
+ 100	1.6		0.082	0.13	3.5	
+ 150	20.0	0.196	0.027	0.54	23.8	14.5
+ 200	22.4	0.072	0.031	0.69	16.2	18.5
+ 325	30.0	0.182	0.046	1.38	30.6	37.0
- 325	26.0	0.209	0.038	0.99	26.4	26.5
	100.0			3.73	100.0	100.0

LBS PER TON

OPERATION	Condit	Rough.
TIME	18	5
Amyl Xanthate	0.14	
208	0.07	
404	0.3	
Lime.	1.5	
MACHINE	2000 gm.	
R. P. M.	1000	
pH		11.0
% SOLIDS	26	
TEMPERATURE		

GRINDING

Mesh	Product %	%
+ 10		
+ 14		
+ 20		
+ 28		
+ 35		
+ 48		
+ 65		
+ 100		
+ 150		
+ 200		
+ 325		
- 325		

REMARKS :

Calculated Head 0.25

Overall Recovery 77.4%

Calculated Tail 0.037

Assayed Tail 0.030

91% rec on assay.

APPENDIX 7

List of Proposed Drillholes

Appendix 7

7.1 Blocks Proposed Holes

Abbreviated Name	Line No	Position On Line	Predicted Depth (m)	Line Total
B1	080N	080W	50	
B2	080N	040W	200	
B3	080N	000	180	
				430
B4	000	080W	50	
B5	000	040W	200	
B6	000	000	200	
B7	000	040E	180	
				630
B8	080S	080W	30	
B9	080S	040W	120	
B10	080S	000	150	
B11	080S	040E	130	
				430
B12	160S	040W	30	
B13	160S	000	80	
B14	160S	040E	90	
				200
B15	240S	000	40	
B16	240S	040E	60	
B17	240S	080E	80	
				180
B18	320S	080W	30	
B19	320S	040W	70	
B20	320S	000	90	
B21	320S	040E	100	
B22	320S	080E	120	
				410
GRAND TOTAL				**2,280**

7.2 Consols Proposed Holes

Abbreviated Name	Line No	Position On Line	Predicted Depth (m)	Line Total
C1	6220E	5280N	10	
C2	6220E	5320N	80	
C3	6220E	5360N	80	170
C4	6300E	5280N	10	
C5	6300E	5320N	60	
C6	6300E	5360N	60	130
C7	6380E	5280N	10	
C8	6380E	5320N	80	
C9	6380E	5360N	70	
C10	6380E	5400N	30	
C11	6380E	5440N	70	
C12	6380E	5480N	40	300
C13	6460E	5320N	60	
C14	6460E	5360N	60	
C15	6460E	5400N	70	
C16	6460E	5440N	100	290
C17	6540E	5320N	80	
C18	6540E	5360N	90	
C19	6540E	5400N	110	
C20	6540E	5440N	100	380
GRAND TOTAL				**1,270**

7.3 King Lyell Proposed Holes

Abbreviated Name	Line No	Position On Line	Predicted Depth (m)	Line Total
K1	6260E	4660N	80	
				80
K2	6340E	4500N	150	
K3	6340E	4540N	120	
K4	6340E	4580N	80	
K5	6340E	4620N	70	
K6	6340E	4660N	60	
K7	6340E	4700N	40	
K8	6340E	4740N	70	
				590
K9	6420E	4540N	100	
K10	6420E	4580N	100	
K11	6420E	4620N	80	
K12	6420E	4660N	60	
K13	6420E	4700N	70	
K14	6420E	4740N	80	
				490
K15	6500E	4580N	120	
K16	6500E	4620N	120	
K17	6500E	4660N	110	
K18	6500E	4700N	90	
K19	6500E	4740N	60	
				500
K20	6580E	4620N	120	
K21	6580E	4660N	140	
K22	6580E	4700N	120	
				380
GRAND TOTAL				**2,040**

Summary:

Deposit	No. of Holes	No. of Metres
Blocks	22	2,280
Consols	20	1,270
King Lyell	22	2,040
Total	64	5,590

322126

APPENDIX 8

XRD Examination of 'Clay' Samples



ROGER TOWNEND AND ASSOCIATES
CONSULTING MINERALOGISTS
ACN 069 920 476

Principal: Dr. Roger Townend

PHONE: (09) 358 1138
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FAX: (09) 358 1139

KEVIN WILLS,

COPPER MINES OF TASMANIA,

BOX 84 ,

QUEENSTOWN,

TASMANIA

21-7-95

OUR REF 95037

YOUR REF c 0223

XRD EXAMINATION OF FIVE DRILL CORE "CLAY" SAMPLES AND ONE POWDER.

R TOWNEND

INTRODUCTION

Five drill cores and one powder were submitted for XRD etc with reference to their copper bearing clay component.

Part of the core was lightly ground , and as initial binocular examination suggested significant non clay material, a representative portion was wet sieved through a 38 micro screen.It was dried at 65oC.The black powder FS G 5034 was analysed as received.

RESULTS

1. SCREENING.

	-38 MICRONS WT%
FS G 5029	77.3
FS G 5030	41.5
FS G 5031	71.2
FS G 5032	62.7
FS G 5033	58.1

2. XRD ANALYSES.

The five -38 micron fractions and one powder all gave similar results. Only sample FS G 5033 had significant amounts of other phases.

The major minerals in all samples were QUARTZ and MICA (? MUSCOVITE). KAOLIN was also present , major in 5029 and 5033, trace in 5034 and accessory to minor in the others. SIDERITE was significant in 5033, and there was a major peak at 9.12 in the same sample,which has not been assigned.

The 14-15 angstrom smectite peaks were absent or of trace presence only. These results appear to confirm the work of Solomon(1969, Proc. Aus. IMM.)

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AMG | MINE GRID

MT LYELL GRID IS PARALLEL TO PREVIOUS IMPERIAL MINE GRID

322129

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A.C.N. 065 339 835

MT LYELL PROJECT
OPEN CUT POTENTIAL
GEOLOGICAL MAP OF THE COPPER CLAYS AREA

FIG. 1

PREPARED: K.W.	DATE: JUNE 1995	SCALE: 1:5,000	DWG. No. CG-1001
DRAFTED: E.S.	REVISED:		

0 100 200 300 400m

REFERENCE

MINERALISATION

DERWENT REF		
	CAINOZOIC	
68	Mcc	Mineralisation - copper clays, predominantly native Cu in clay after limestone
71	Mpc	Mineralisation - potential copper clays
	LATE CAMBRIAN & TABBERABBERAN	
20	Mmp	Mineralisation - massive py-cpy ores, eg Blow & South Lyell
23	Mmb	Mineralisation - massive bornite-chalcopyrite ores, eg North Lyell
14	Mdc	Mineralisation - disseminated cores of py-cpy type ores
10	Mdh	Mineralisation - disseminated haloes of py-cpy type ores

HOST ROCKS

RECENT

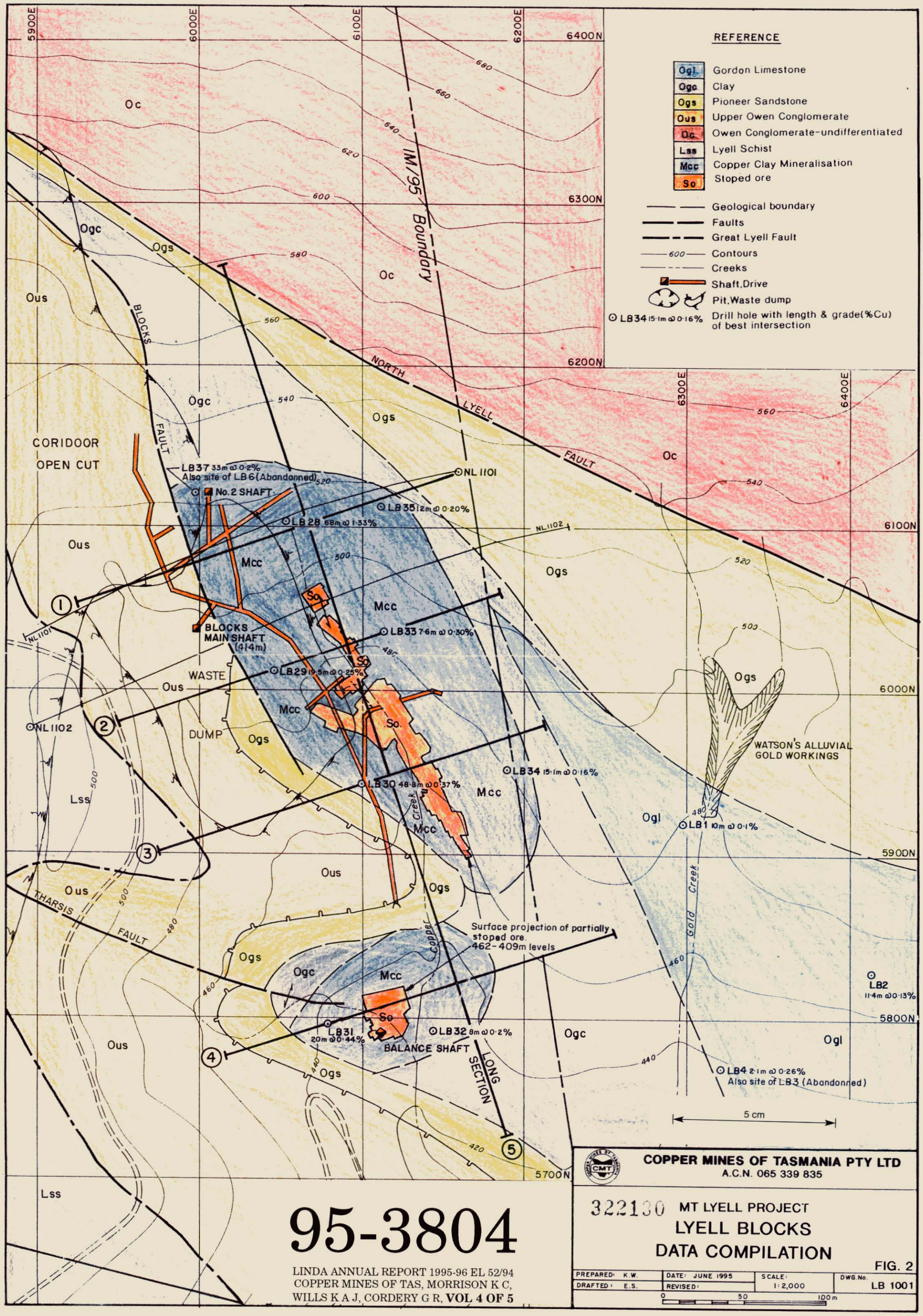
Waste dumps

DERWENT REF		
	CAINOZOIC	
69	Ogc	Clay ("black pug") - argillaceous remnants after Gordon Limestone dissolution
	ORDOVICIAN TO LATE CAMBRIAN	
33	Ogl	Limestone with interbedded shaley layers - Gordon limestone
1	Ogs	Sandstone and conglomerate - Pioneer Sandstone
		Haulage Unconformity
57	Oc	Conglomerate and sandstone - Owen Conglomerate
70	Ls	Sericite pyrite and chlorite schists Metamorphosed altered Mount Read Volcanics - Lyell Schists
	PLEISTOCENE	
		Boulder clay, sand, gravel; glacial deposits

SYMBOLS

- ML 1M/95 lease boundary
- 450 Contours at 50m intervals
- Creeks
- Main bitumen roads
- Access tracks
- Late Faults (Tabberabberan)
- Great Lyell Fault (Cambrian)
- Haulage Unconformity
- Geological boundaries
- Boundary of glacial cover
- Boundary of waste dumps
- Strike and dip of bedding, overturned & schistosity
- Shafts, sluicing workings - Au-Gold Cu-Copper

5 cm



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322130 MT LYELL PROJECT

LYELL BLOCKS DATA COMPILATION

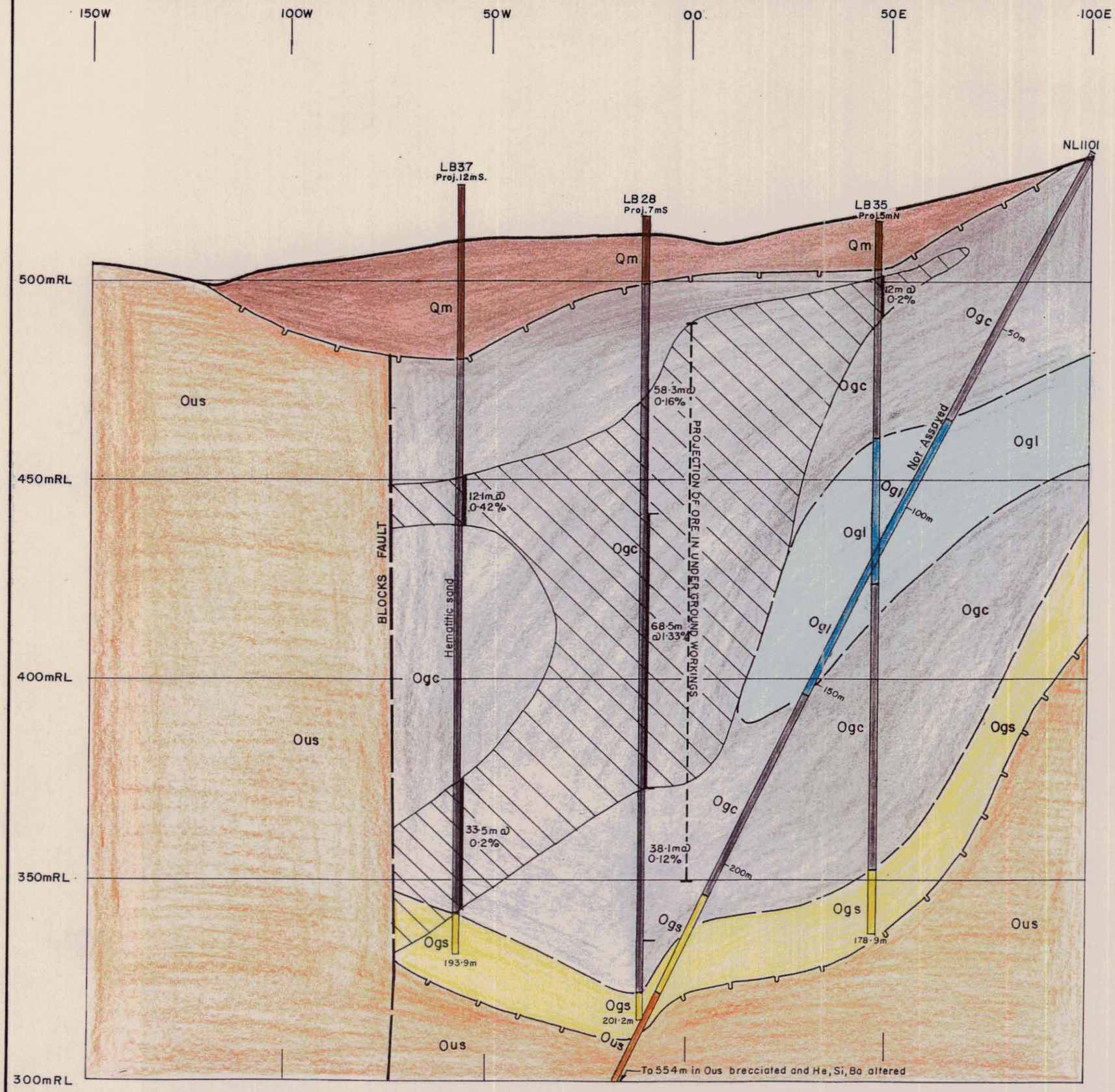
FIG. 2

PREPARED: K.W.	DATE: JUNE 1995	SCALE: 1:2,000	DWG.No. LB 1001
DRAFTED: E.S.	REVISED:		

0 50 100 m

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COPPER MINES OF TAS, MORRISON K C,
WILLS K A J, CORDERY G R, **VOL 4 OF 5**



REFERENCE

- Qm — Quaternary Moraine
- Ogl — Gordon Limestone
- Ogc — Clay
- Ogs — Pioneer Sandstone
- Ous — Upper Owen Conglomerate
- Oc — Owen Conglomerate–undifferentiated
- Lss — Lyell Schist
- Copper clay mineralisation
- So — Stoped ore
- Access
- Geological boundary
- Unconformity
- Fault
- Ogc 7·6m @ 0·3% — Drill hole with summary log and length and grade(%Cu) of best intersection.

5 cm

322131

COPPER MINES OF TASMANIA PTY LTD
A.C.N. 065 339 835

MT LYELL PROJECT

LYELL BLOCKS
CROSS SECTION 1 (000S)

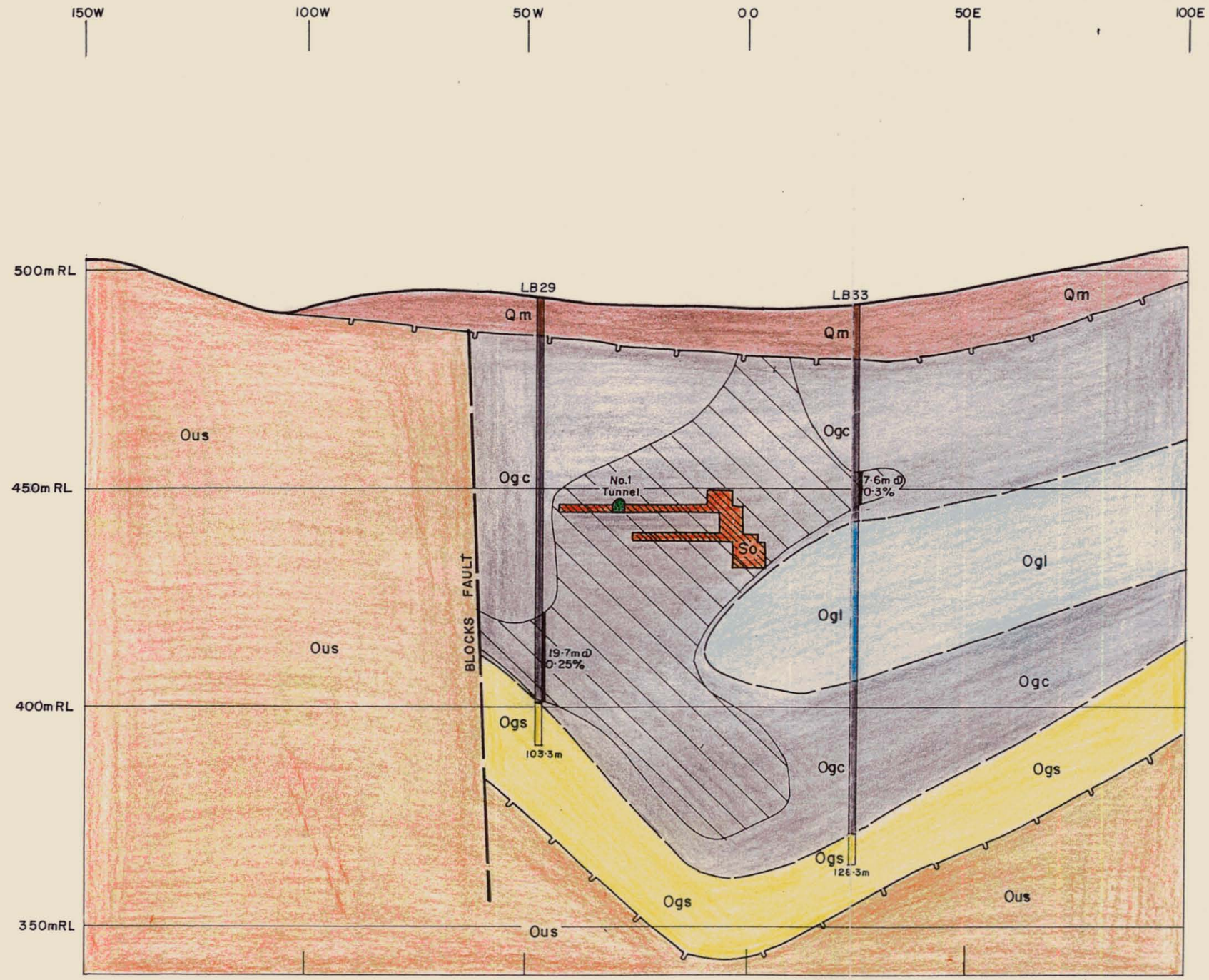
FIG. 3

PREPARED: K.W.	DATE: JUNE 1995	SCALE: 1:1,000	DWG.No. LB 1002
DRAFTED: E.S.	REVISED:		

0 5 10 20 30 40 50m

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COPPER MINES OF TAS, MORRISON K C,
WILLS K A J, CORDERY G R, **VOL 4 OF 5**



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- Copper clay mineralisation
- So — Stoped ore
- Access
- Geological boundary
- Unconformity
- Fault
- Ogc 7·6m @ 0·3% — Drill hole with summary log and length and grade(%Cu) of best intersection.

322132

5 cm

COPPER MINES OF TASMANIA PTY LTD
A.C.N. 065 339 835

MT LYELL PROJECT

LYELL BLOCKS
CROSS SECTION 2 (078S)

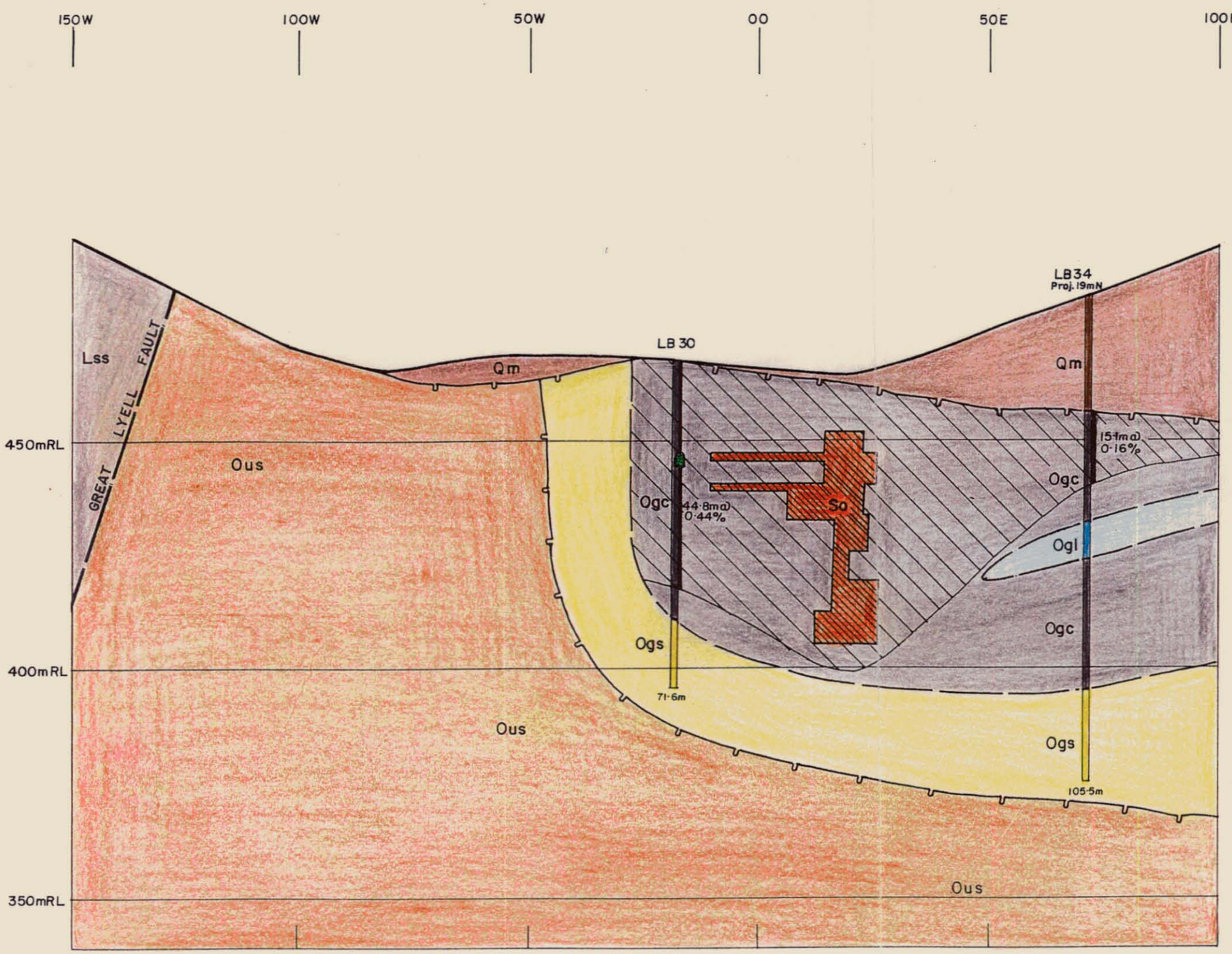
FIG. 4

PREPARED: K.W.	DATE: JUNE 1995	SCALE: 1:1,000	DWG. No. LB 1003
DRAFTED: E.S.	REVISED:		

0 5 10 20 30 40 50m

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COPPER MINES OF TAS, MORRISON K C,
WILLS K A J, CORDERY G R, **VOL 4 OF 5**



REFERENCE

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- Lss — Lyell Schist
- Copper clay mineralisation
- So — Stoped ore
- Access
- Geological boundary
- Unconformity
- Fault
- Ogc 7·6m @ 0·3% — Drill hole with summary log and length and grade(%Cu) of best intersection.

322133

5 cm

COPPER MINES OF TASMANIA PTY LTD
A.C.N. 065 339 835

MT LYELL PROJECT

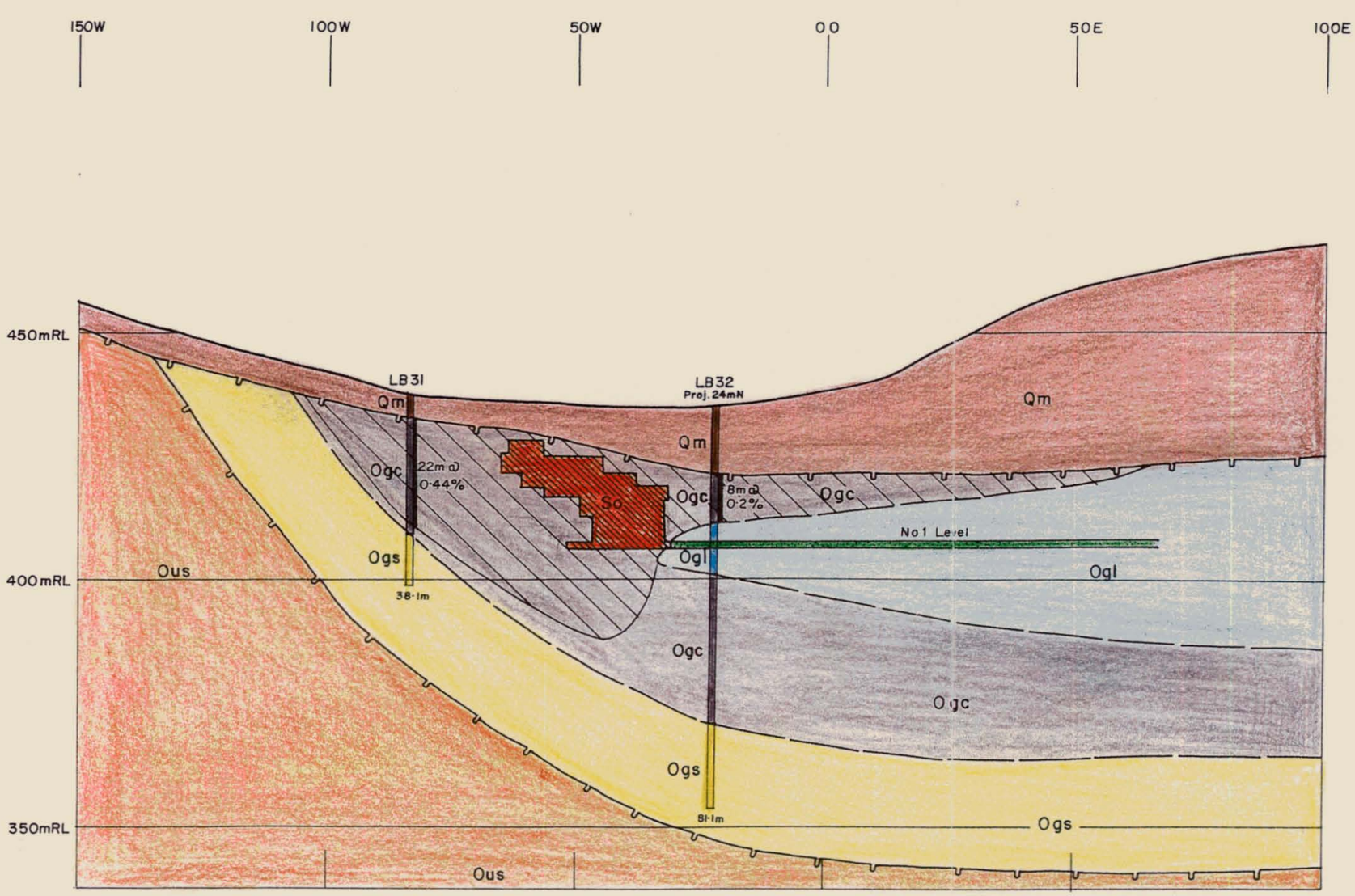
LYELL BLOCKS
CROSS SECTION 3 (163S)

FIG. 5

PREPARED: K.W.	DATE: JUNE 1995	SCALE: 1:1,000	DWG.No. LB 1004
DRAFTED: E.S.	REVISED:	0 5 10 20 30 40 50m	

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COPPER MINES OF TAS, MORRISON K C,
WILLS K A J, CORDERY G R, **VOL 4 OF 5**



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- Lss — Lyell Schist
- Copper clay mineralisation
- So — Stoped ore
- Access
- Geological boundary
- Unconformity
- Fault
- Ogc 7·6m @ 0·3% — Drill hole with summary log and length and grade(%Cu) of best intersection.

322134

5 cm

COPPER MINES OF TASMANIA PTY LTD
A.C.N. 065 339 835

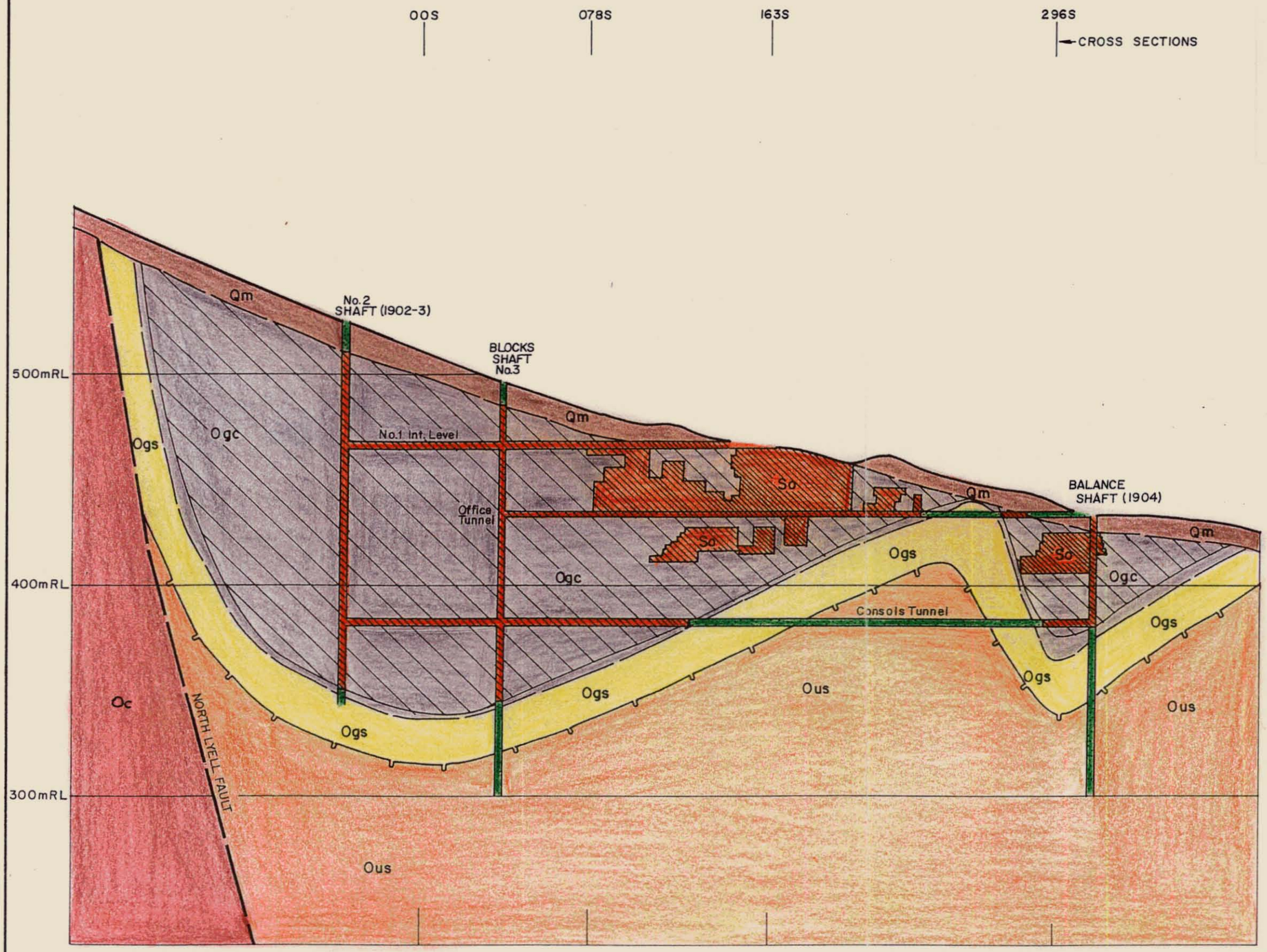
MT LYELL PROJECT
LYELL BLOCKS
BALANCE SHAFT
CROSS SECTION 4 (296S)

FIG. 6

PREPARED: K.W.	DATE: JUNE 1995	SCALE: 1:1,000	DWG.No. LB 1005
DRAFTED: E.S.	REVISED:		

0 10 20 30 40 50m

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WILLS K A J, CORDERY G R, **VOL 4 OF 5**



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- Oc — Owen Conglomerate–undifferentiated
- Lss — Lyell Schist
- Copper clay mineralisation
- So — Stoped ore
- Access
- Geological boundary
- Unconformity
- Fault
- Ogc 7·6m @ 0·3% — Drill hole with summary log and length and grade(%Cu) of best intersection.

322135

5 cm

COPPER MINES OF TASMANIA PTY LTD
A.C.N. 065 339 835

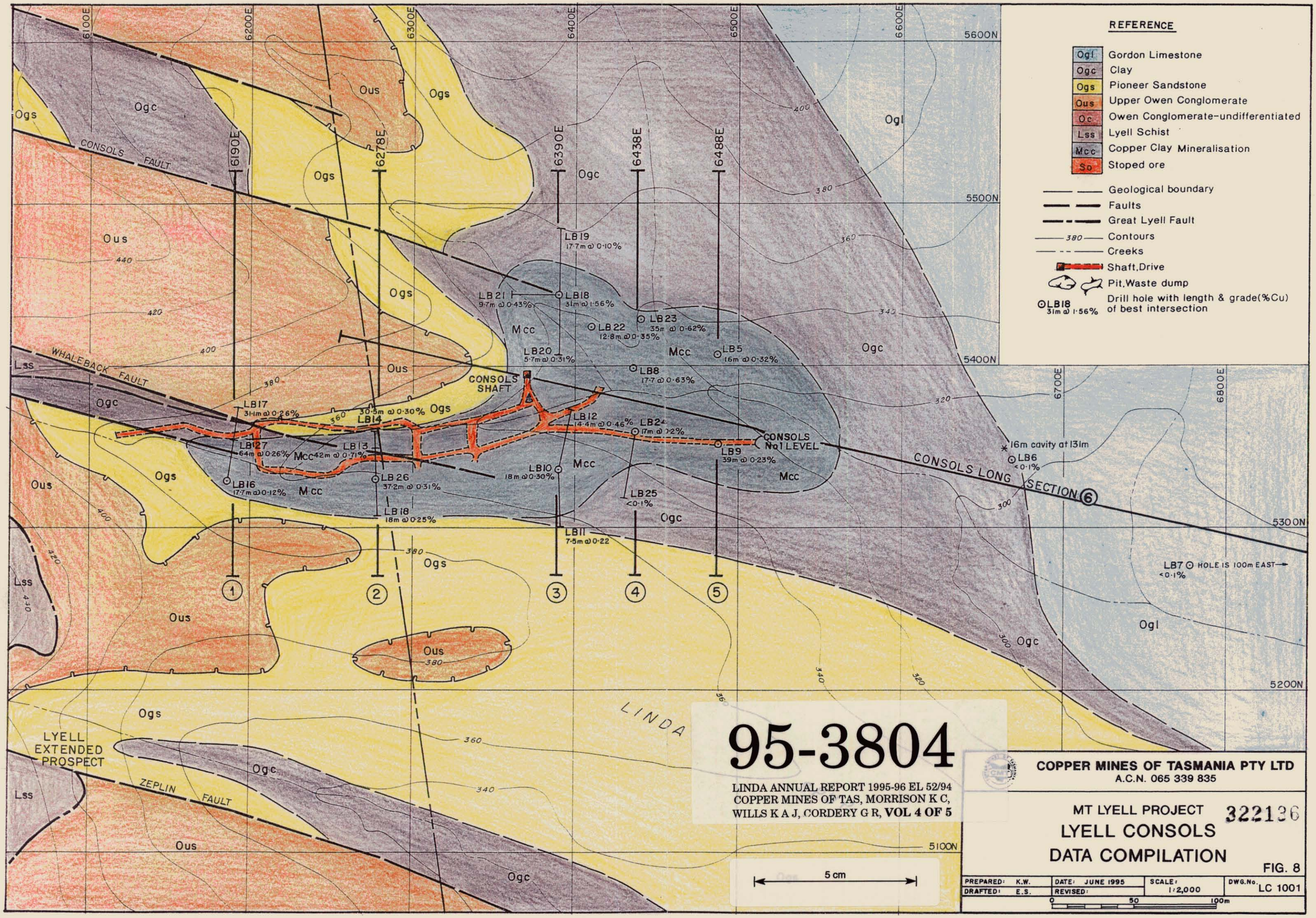
MT LYELL PROJECT

LYELL BLOCKS LONG SECTION 5

FIG. 7

PREPARED: K.W.	DATE: JUNE 1995	SCALE: 1:2,000	DWG. No. LB 1006
DRAFTED: E.S.	REVISED:		

0 20 40 60 80 100m



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WILLS K A J, CORDERY G R, **VOL 4 OF 5**

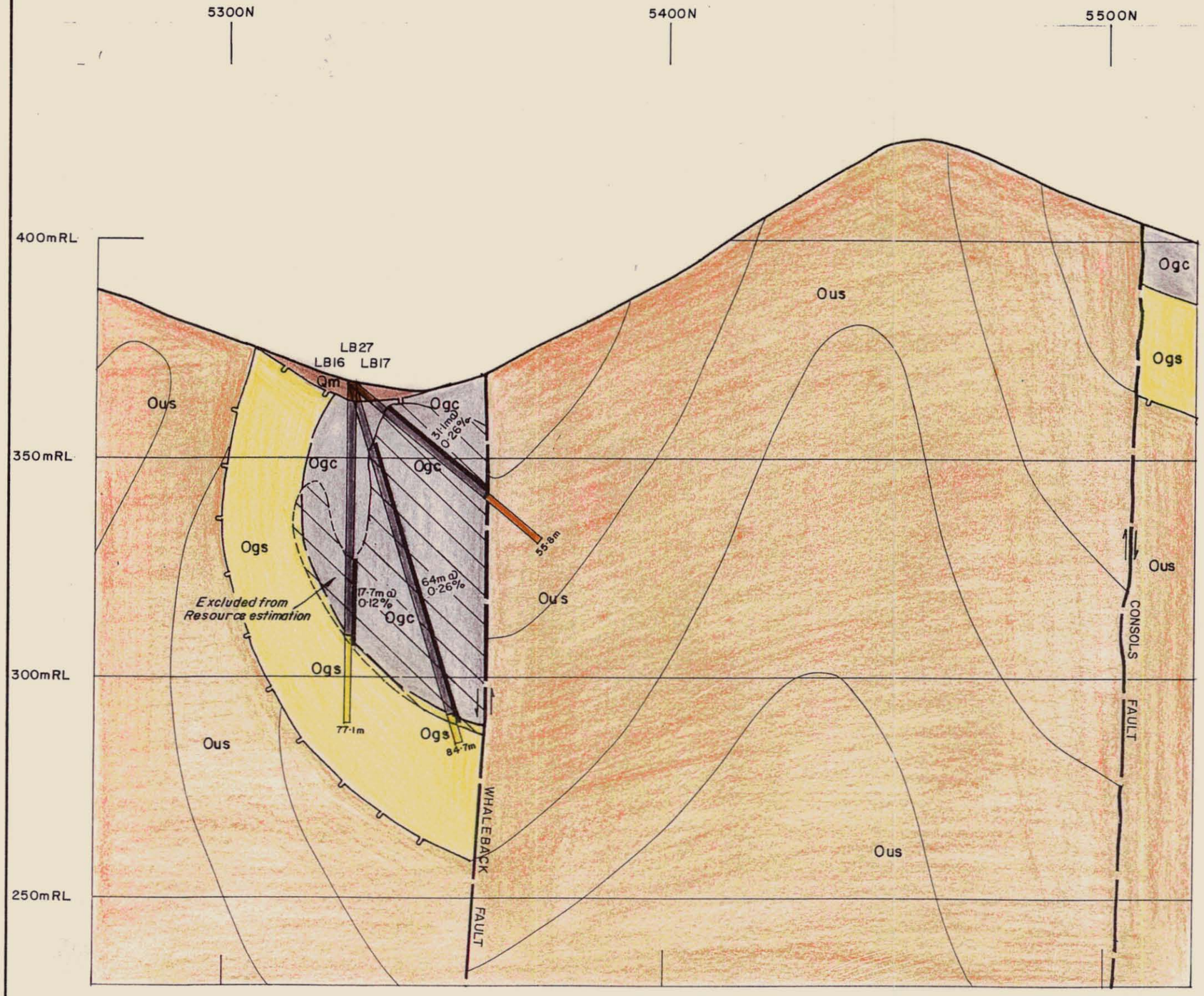
COPPER MINES OF TASMANIA PTY LTD
A.C.N. 065 339 835

MT LYELL PROJECT 322136

LYELL CONSOLS DATA COMPILATION

FIG. 8

PREPARED: K.W.	DATE: JUNE 1995	SCALE: 1:2,000	DWG.No. LC 1001
DRAFTED: E.S.	REVISED:		



REFERENCE

- Qm — Quaternary Moraine
- Ogl — Gordon Limestone
- Ogc — Clay
- Ogs — Pioneer Sandstone
- Ous — Upper Owen Conglomerate
- Oc — Owen Conglomerate–undifferentiated
- Lss — Lyell Schist
- Copper clay mineralisation
- Sa — Stoped ore
- Access
- Geological boundary
- Unconformity
- Fault
- Ogc 7·6m @ 0·3% — Drill hole with summary log and length and grade(%Cu) of best intersection.

322137

5 cm

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MT LYELL PROJECT

LYELL CONSOLS CROSS SECTION 1 (6190E)

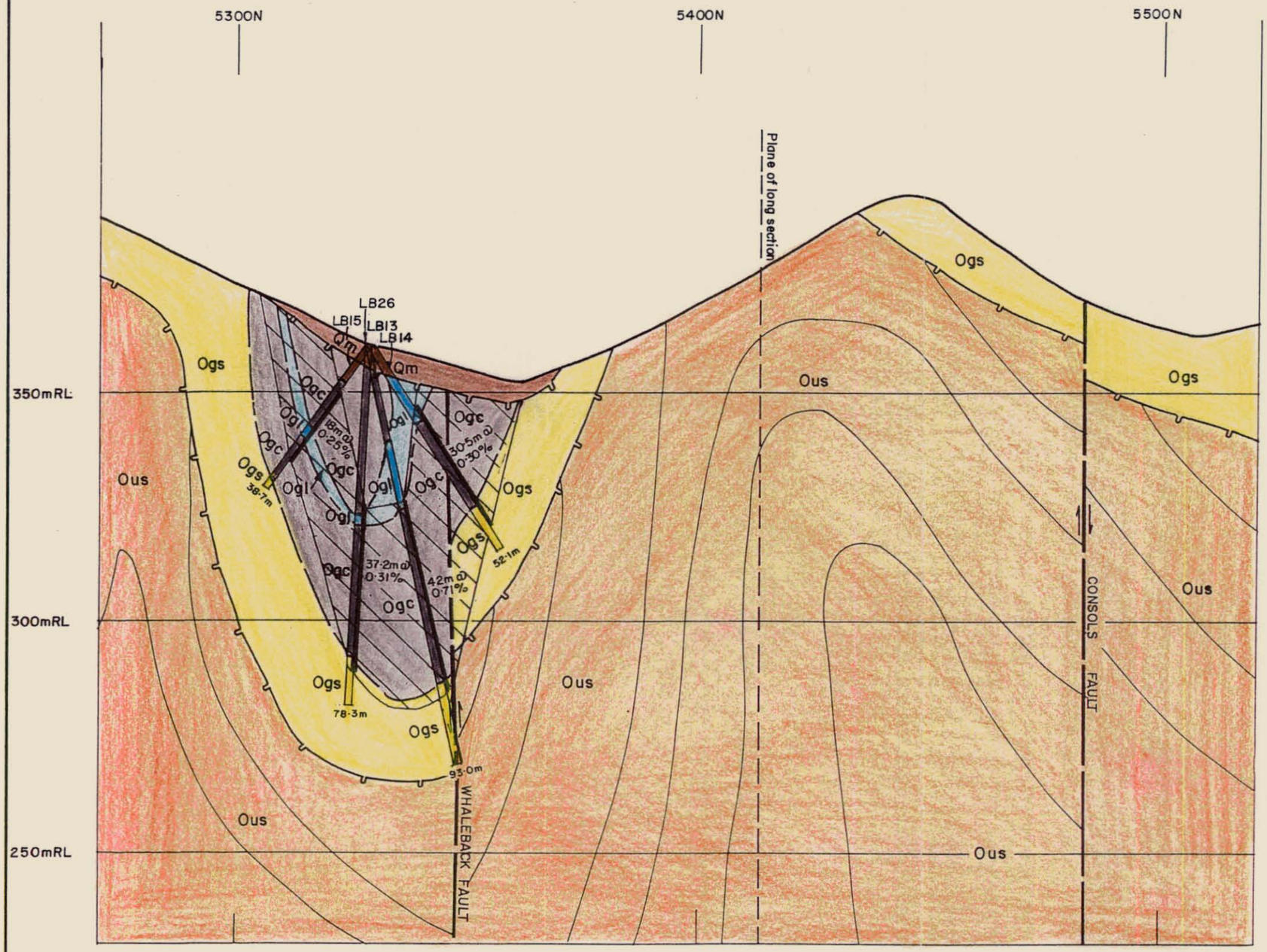
FIG. 9

PREPARED: K.W.	DATE: JUNE 1995	SCALE: 1:1,000	DWG. No. LC 1002
DRAFTED: E.S.	REVISED:		

0 5 10 20 30 40 50m

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COPPER MINES OF TAS, MORRISON K C,
WILLS K A J, CORDERY G R, **VOL 4 OF 5**



REFERENCE

- Qm — Quaternary Moraine
- Ogl — Gordon Limestone
- Ogc — Clay
- Ogs — Pioneer Sandstone
- Ous — Upper Owen Conglomerate
- Oc — Owen Conglomerate–undifferentiated
- Lss — Lyell Schist
- Copper clay mineralisation
- Sq — Stoped ore
- Access
- Geological boundary
- Unconformity
- Fault
- Ogc 7·6m @ 0·3% — Drill hole with summary log and length and grade(%Cu) of best intersection.

322138

5 cm

COPPER MINES OF TASMANIA PTY LTD
A.C.N. 065 339 835

MT LYELL PROJECT

LYELL CONSOLS CROSS SECTION 2 (6278E)

FIG.10

PREPARED: K.W.	DATE: JUNE 1995	SCALE: 1:1,000	DWG.No. LC 1003
DRAFTED: E.S.	REVISED:		

0 5 10 20 30 40 50m

95-3804

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COPPER MINES OF TAS, MORRISON K C,
WILLS K A J, CORDERY G R, **VOL 4 OF 5**

5300N

5400N

5500N

350mRL

300mRL

250mRL

Plane of long section

BLOCK 3S | BLOCK 3N

LB11 LB10 LB12 LB18 LB19 LB20

Qm Ogc Ogs Ogl Ous Oc Lss

? Consols ? Not Level

1.5m@ 0.22%

18m@ 0.30%

14.4m@ 0.46%

5.7m@ 0.31%

3.1m@ 56%

7.7m@ 0.1%

42.4m

58.5m

64.6m

49.9m

47.2m

93.3m

WHALEBACK FAULT

CONSOLS FAULT

Excluded from Resource estimation

REFERENCE

- Qm — Quaternary Moraine
- Ogl — Gordon Limestone
- Ogc — Clay
- Ogs — Pioneer Sandstone
- Ous — Upper Owen Conglomerate
- Oc — Owen Conglomerate–undifferentiated
- Lss — Lyell Schist
- Copper clay mineralisation
- Sq — Stoped ore
- Access
- Geological boundary
- Unconformity
- Fault
- Ogc 7.6m@ 0.3% — Drill hole with summary log and length and grade(%Cu) of best intersection.

322139

5 cm

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A.C.N. 065 339 835

95-3804

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COPPER MINES OF TAS, MORRISON K C,
WILLS K A J, CORDERY G R, **VOL 4 OF 5**

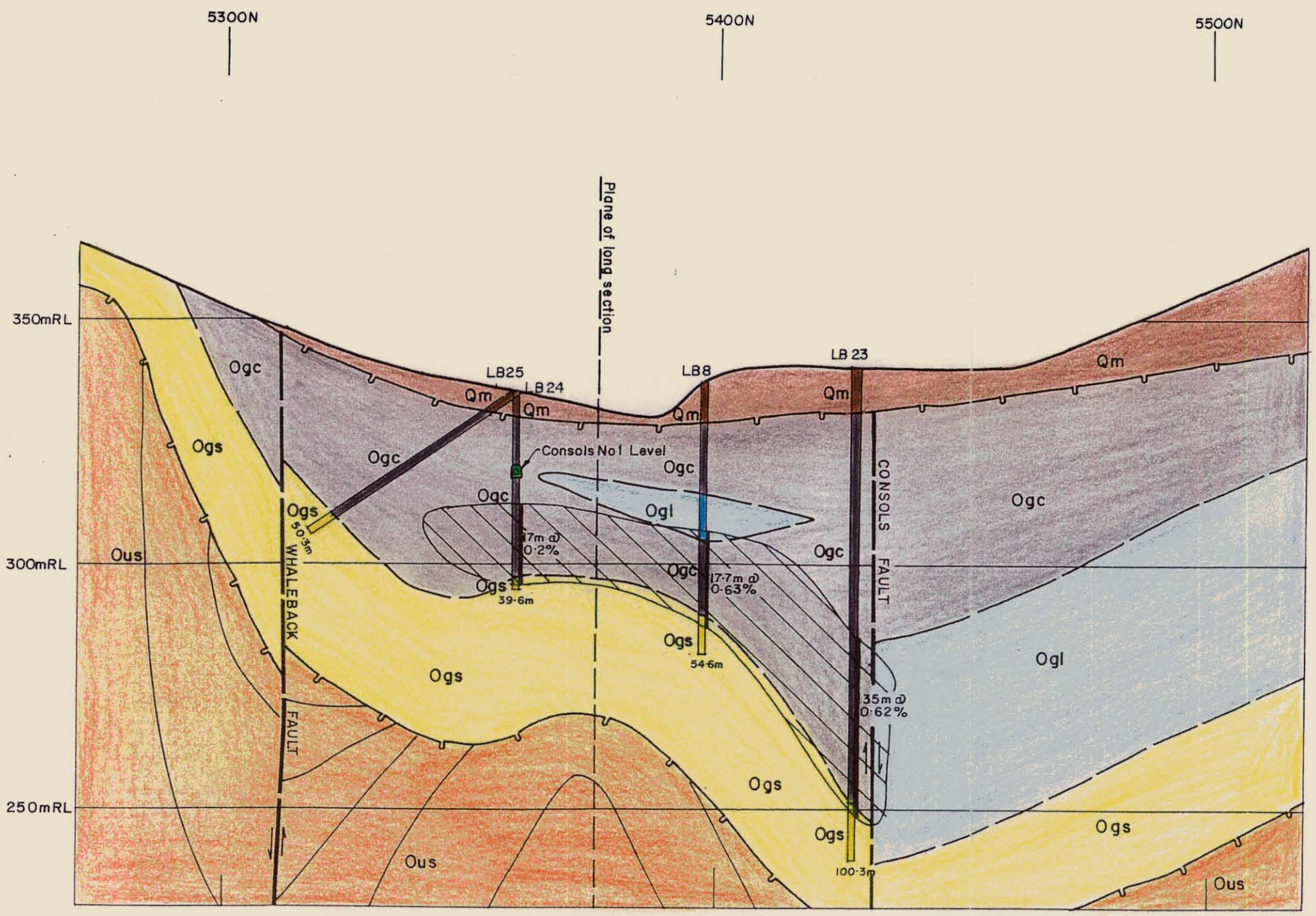
MT LYELL PROJECT

LYELL CONSOLS CROSS SECTION 3 (6390E)

FIG.11

PREPARED: K.W.	DATE: JUNE 1995	SCALE: 1:1,000	DWG.No. LC 1004
DRAFTED: E.S.	REVISED:		

0 5 10 20 30 40 50m



REFERENCE

- Qm — Quaternary Moraine
- Ogl — Gordon Limestone
- Ogc — Clay
- Ogs — Pioneer Sandstone
- Ous — Upper Owen Conglomerate
- Oc — Owen Conglomerate–undifferentiated
- Lss — Lyell Schist
- Copper clay mineralisation
- Sq — Stoped ore
- Access
- Geological boundary
- Unconformity
- Fault
- Ogc 7·6m @ 0·3% — Drill hole with summary log and length and grade(%Cu) of best intersection.

322140

5 cm

COPPER MINES OF TASMANIA PTY LTD
A.C.N. 065 339 835

MT LYELL PROJECT

LYELL CONSOLS CROSS SECTION 4 (6438E)

FIG. 12

PREPARED: K.W.	DATE: JUNE 1995	SCALE: 1:1,000	DWG. No. LC 1005
DRAFTED: E.S.	REVISED:		

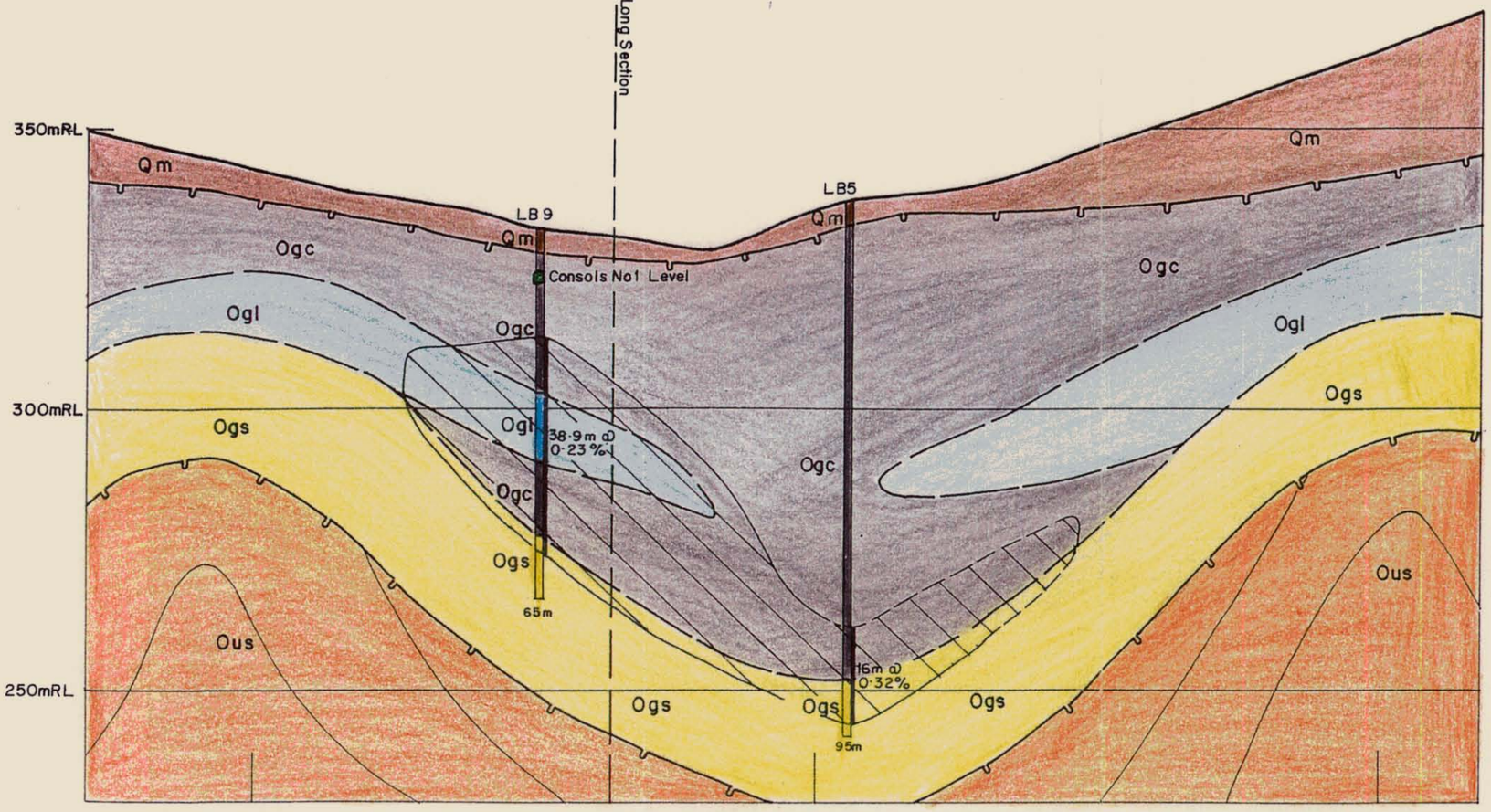
0 5 10 20 30 40 50m

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COPPER MINES OF TAS, MORRISON K C,
WILLS K A J, CORDERY G R, **VOL 4 OF 5**

5300N 5400N 5500N

Plane of Long Section



REFERENCE

- Qm — Quaternary Moraine
- Ogl — Gordon Limestone
- Ogc — Clay
- Ogs — Pioneer Sandstone
- Ous — Upper Owen Conglomerate
- Oc — Owen Conglomerate–undifferentiated
- Lss — Lyell Schist
- Copper clay mineralisation
- So — Stoped ore
- Access
- Geological boundary
- Unconformity
- Fault
- Ogc 7·6m @ 0·3% — Drill hole with summary log and length and grade(%Cu) of best intersection.

322141

5 cm

COPPER MINES OF TASMANIA PTY LTD
A.C.N. 065 339 835

95-3804

MT LYELL PROJECT

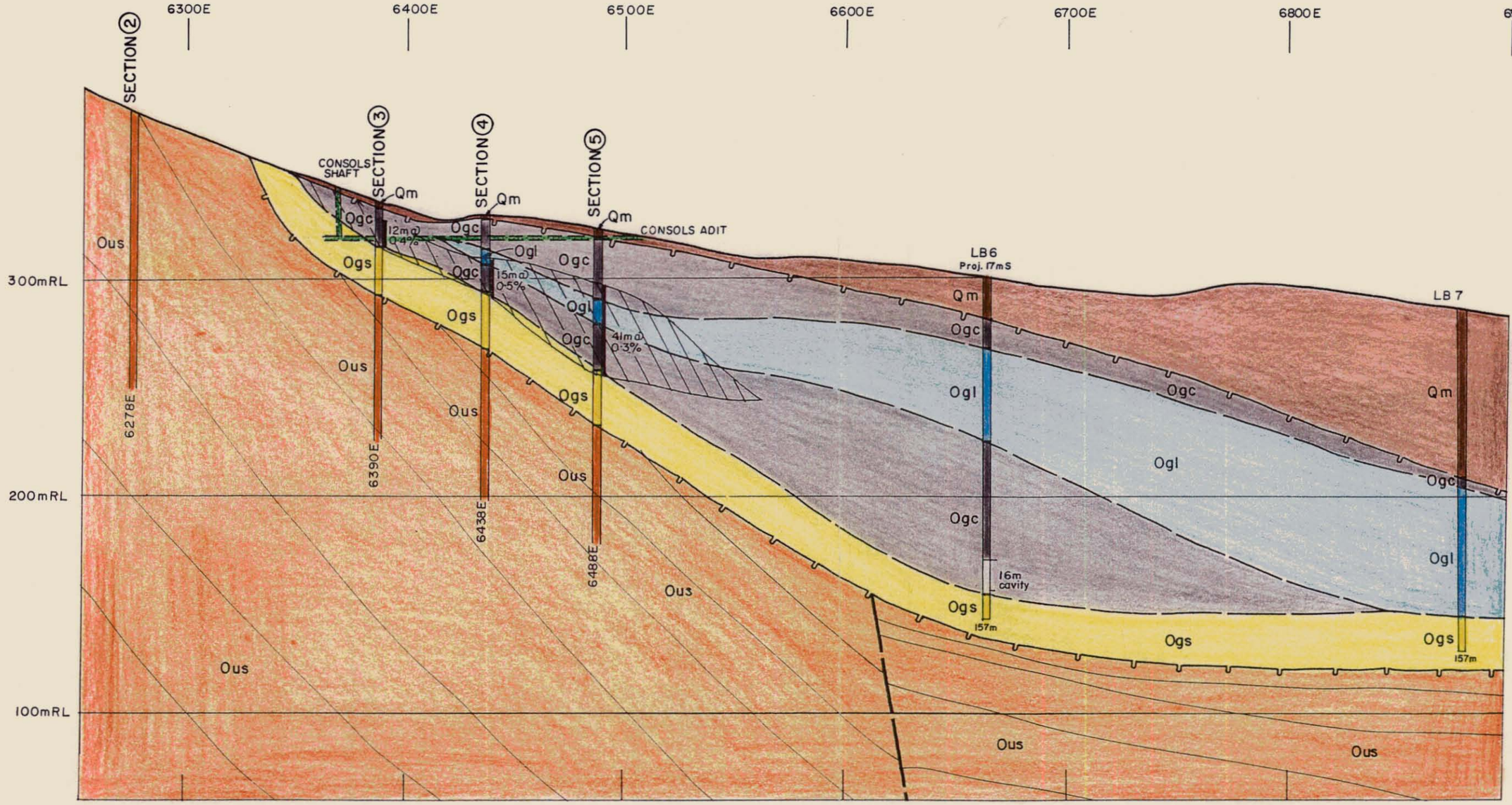
LYELL CONSOLS
CROSS SECTION 5 (6488E)

FIG.13

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COPPER MINES OF TAS, MORRISON K C,
WILLS K A J, CORDERY G R, **VOL 4 OF 5**

DRAWN: K.V.	DATE: JUNE 1995	SCALE: 1:1,000	DWG.No. LC 1006
TRACED:	REVISED:		

0 5 10 20 30 40 50m



REFERENCE

- Qm — Quaternary Moraine
- Ogl — Gordon Limestone
- Ogc — Clay
- Ogs — Pioneer Sandstone
- Ous — Upper Owen Conglomerate
- Oc — Owen Conglomerate–undifferentiated
- Lss — Lyell Schist
- Copper clay mineralisation
- Sq — Stoped ore

- Access
- Geological boundary
- Unconformity
- Fault
- Ogc 7·6m @ 0·3% — Drill hole with summary log and length and grade(%Cu) of best intersection.

322142

5 cm

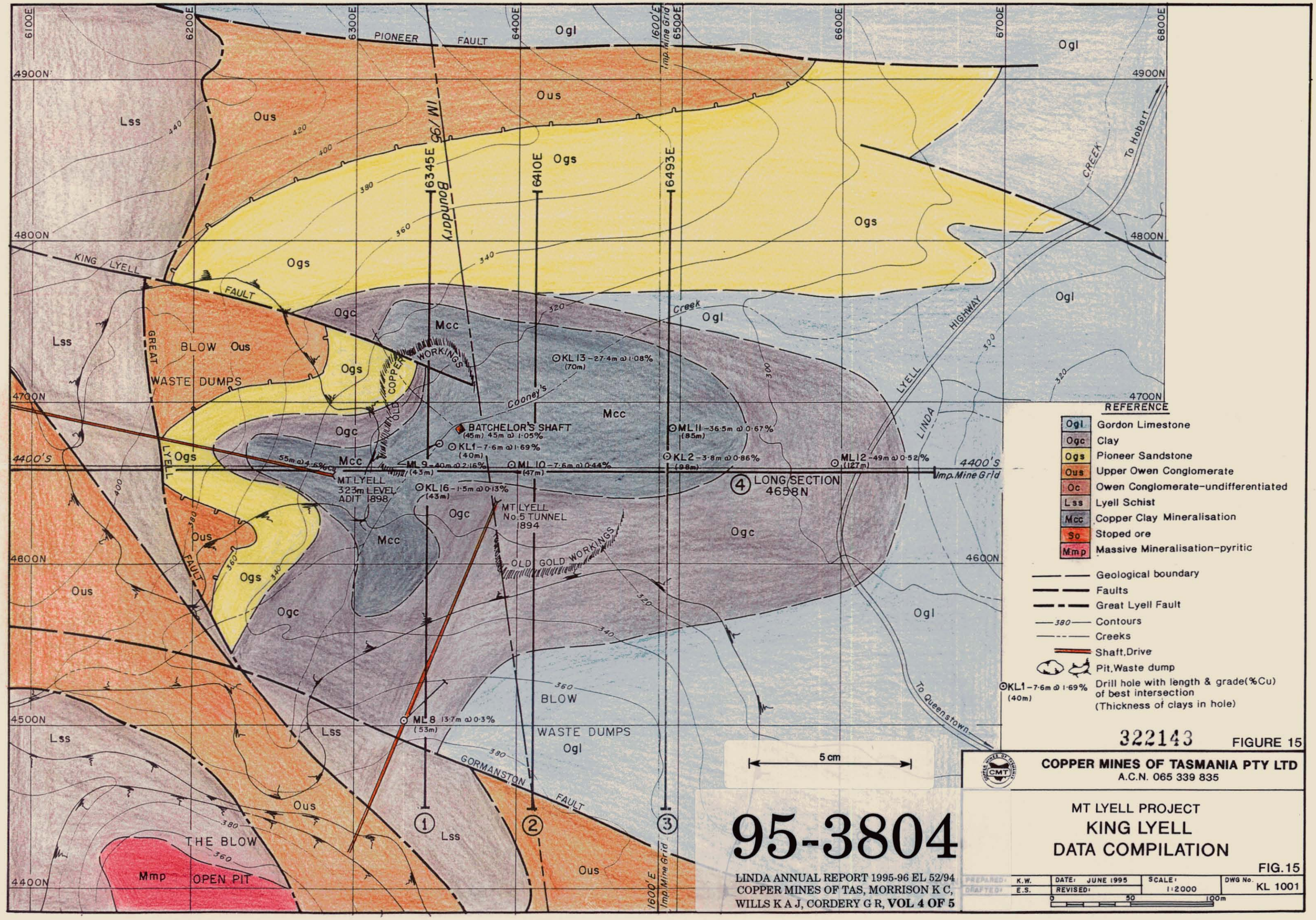
COPPER MINES OF TASMANIA PTY LTD
A.C.N. 065 339 835

MT LYELL PROJECT

LYELL CONSOLS LONG SECTION 6

FIG. 14

PREPARED: K.W.	DATE: JUNE 1995	SCALE: 1 :2,000	DWG. No. LC 1007
DRAFTED: E.S.	REVISED:	0 20 40 60 80 100 m	



REFERENCE

Ogl	Gordon Limestone
Ogc	Clay
Ogs	Pioneer Sandstone
Ous	Upper Owen Conglomerate
Oc	Owen Conglomerate-undifferentiated
Lss	Lyell Schist
Mcc	Copper Clay Mineralisation
So	Stoped ore
Mmp	Massive Mineralisation-pyritic

Geological boundary
Faults
Great Lyell Fault
380 Contours
Creeks
Shaft, Drive
Pit, Waste dump
KL1 - 7·6m @ 1·69% (40m) Drill hole with length & grade(%Cu) of best intersection (Thickness of clays in hole)

322143

FIGURE 15

5 cm

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COPPER MINES OF TAS, MORRISON K C, WILLS K A J, CORDERY G R, **VOL 4 OF 5**

COPPER MINES OF TASMANIA PTY LTD
A.C.N. 065 339 835

MT LYELL PROJECT

KING LYELL DATA COMPILATION

FIG.15

PREPARED: K.W.	DATE: JUNE 1995	SCALE: 1:2000	DWG No. KL 1001
DRAFTED: E.S.	REVISED:	0 50 100m	

4500N 4600N 4700N 4800N

350mRL 300mRL 250mRL 200mRL

BLOW WASTE DUMPS

Ous Lss Ogc Ogl

ML8 MT LYELL Co. IRON BLOW N°5 ACCESS TUNNEL 1894 Proj. max 33mW

KL16 ML9 BATCHELORS SHAFT 1902 Proj 20mW

OLD KING LYELL SLUICE WORKINGS

13·7m @ 0·3%

25·6m @ 1·98%

1·5m @ 0·13%

40m @ 2·16%

45m @ 1·04%

Ogs 44·8m

58·2m

86·9m

GREAT LYELL FAULT

GORMANSTON FAULT

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REFERENCE

Qm	Quaternary Moraine
Ogl	Gordon Limestone
Ogc	Clay
Ogs	Pioneer Sandstone
Ous	Upper Owen Conglomerate
Oc	Owen Conglomerate–undifferentiated
Lss	Lyell Schist
	Copper clay mineralisation
So	Stoped ore

Access

Geological boundary

Unconformity

Fault

Ogc 7·6m @ 0·3% Drill hole with summary log and length and grade(%Cu) of best intersection.

322144

5 cm

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MT LYELL PROJECT

KING LYELL
CROSS SECTION 1 (6345E)

FIG.16

PREPARED: K.W.	DATE: JUNE 1995	SCALE: 1:1,000	DWG. No. KL 1002
DRAFTED: E.S.	REVISED:	0 5 10 20 30 40 50m	

4500N 4600N 4700N 4800N

350mRL
300mRL
250mRL
200mRL

BLOW WASTE DUMP

MT LYELL Co IRON BLOW No5
ACCESS TUNNELL 1894
Proj. max. 33mE

KL13
ML10

GORMANSTON FAULT

7·6m @ 0·44%
27·4m @ 1·08%
51·2m
73·2m

Ous
Ogl
Qm
Ogc
Ogs
?

REFERENCE

- Qm Quaternary Moraine
- Ogl Gordon Limestone
- Ogc Clay
- Ogs Pioneer Sandstone
- Ous Upper Owen Conglomerate
- Oc Owen Conglomerate–undifferentiated
- Lss Lyell Schist
- Copper clay mineralisation
- So Stoped ore
- Access
- Geological boundary
- Unconformity
- Fault
- Ogc 7·6m @ 0·3% — Drill hole with summary log and length and grade(%Cu) of best intersection.

322145

5 cm

COPPER MINES OF TASMANIA PTY LTD
A.C.N. 065 339 835

MT LYELL PROJECT

KING LYELL
CROSS SECTION 2 (6410E)

FIG.17

PREPARED: K.W.	DATE: JUNE 1995	SCALE: 1:1,000	DWG.No. KL 1003
DRAFTED: E.S.	REVISED:	0 5 10 20 30 40 50m	

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4500N 4600N 4700N 4800N

350mRL
300mRL
250mRL
200mRL

BLOW WASTE DUMPS

KL2 MLII

Qm Ogc Ogl Ogs Ous Cgc

Not assayed

36·5m @ 0·67%

3·8m @ 0·86%

87·8m

98·5m

REFERENCE

- Qm Quaternary Moraine
- Ogl Gordon Limestone
- Ogc Clay
- Ogs Pioneer Sandstone
- Ous Upper Owen Conglomerate
- Oc Owen Conglomerate–undifferentiated
- Lss Lyell Schist
- Copper clay mineralisation
- So Stoped ore

- Access
- Geological boundary
- Unconformity
- Fault

Ogc 7·6m @ 0·3% — Drill hole with summary log and length and grade(%Cu) of best intersection.

5 cm

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MT LYELL PROJECT

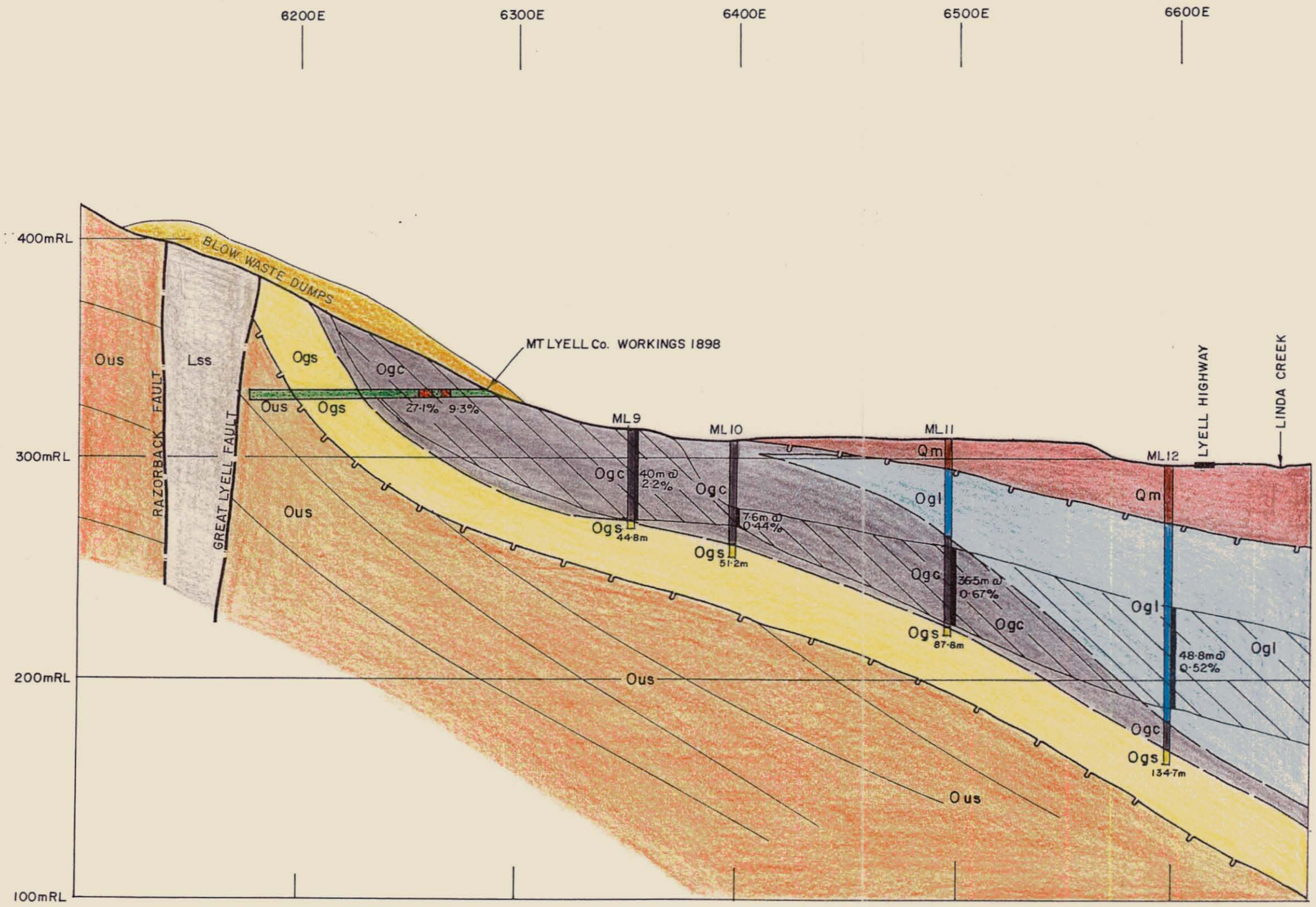
KING LYELL
CROSS SECTION 3 (6493E)

FIG. 18

PREPARED: K.W.	DATE: JUNE 1995	SCALE: 1:1,000	DWG. No. KL 1004
DRAFTED: E.S.	REVISED:		

0 5 10 20 30 40 50m

322146



REFERENCE

- Qm — Quaternary Moraine
- Ogl — Gordon Limestone
- Ogc — Clay
- Ogs — Pioneer Sandstone
- Ous — Upper Owen Conglomerate
- Oc — Owen Conglomerate–undifferentiated
- Lss — Lyell Schist
- Copper clay mineralisation
- So — Stoped ore
- Access
- Geological boundary
- Unconformity
- Fault
- Ogc 7·6m @ 0·3% — Drill hole with summary log and length and grade(%Cu) of best intersection.

322147

5 cm

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A.C.N. 065 339 835

MT LYELL PROJECT
KING LYELL
LONG SECTION 4 (4658N)

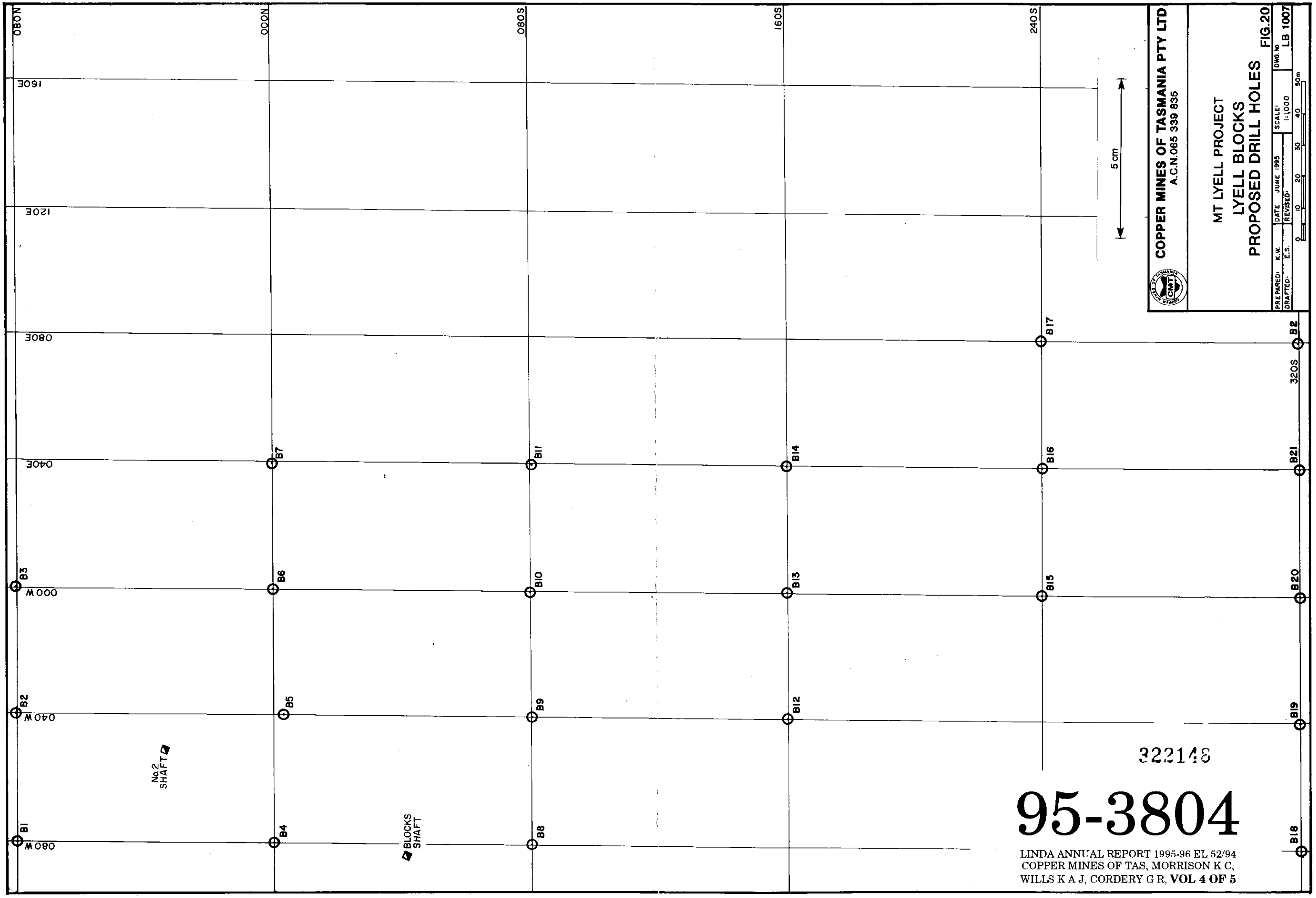
FIG.19

PREPARED: K.W.	DATE: JUNE 1995	SCALE: 1:2,000	DWG. No. KL 1005
DRAFTED: E.S.	REVISED:		

0 20 40 60 80 100m

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6220E 6300E 6380E 6460E 6540E

5480N

5440N

5400N

5360N

5320N

5280N

C12 C11 C16 C20 C10 C15 C19 C3 C6 C9 C14 C18 C2 C5 C8 C13 C17 C1 C4 C7

CONSOLS SHAFT

322149

5 cm

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A.C.N. 065 339 835

MT LYELL PROJECT

LYELL CONSOLS PROPOSED DRILL HOLES

FIG.21

PREPARED: K.W.	DATE: JUNE 1995	SCALE: 1:1,000	DWG.No. LC 1008
DRAFTED: E.S.	REVISED:		

0 5 10 20 30 40 50m

6260E 6340E 6420E 6500E 6580E

4740N K8 K14 K19

4700N K7 K13 K18 K22

BATCHELOR'S SHAFT

4660N K1 K6 K12 K17 K21

4620N K5 K11 K16 K20

4580N K4 K10 K15

4540N K3 K9

4500N K2

322150

5 cm

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MT LYELL PROJECT

KING LYELL
PROPOSED DRILL HOLES

FIG.22

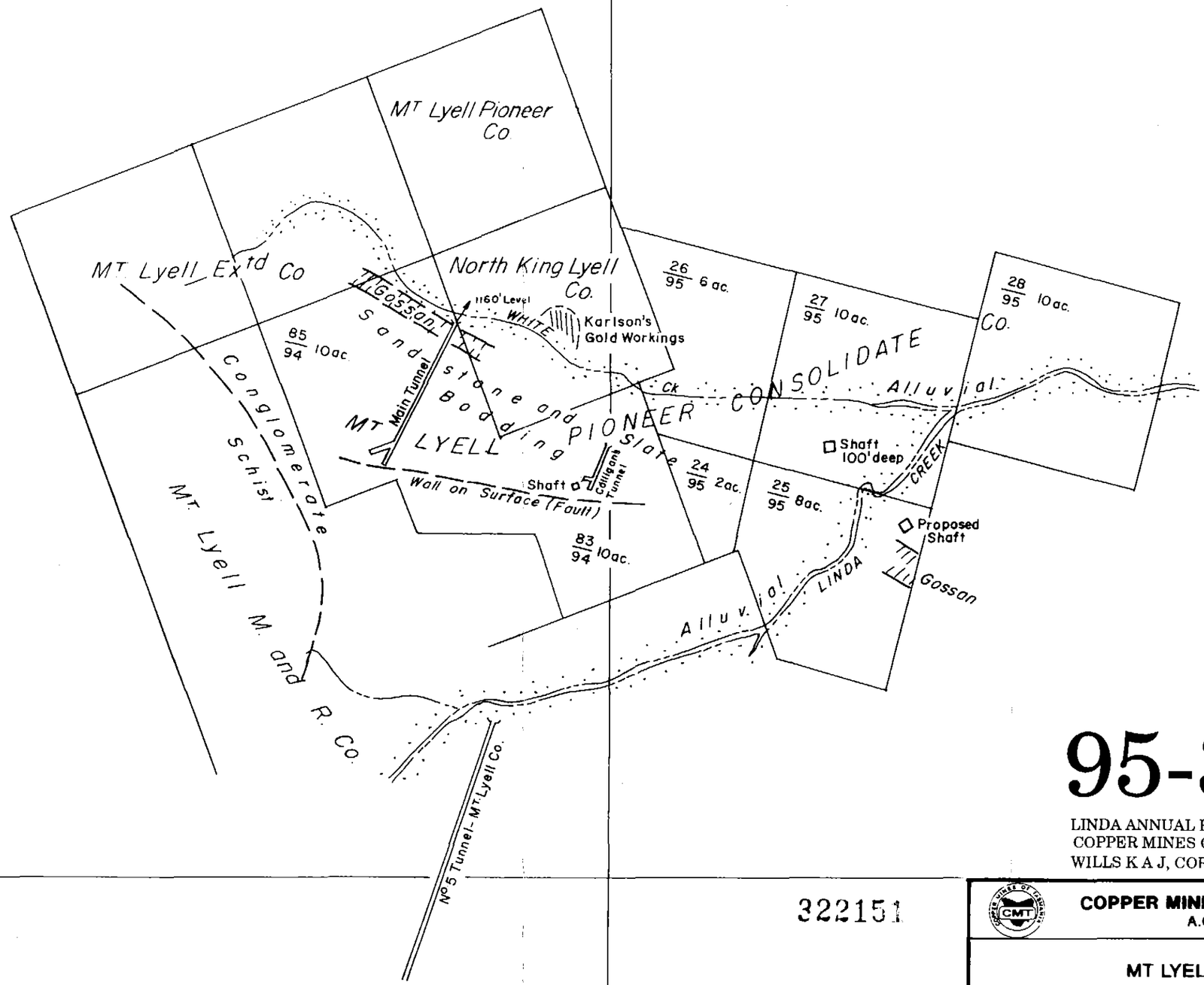
PREPARED: K.W.	DATE: JUNE 1995	SCALE: 1:1,000	DWG.No. KL 1008
DRAFTED: E.S.	REVISED:		

0 5 10 20 30 40 50m

5500E

6500E

5500N



CURRENT MINE GRID NORTH

4500N

322151

5 cm

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COPPER MINES OF TASMANIA PTY LTD
A.C.N. 065 339 835

MT LYELL PROJECT

LOCATION AND GEOLOGY OF LYELL PIONEER AND LYELL EXTENDED

(ORIGINAL BY W.H.CURDY 27/3/1901) FIG.23

PREPARED: K.W	DATE: JUNE 1995	SCALE: 1:5,000	DWG No. LP 1001
DRAFTED: E.S.	REVISED:		

0 50 100 200 300m

6000N METRIC MINE GRID

5500N

4500N

6500E

6000E METRIC MINE GRID

CONSOLS No 1. LEVEL.

CONSOLS SHAFT.

CONSOLS COPPER CLAYS.

PIONEER GOLD WORKINGS (in clay)

UNTESTED CLAYS.

UNTESTED CLAYS.

BALANCE SHAFT.

LONGITUDINAL SECTION.

BLOCKS COPPER CLAYS.

BLOCKS No 1. SHAFT.

BLOCKS SHAFT.

NORTH LYELL OPEN CUT.

1670.

NORTH LYELL SHAFT.

CROWN SHAFT.

1760

1695

1640

1695.

1760

1685

1640

LYELL THARSIS. OPEN CUT.

NORTH LYELL TUNNEL

No 11 BORE. 0·72 oz. cu. dcy.

PROPOSED DRILL HOLES.

MT. LYELL SHAFT.

No 9 BORE.

No 3 SHAFT.

KING LYELL CLAYS

MT. LYELL ADIT.

Native cu. & Chalcopyrite.

Chalcopyrite.

— LEGEND —

OPEN CUTS PLANNED IN 1954.

OUTCROP OF COPPER CLAYS.

UNDERGROUND WORKINGS.

Mag North

SURFACE PLAN SHOWING COPPER CLAYS

SCALE :- 1:2,500

5 cm

OCT. 1957.

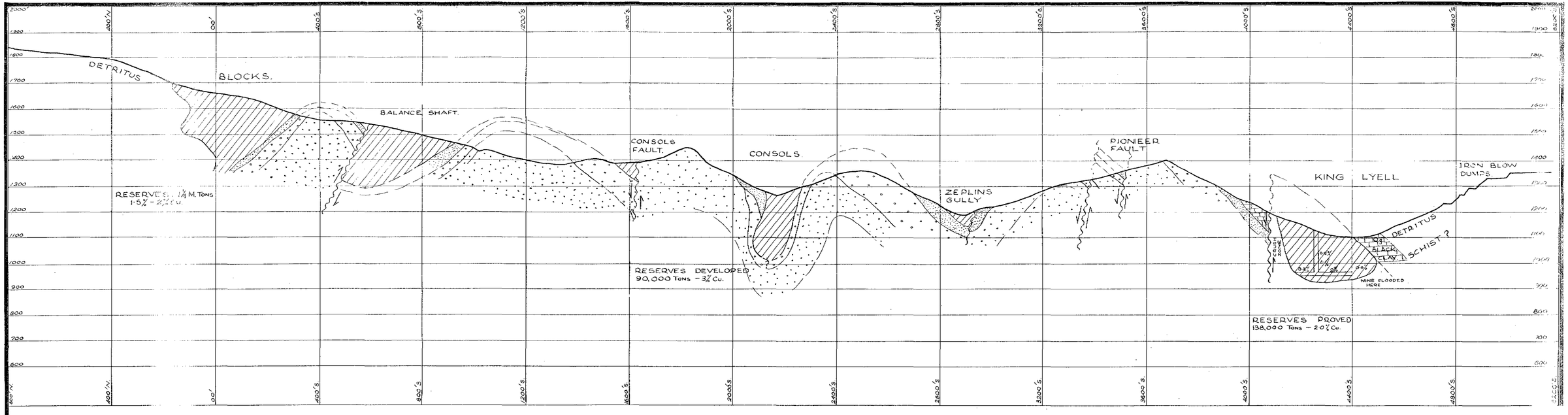
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FIGURE 24
B 15

T 130

322152



BLACK CLAY – GORDON LSt. (Og)

COPPER CLAYS.

GREY SANDSTONE.

N – S LONGITUDINAL SECTION THROUGH COPPER CLAYS

SCALE : 1"=200'

1957.

5 cm

LINDA BEDS.

UNCONFORMITY.

CHOCOLATE SANDSTONE.

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FIGURE 25
B 7s

T 131

322153

PEAKS

TASMAN

LYELL

NORTH MT. LYELL CO. CO.

631 FT LEVEL — No 4 — 797 FT LEVEL — No 5 — No 9

Very thick Scrub with some fair timber

Work done before 1898
Work done 1898 1st half year
Work done 1898 2nd half year
Ore bearing ground
Alluvial Gold Wash
Gossan and Native Copper

Section 11-92

Thick Scrub Poor Mining Timber

Section 10-92

Natural Surface of Country hidden by 10ft of loose Conglomerate Boulders

Shaft 372 FT LEVEL — No 3 — No 6 — No 10 — No 13

Belt of Fair Mining Timber

Fair Timber

Poor Timber

Poor Timber

Section 12-92

Section 9-92

Section 8-92

Shaft — East Ore Body — SHAFT — East Winze 100ft deep — SHAFT — Winze 50 — 340 ft — 1093 ft — No 2 Tunnel — No 2 W. Crosscut — Main Footwall Drive — Proposed New Tunnel to Explore New Source of Gossans — Timberland — COPPER — NATIVE — No 3 Tunnel — No 1 E. Crosscut — No 4 Tunnel — No 1 Tunnel North Lyell — 151 FT LEVEL — No 2 — 243 FT LEVEL — No 7 — No 11 — No 14

In Easement of North Lyell Company

6000N

Section 6-92

Section 7-92

No Timber

5 cm

SHAFT — No 5 Tunnel — Cedar Creek — Main Tunnel — GOSSAN AND — DEPOSIT OF

Proposed Main Tunnel to explore Sections 7.8.9 & 10

Old Alluvial Gold Workings

Gold Creek

6000E METRIC MINE GRID

No 2 Tunnel North Lyell — 130 FT LEVEL — No 1 — 0 FT LEVEL — No 8 — No 12

Mt. LYELL BLOCKS.

SCALE 1:2,000

SCALE

1" = 100'

Rob Schleeser, Jan 24 1899

RAE & MUNN. MELB.

B1

T 142

FIGURE 26

322154

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THE MOUNT LYELL M&R.CO.LTD.

LYELL BLOCKS MINE

SCALE 1:1,000

FIGURE 27

B9 T 133

SHAFT	LEVEL OR TUNNEL	R.L.	COLOR
West No.2	Top Tunnel		
No.2	Collar	1808	
No.3	Collar	1778	
No.3	150' Level (North Lyell 200' Level)	1653	
West No.3	No.2 Tunnel		
	No.3 Tunnel	1633	
Prop	No.4 Tunnel		
No.2	300' Level	1618	
Prop	No.1 Intermediate	1608	
Prop	No.2 Adit or No.5 Tunnel	1573	
No.2	340' Level or No.1 Tunnel	1568	
Prop	No.1 Tunnel or No.1 Adit	1554	
Prop	No.2 Intermediate Level	1554	
Prop	Office Tunnel or No.3 Adit	1553	

SHAFT	LEVEL OR TUNNEL	R.L.	COLOR
No.1	Collar	1432	
No.1	No.1 Level (1080' level)	1423	
No.1	No.2 Level	1363	
No.2	450' Level	1353	
No.3	500' Level North Lyell	1346	
No.1	Conrad's Tunnel or No.4 Adit	1332	
No.2	550' Level or No.5 Level		
No.3	600' Level (also called 630' level	1257	
No.3	700 " (Not only)	1175	
No.3	1000 "	879	
No.3	1100 "	751	
No.3	1200 "	632	
No.3	1300 "	553	

5 cm

DIAGRAM "B"

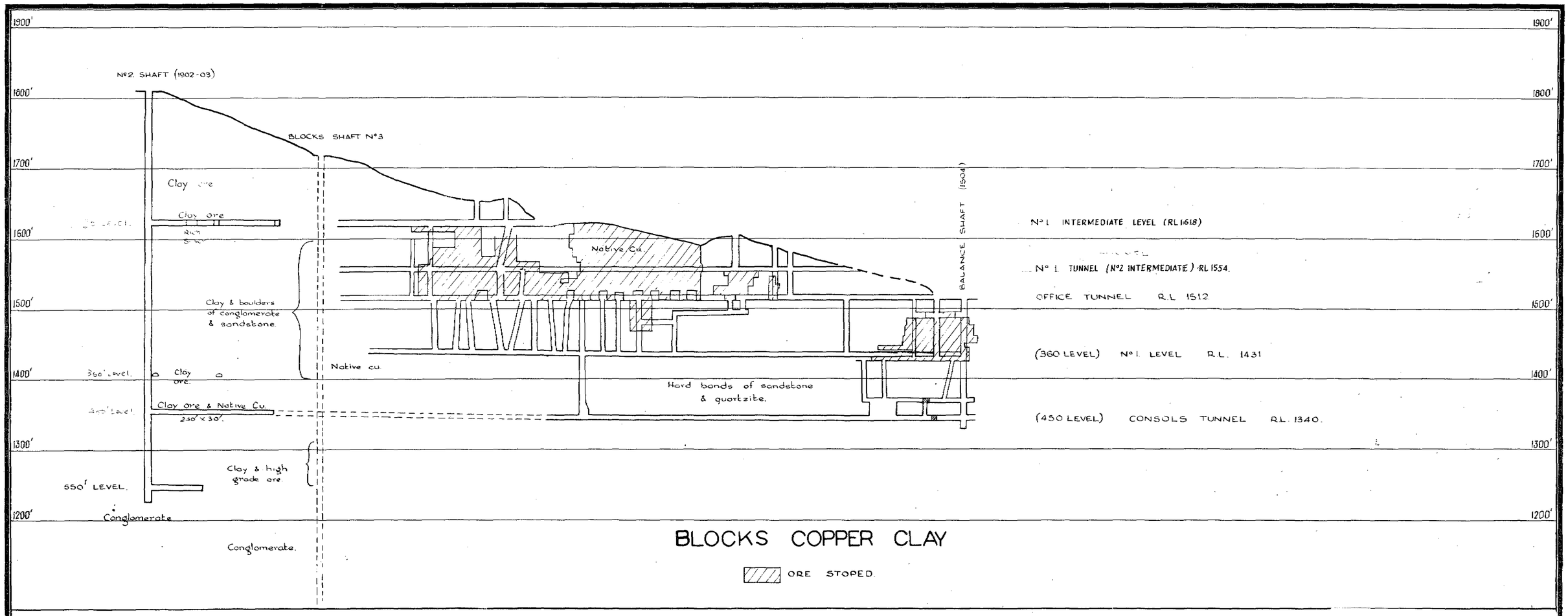
DIAGRAM "A"

See Diagram "B"

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BLOCKS COPPER CLAY

ORE STOPED

LONGITUDINAL SECTION SHOWING ORE DEVELOPED

SCALE : 1:1,000

1957

95-3804

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WILLS K A J, CORDERY G R, VOL 4 OF 5

5 cm

FIGURE 28

T 95

322156

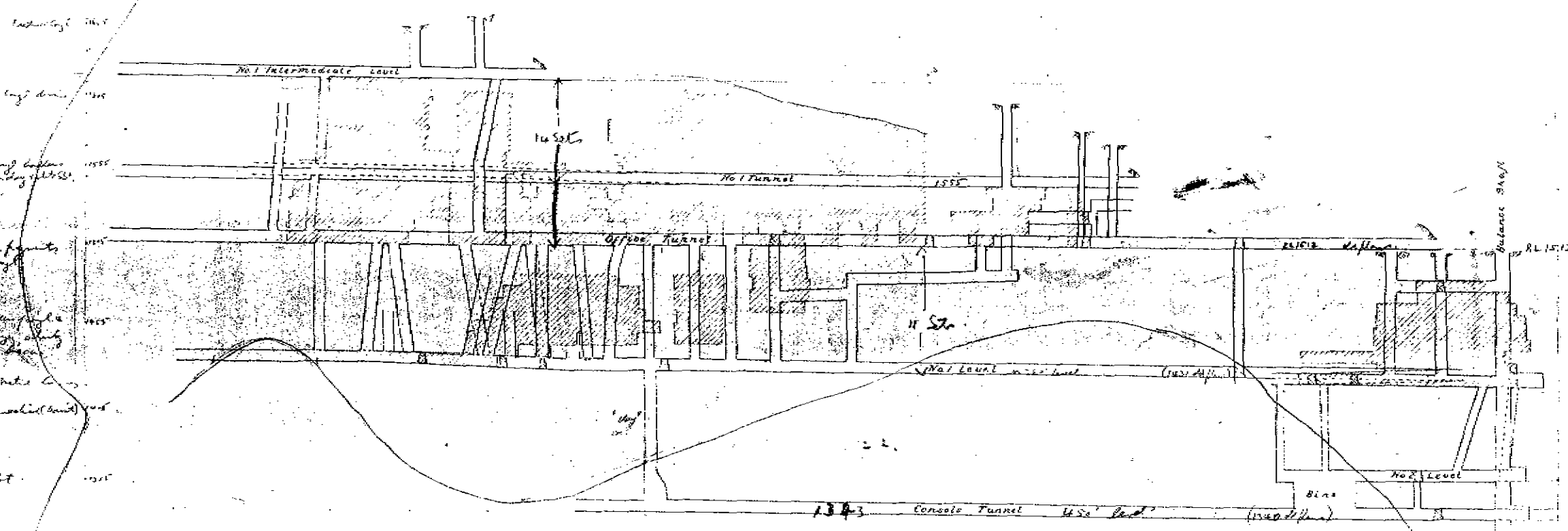
MT LYELL BLOCKS M. CO. N.L.

LONGITUDINAL SECTION

Shewing workings projected on a plane parallel to Western Boundary

5 cm

SCALE 1:1,000



Stoping shewn thus

550 Level RL 1242

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FIGURE 29

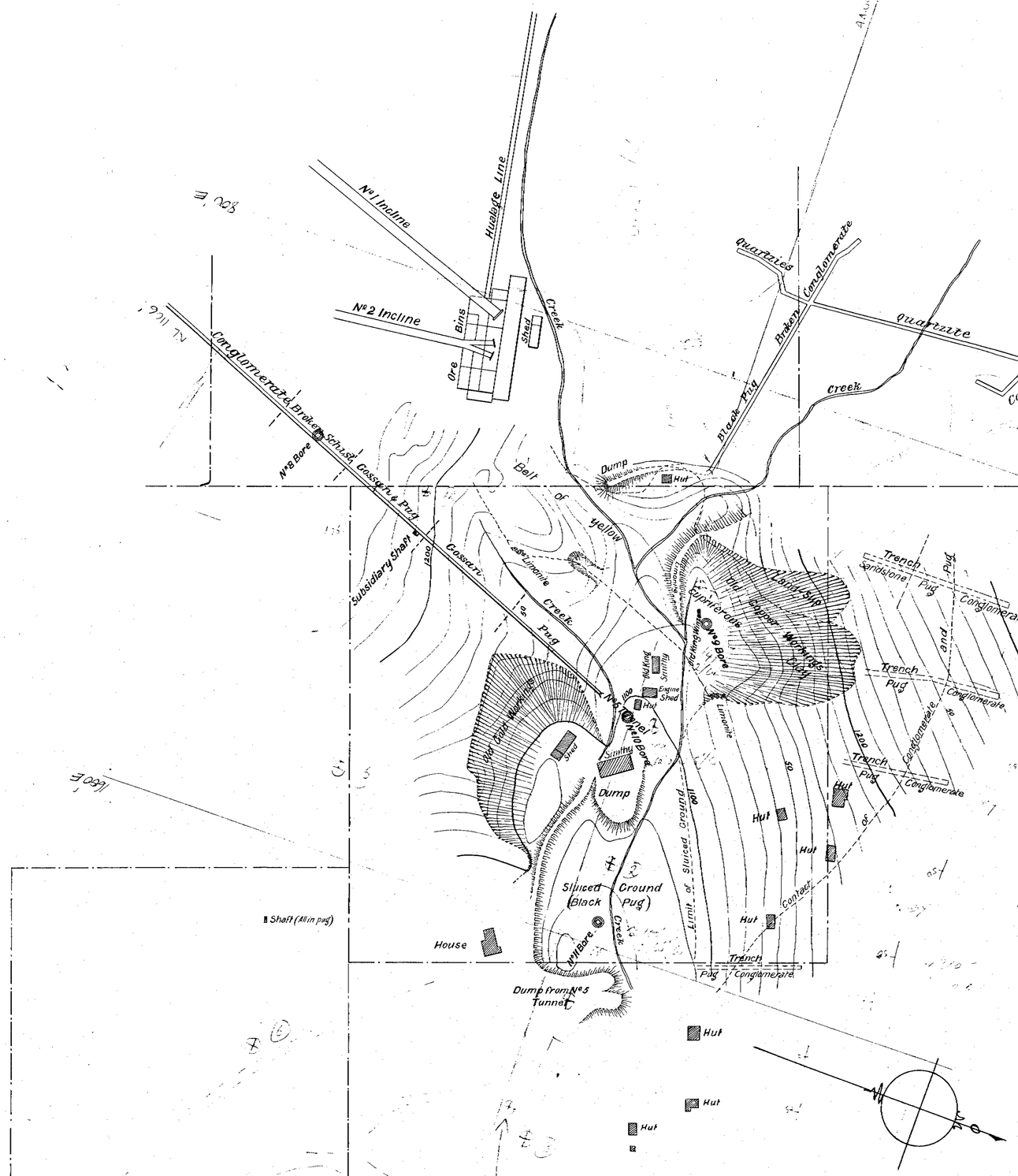
322157

The Mount Lyell M. and R Co, Ltd

Plan of King Lyell

SCALE 1:1,000

5 cm



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K 3

FIGURE 30
T 97

322158

322150

MICROFILMED
FICHE No 014074-83

Copper Mines of Tasmania Pty Ltd

EL 52/94 Annual Report

Year 1 (13-1-95 to 13-1-96)

95-3804

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15 DEC 1995

K.C. Morrison
K.A.J. Wills
G.R. Cordery
12 December 1995

333100

APPENDIX 2

MAGNETICS DATA

File 322161
Mt Lyell Geophysics

G.C

UTS GEOPHYSICS PTY LTD

LOGISTICS REPORT

HELICOPTER GEOPHYSICAL SURVEYS

FOR

GOLD MINES OF AUSTRALIA LIMITED

MT LYELL AREA

TASMANIA, AUSTRALIA

20 FEBRUARY 1995

95-3804

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Received 14.3.95

322162

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1 GENERAL SURVEY INFORMATION

In February 1995, UTS Geophysics conducted an airborne magnetometer survey of the Mt Lyell area in Tasmania for Gold Mines of Australia Limited. This report summarises the logistics, survey parameters and processing details of the survey.

The survey was commenced on 8 February 1995 and completed on 23 February 1995.

UTS Geophysics provided the described survey for the following mining company:

Gold Mines of Australia Limited
A.C.N. 000 690 308
P.O. Box 792
CLOVERDALE WA 6105

2 GENERAL FLYING SPECIFICATIONS

Helicopter magnetic surveys were flown over one (1) prospect(s) in West Tasmania. The base of operations was Queenstown, Tasmania. Flight specifications for each area are shown in the following table.

PROSPECT NAME	LINE SPACING	LINE DIRECTION	TIE LINE SPACING	TIE LINE DIRECTION	SENSOR HEIGHT	SAMPLE DENSITY	TOTAL LINE KM
Mt Lyell	100m	090 - 270	1000m	000 - 180	20-30m	3 - 4 m	473
TOTAL							473

The total number of line kilometres of survey data collected over the survey area(s) specified in the above table was 473.

The specified sensor height for the magnetic samples is as stated in the above table. This sensor height may be varied where topographic relief or laws pertaining to built up areas do not allow this altitude to be maintained, or where the safety of the helicopter and equipment is endangered.

The coordinate boundaries and associated maps for the survey area(s) flown is detailed in Appendix B.

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3 EQUIPMENT USED AND SPECIFICATIONS

The list of geophysical and navigation equipment used for the survey is as follows:

- UTS helicopter based stinger.
- Geometrics G-833 Metastable Helium Magnetometer
- Develco Vector Magnetometer.
- UTS data acquisition system, digital recording and output system.
- RMS Aeromagnetic Automatic Digital Compensator (AADC II).
- UTS navigation and acquisition software.
- Bendix King KRA-10 Radar Altimeter.
- Magnavox MX-9212 Navigation GPS.
- Magnavox MX-9012 Differential GPS.
- UTS LCD pilot navigation display.
- UTS Radios and radio modem communication system.
- Diurnal monitoring magnetometer (Geometrics G-856)

3.1 Aircraft Used

- Model: Aerospatiele Squirrel AS 350B
- Registration: VH-HBA
- Operator: Helicopter Resources Pty Ltd

3.2 UTS Helicopter Based Stinger System

The platform used for data acquisition was the UTS developed, helicopter stinger. The stinger is a carbon fibre, forward mounted boom, fixed beneath the helicopter and extending beyond the front of the aircraft cabin.

All magnetic and positional sensors are mounted within the stinger.

3.3 Magnetics

Total magnetic field data readings for the survey were made using a Geometrics G-833 Helium Magnetometer. This precision sensor has the following specifications:

- Model: Geometrics G-833 Metastable Helium Magnetometer
- Sample Rate: 0.1 Seconds (10Hz)
- Sensitivity: 0.01nT
- Operating Range: 20,000nT to 95,000nT
- Temperature Range: -20°C to +50°C

3.4 Data Positioning and Flight Navigation

Data positioning and navigation was derived using differential, real-time GPS (Global Positioning System).

A Differential GPS receiver and associated radio data communications were established in the vicinity of the survey area by UTS. Positional corrections from a base reference GPS were transmitted to the aircraft GPS for real-time corrections to the aircraft's GPS derived position.

Differential corrections were recorded at the base station GPS site to allow for post flight correcting of the positions recorded by the aircraft.

The GPS systems used for the survey were:

- Aircraft Navigation GPS Model — Magnavox MX9212
- Satellite Channels Available — 12
- Differential Reference GPS Model — Magnavox MX9012
- Satellite Channels Available — 12
- Typical Differentially Corrected Accuracy — 2-3 metres (horizontal accuracy)

3.5 UTS Data Acquisition System, Digital Recording and Output System

All geophysical and positional information for the survey was recorded using a UTS developed, high speed, precision computer data acquisition system.

Instrument synchronisation, recording and parallax were measured and removed in real-time using the UTS data acquisition system.

The information recorded for each one tenth of a second (0.1 second) interval was:

- scan time (Local and UTC time)
- one total field magnetometer reading
- one vector magnetometer reading (X,Y,Z)
- one radar altimeter reading
- one WGS84 GPS position
- one AMG84 metric grid coordinate
- one GPS geodetic height reading
- other GPS information including dilution of position, signal information, satellites tracked and pseudo-range information

Survey flight data was down loaded onto magnetic tape.

3.6 Aircraft Compensation

At the start of the survey, the system was calibrated for reduction of heading error.

The heading and manoeuvre effect of the aircraft on the magnetic data was removed using an RMS Automatic Airborne Digital Compensator (AADC). UTS static proprietary compensation techniques were also employed to further refine the removal of the heading effect of the aircraft

A three axis fluxgate magnetometer was used to the record the magnetic field in the X,Y and Z direction. These recorded values were used by the RMS AADC compensator to remove the heading effect of the helicopter.

3.7 UTS Navigation System

All data positioning and pilot navigation was controlled through advanced UTS navigation software.

Accurate pilot navigation was achieved through computer controlled aircraft flight instruments and guidance displays located in the cockpit of the aircraft.

GPS derived positions were used to provide aircraft navigation and position information.

3.8 Altitude Readings

Accurate height above the terrain was measured using a Bendix King radar altimeter installed in the aircraft. The height of each magnetic reading was taken from the radar altimeter and stored by the acquisition system.

- Model — Bendix King KRA-10 radar altimeter
- Sample Rate — 0.1 Seconds (10Hz)

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3.9 Diurnal Monitoring Magnetometer

A base station magnetometer was located in a low gradient area beyond the region of influence by any man made interference to monitor diurnal variations during the survey.

The specifications for the magnetometer used are as follows:

- Model — Geometrics G-856
- Resolution — 0.1 nT
- Sample Interval — 10 seconds (0.1Hz)
- Operating Range — 20,000nT to 90,000nT
- Temperature — -20°C to +50°C

4 SURVEY LOGISTICS

The base location used for operating the aircraft and in-field processing of the survey data was Queenstown, Tasmania.

4.1 Survey Flight Summary

The following table summarises the flight logs provided by the operator for the survey areas flown:

Flight Date	Area No	Flight No	Area Name	Line Km Flown	Lines Flown	Weather Conditions
8 FEB 95	01	01	Mt Lyell	162	33	Survey Production
9 FEB 95	-	-	Mt Lyell	-	-	Bad weather - standby
10 FEB 95			Mt Lyell	-	-	Bad weather - standby
11 FEB 95	01	02	Mt Lyell	113	24	Survey Production
12 FEB 95	01	03	Mt Lyell	12	4	Survey Production
	01	04	Mt Lyell	124	35	Survey Production
	01	05	Mt Lyell	68	13	Survey Production
23 FEB 95	01	T1	Mt Lyell	46	6	Survey Production
	01	06	Mt Lyell	94	21	Survey Production

4.2 Differential GPS Station Locations

The following table contains the locations used for the differential GPS reference station.

Area Name	Period	Trig Station Name	Latitude	Longitude
Mt Lyell	8 - 23 FEB 95	Queenstown	S 42° 04.59672'	E 145° 33.52118'

4.3 Diurnal Magnetometer Locations

The following table contains the approximate locations where the diurnal base station magnetometer was located for each survey area.

Area Name	Period	Base Station ID	Latitude	Longitude
Mt Lyell	8-23 FEB 95	00	S 42° 15'	E 145° 32'

4.4 Cultural Features Noted from Flight Logs

The following table contains operator flight notes made during the survey where cultural features may cause significant interference to the survey data acquired.

Area Name	Flight Line	Easting	Northing	Description
Mt Lyell	-	-	-	Numerous cultural features in the survey area

322170

5 Processed Products Supplied

5.1 Data Processing and Levelling

The raw survey data was loaded from the field tapes and levelled in the following manner to produce preliminary maps:

- Base station magnetometer diurnal levelling
- Tie line levelling

The preliminary levelled data was then plotted to produce the following verification maps:

- Total magnetic intensity contour maps
- Flight path maps

5.2 Final Geophysical Products

A levelled located data tape, containing all traverse lines and tie lines was recorded on the following media:

- EXABYTE TAR format tape

The format for the located data tape is described in Appendix A.

The following geophysical maps and images were supplied:

- None supplied

322171

For further information concerning the survey flown, please contact the following office:

Head Office Address:

UTS Geophysics Pty Ltd
Valentine Road
Perth Airport
REDCLIFFE WA 6104

Tel: +61 9 479 4232
Fax: +61 9 479 1008

Postal Address:

P.O. Box 126
BELMONT WA 6104

322172

APPENDIX A: LOCATED DATA TAPE FORMAT

322173

UTS GEOPHYSICS
HELICOPTER GEOPHYSICAL SURVEYS
LOCATED DATA TAPE FORMAT

MEDIA: EXABYTE
DATA TYPE: ASCII
RECORD LENGTH:
BLOCK SIZE: 18, 983, 475 bytes

FIELD	CONTENTS	UNITS	FORMAT
1 - 7	Line Number	N/A	(I7)
8 - 14	Fiducial Number	N/A	(I7)
15 - 24	Easting in Metres	m	(F10.2)
25 - 35	Northing in Metres	m	(F10.2)
39 - 44	Time	sec	(I6)
45 - 53	GPS Time	sec	(F9.1)
55 - 57	Julian Day Number	N/A	(I3)
59 - 67	Diurnal Magnetometer Value	nT	(F9.2)
68 - 76	Raw Magnetometer Value	nT	(F9.2)
77 - 85	Levelled Magnetometer Value	nT	(F9.2)
87 - 94	Radar Altimeter Value	m	(F8.3)
95 - 103	GPS Height	m	(F9.3)

Note: Where any data item is unknown or undefined, the entire output field for the item will be filled with nines in the appropriate format.
(e.g. Format (F10.1) is 99999999.9, while (I8) is 99999999)

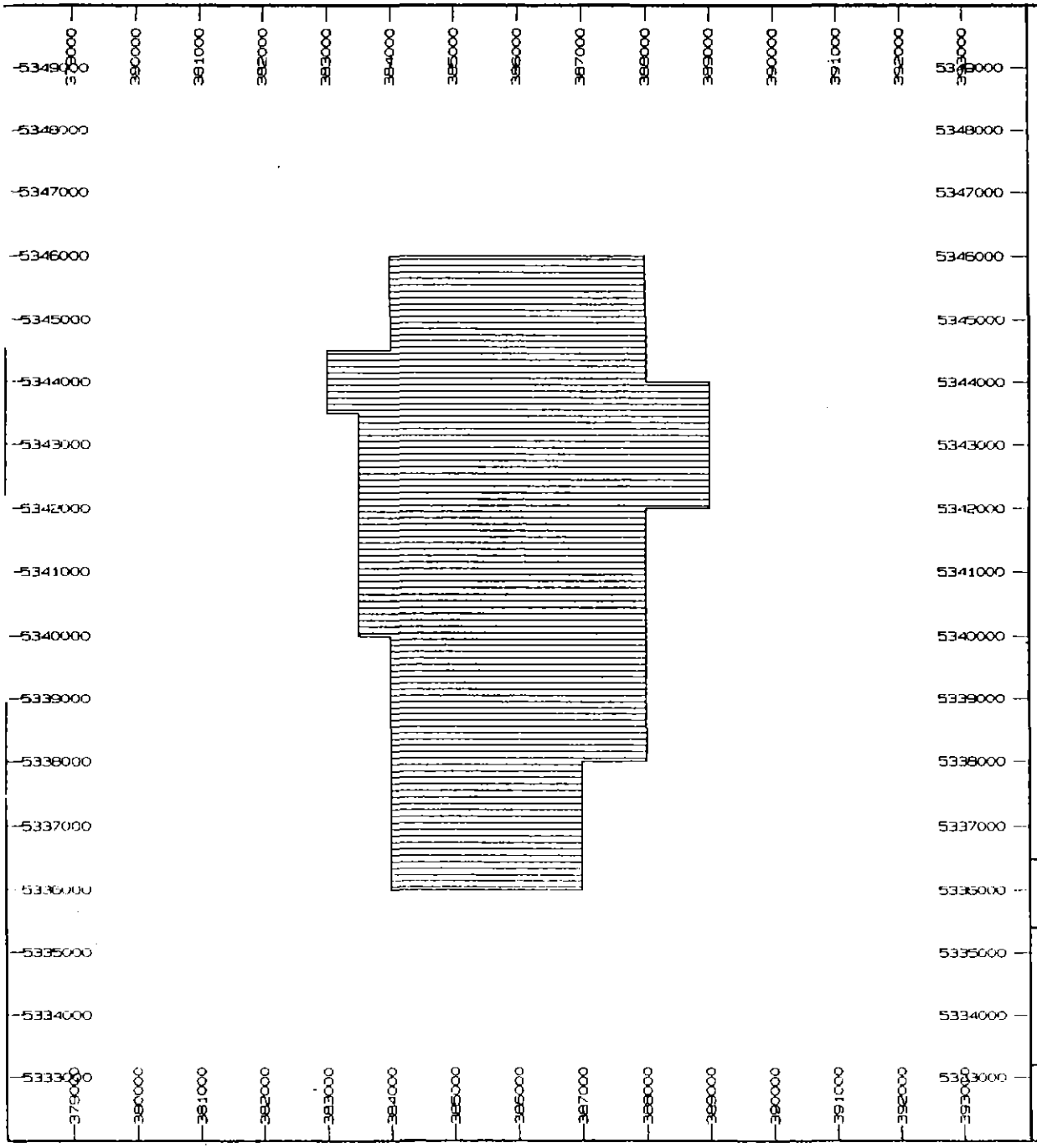
Sample located data tape listing:

```
        1         2         3         4         5         6         7         8         9         10
12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890123
  30190  401635 710426.28 9389995.30   110924 472164.0 259  41261.05 41418.92 41260.54   156.270 3139.600
  30190  401636 710426.49 9389991.27   110924 472164.1 259  41261.05 41418.92 41260.51   155.530 3138.820
  30190  401637 710426.70 9389987.24   110924 472164.2 259  41261.05 41418.93 41260.48   156.080 3138.040

 340270  302998 712033.73 9373178.07    82460 462301.0 259  41252.35 41487.84 41249.34    92.650 2863.800
 340270  302999 712033.85 9373175.92    82460 462301.1 259  41252.34 41487.81 41249.31    92.650 2864.320
 340270  303000 712033.97 9373173.77    82500 462301.2 259  41252.34 41487.78 41249.27    92.270 2864.840
   LINE     FID   EASTING   NORTHING     TIME  GPSTIME DAY   DIURNAL  RAW MAG  LEV MAG  RAD ALT  GPS ALT
```

322174

APPENDIX B: SURVEY AREA MAPS



JOB DETAILS

Job Number:	-
Product:	Helimag survey
Aircraft Type:	AS350B
Aircraft Rego:	VH-HBA
Pilot:	
Operator:	UTS
Line Spacing	100 m
Line Direction	090 - 270 deg

5 cm

MAP DETAILS

Grid North

Projection: AMG84
Sheet 1 of 1
Scale 1: 100000

0 1000 2000 3000 4000 5000 6000 7000 8000 9000

Drawn: / /
Checked: / /
Approved: / /

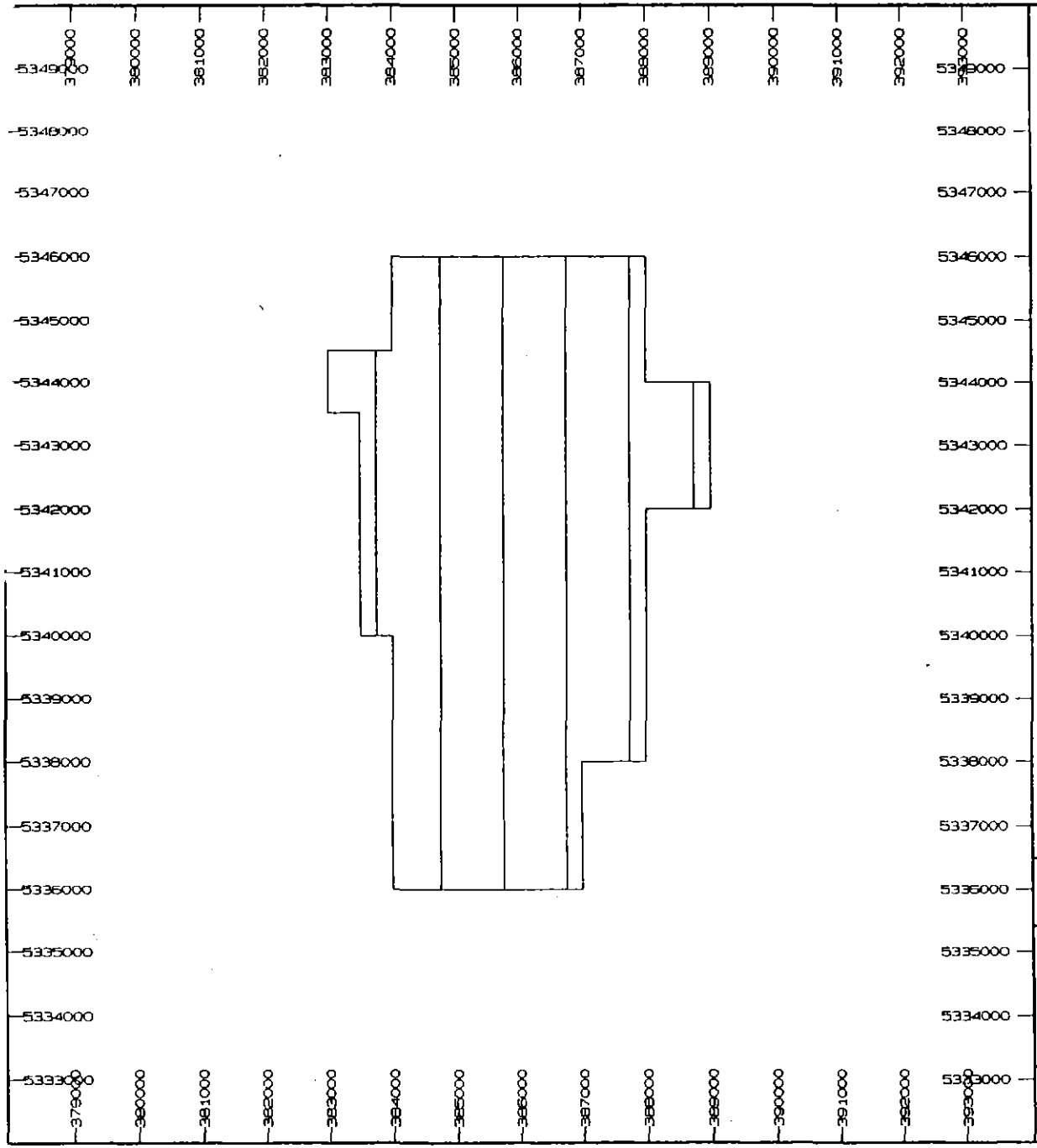
Plotted by Universal Tracking Systems Flight Block Plotter

GOLD MINES OF AUSTRALIA

MOUNT LYELL

Flown by: U.T.S.
Job: Mount Lyell
Flight Date:

322175



JOB DETAILS

Job Number:	-
Product:	Helimag Survey
Aircraft Type:	AS350B
Aircraft Rego:	VH-HBA
Pilot:	
Operator:	UTS
Line Spacing	1000 m
Line Direction	000 - 180 deg

5 cm

MAP DETAILS

Grid North

Projection: AMG84
Sheet 1 of 1
Scale 1: 100000

0 1000 2000 3000 4000 5000 6000 7000 8000 9000

Drawn: / /
Checked: / /
Approved: / /

Plotted by Universal Tracking Systems Flight Block Planner

GOLD MINES OF AUSTRALIA

MOUNT LYELL (TIE LINES)

Flown by: U.T.S.
Job: Mount Lyel Tie Lines
Flight Date:

32211

383 000 384 000 385 000 386 000 387 000 388 000 389 000

5346 000
5345 000
5344 000
5343 000
5342 000
5341 000
5340 000
5339 000
5338 000
5337 000
5336 000

AIRBORNE SURVEY SPECIFICATIONS

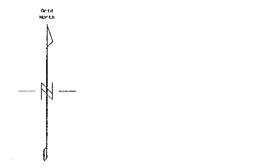
Flight Line Direction:	090 - 270 degrees
Flight Line Separation:	100 metres
Tie Line Direction:	000 - 180 degrees
Tie Line Separation:	1000 metres
Mean Terrain Clearance:	40 metres
Sample Interval:	3-4 metres
Navigation:	Differential GPS
Survey Flown:	February 1995

AIRBORNE SURVEY EQUIPMENT

Acquisition:	UTS Geophysics
Aircraft:	AS350B Helicopter
Magnetometer:	Geometrics G-833 Helium
Resolution:	0.001 nT
Sensitivity:	0.001 nT
Recording Interval:	10 Hz
Compensation:	RMS AADC II Compensator

PROCESSING DETAILS

Diurnal levelling applied
Tie line levelling applied
Verticle scale: 50nT/cm



0 200 400 600 800 1000 1200 1400
Scale 1: 10000

UTS Geophysics

5 cm

95-3804

LINDA ANNUAL REPORT 1995-96 EL 52/94
COPPER MINES OF TASMANIA N.L.
WILLIS K.A.J. CORDERY G.R. VOL 5 OF 5

COPPER MINES OF TASMANIA PTY LTD

A.C.N. 065 339 835

MT LYELL - TASMANIA - EL 52/94

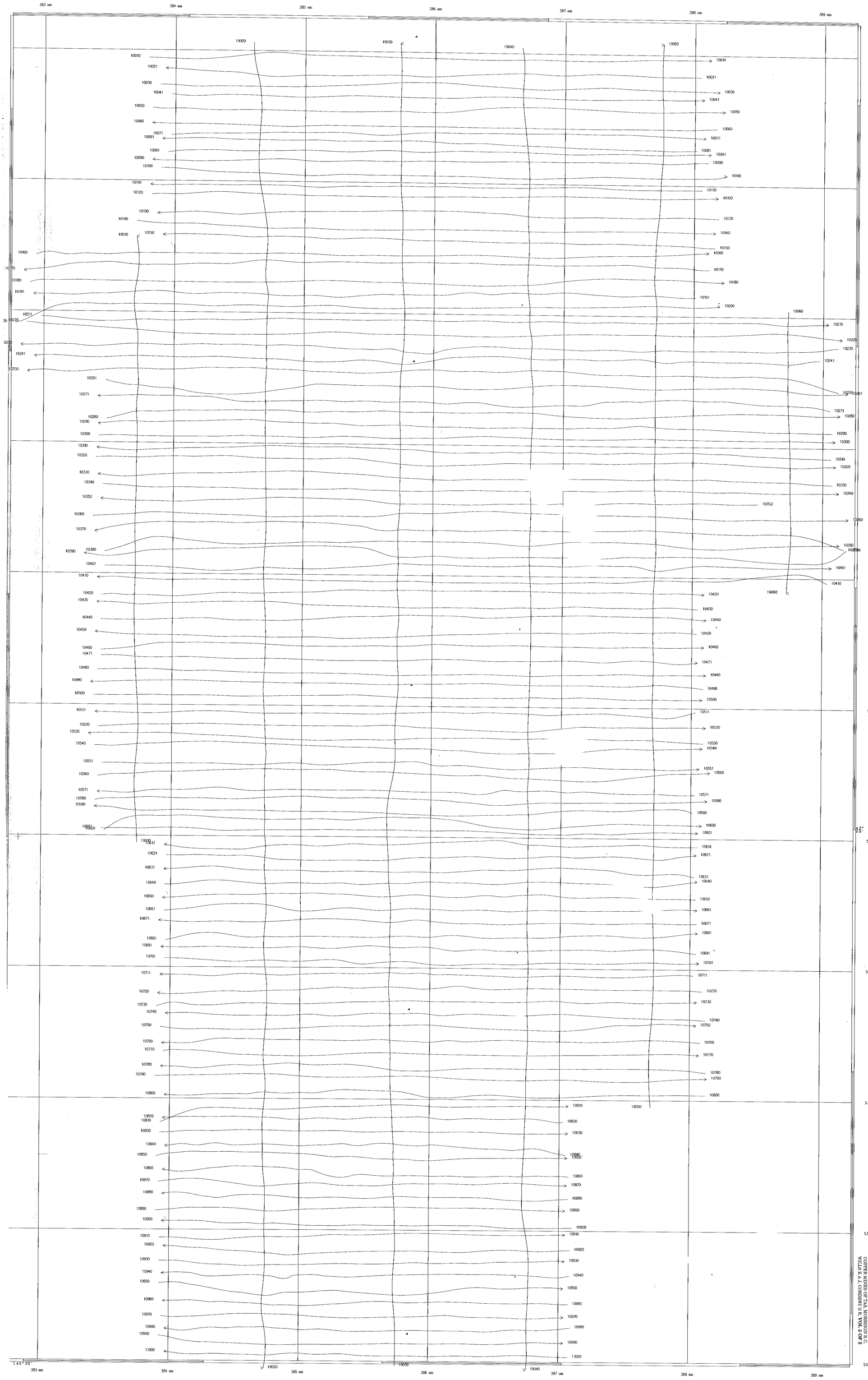
DETAILED HELI-MAG SURVEY

TMI PROFILE MAP

322177

DRAWN: UTS GEOPHYSICS	SCALE: 1: 10000
DATE: 30 JUNE 1995	JOB: A062

LI-1000



AIRBORNE SURVEY SPECIFICATIONS

Flight Line Direction:	090 - 270 degrees
Flight Line Separation:	100 metres
Tie Line Direction:	000 - 180 degrees
Tie Line Separation:	1000 metres
Mean Terrain Clearance:	40 metres
Sample Interval:	3-4 metres
Navigation:	Differential GPS
Survey Flown:	February 1995

AIRBORNE SURVEY EQUIPMENT

Acquisition:	UTS Geophysics Pty Ltd
Aircraft:	AS350B Helicopter
Magnetometer:	Geometrics G-833 Helium
Resolution:	0.001 nT
Sensitivity:	0.001 nT
Recording Interval:	10 Hz
Compensation:	RMS AADC II Compensator

PROCESSING DETAILS

Diurnal levelling applied
Tie line levelling applied

Grid North

0 200 400 600 800 1000 1200

Scale 1: 10000

UTS Geophysics

5 cm

95-3804

322178

LINDA ANNUAL REPORT 1995-96 EL 52/94
COPPER MINES OF TAS; MORRISON K.C.
WILLS K.A.J. CORDERY G.R. VOL 5 OF 5

COPPER MINES OF TASMANIA PTY LTD

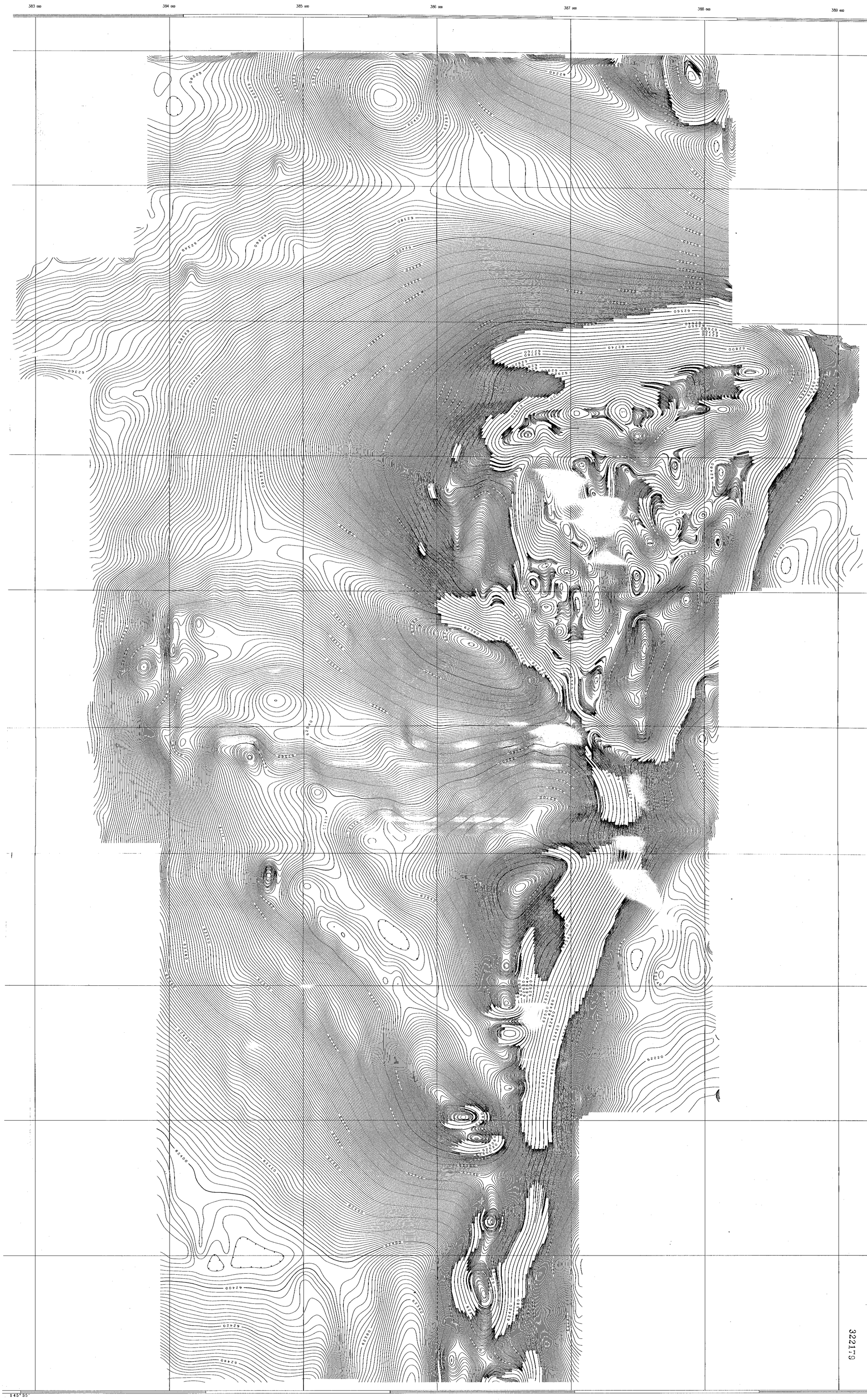
A.C.N. 065 339 835

MT LYELL TASMANIA - EL 52/94

DETAILED HELICOPTER SURVEY

FLIGHT PATH MAP

DRAWN: UTS GEOPHYSICS	SCALE: 1: 10000
DATE: 22 JUNE 1995	JOB: A062 LT-1001



AIRBORNE SURVEY SPECIFICATIONS

Flight Line Direction:	090 - 270 degrees
Flight Line Separation:	100 metres
Tie Line Direction:	000 - 180 degrees
Tie Line Separation:	1000 metres
Mean Terrain Clearance:	40 metres
Sample Interval:	3-4 metres
Navigation:	Differential GPS
Survey Flown:	February 1995

AIRBORNE SURVEY EQUIPMENT

Acquisition:	UTS Geophysics Pty Ltd
Aircraft:	AS350B Helicopter
Magnetometer:	Geometrics G-833 Helium
Resolution:	0.001 nT
Sensitivity:	0.001 nT
Recording Interval:	10 Hz
Compensation:	RMS AADC II Compensator

PROCESSING DETAILS

Diurnal levelling applied
Tie line levelling applied

Grid cell size:	25mE x 25mN
1st contour interval:	2nT
2nd contour interval:	20nT
3rd contour interval:	200nT
4th contour interval:	2000nT

Grid North

0 200 400 600 800 1000 1200

Scale 1: 10000

UTS Geophysics

5 cm

95-3804

32179

LINDA ANNUAL REPORT 1995-96 EL 52/94
COPPER MINES OF TAS, MORRISON K.C.
WILLS K.A.J. CORDERY G.R. **VOL 5 OF 5**

COPPER MINES OF TASMANIA PTY LTD

A.C.N. 065 339 835

MT LYELL TASMANIA - EL 52/94

CONTOUR MAP OF

TOTAL MAGNETIC INTENSITY

DRAWN: UTS GEOPHYSICS	SCALE: 1: 10000
DATE: 30 APRIL 1995	JOB: A062 LI-1002

322180

APPENDIX 3

SAMPLE DESCRIPTIONS & ASSAY DATA

EL 52/94

Sample Locations and Descriptions

Sample No.	Sample type	Location	Description
0544	Rock chip (Paly)	4060E, 2010N	soft clayey grey black shale - outcrop
545	A/A	4060, 2010	A/A
546	A/A (Assay)	4060, 2010	A/A
547	A/A	4060, 2010	A/A
548	A/A	4180, 2020	soft, clayey brecciated black shale - outcrop
549	A/A	4180, 2020	A/A
550	A/A	4180, 2020	A/A
551	A/A	4920, 1490	A/A
552	A/A	4900, 1450	Black shale, vein quartz melange + pyr, sphal - float.
553	A/A	4900, 1450	Haematitic quartz wacke - float
554	A/A	4910, 1380	black shale with quartz veins - outcrop
555	A/A	4910, 1380	black shale - outcrop
556	A/A (Paly)	4910, 1380	A/A
557	A/A	4870, 1240	Humic siltstone in glacial sediments - outcrop
558	A/A (Assay)	4870, 1240	A/A
559	A/A	4860, 1200	fresh, blue grey bedded limestone - outcrop
560	A/A (Paly)	4880, 1260	Humic siltstone in glacial sediments - outcrop
561	A/A (Assay)	4880, 1260	A/A
563	A/A	4300, 2360	Ferricrete on ferug. clay, sand - outcrop
564	A/A	4300, 2360	vein quartz in ferricrete nodules - outcrop
565	A/A	4370, 2340	brecciated vein quartz, concretionary ferricrete - outcrop
570	A/A	6370, 1300	fresh laminated micritic limestone - outcrop
571	A/A	6210, 1380	A/A
572	A/A	6120, 1410	interbedded black shale >

95-3804

LINDA ANNUAL REPORT 1995-96 EL 52/94
COPPER MINES OF TAS, MORRISON K C,
WILLS K A J, CORDERY G R, VOL 5 OF 5

573	A/A	6120, 1410	fresh micritic limestone - outcrop
574	A/A	5780, 1660	soft, laminated black shale - siltstone - outcrop
575	A/A	5780, 1660	A/A with Redox contact - outcrop
576	A/A	5780, 1660	siltstone with vein quartz - outcrop
577	A/A	5330, 1690	interbedded black shale - limestone - outcrop
578	A/A	5330, 1690	massive micritic limestone - outcrop
579	A/A	5220, 1690	planar bedded, partly weathered limestone - outcrop
580	A/A	5160, 1680	fresh laminated micritic limestone - outcrop
581	A/A	5160, 1680	Interbedded micrite carbonaceous marl - outcrop
582	A/A	4900, 1680	soft clayey deformed black shale
583	A/A	4900, 1680	A/A
584	A/A	4970, 1640	Fresh micritic limestone, calcite, quartz vein stockwork - outcrop
586	A/A	7090, 1060	quartz vein stockwork on fault zone - outcrop
587	A/A	7080, 1060	A/A
588	A/A	7070. 1060	A/A
589	A/A	7070, 1070	A/A
590	A/A	7060, 1070	A/A
591	A/A	7050, 1070	A/A
592	A/A	7050, 1080	A/A
593	A/A	7040, 1090	A/A
594	A/A	7030, 1090	A/A
595	A/A	7020, 1100	A/A
596	A/A	6100, 1410	black shale with fossils, pyrite - float
597	A/A	4320, 2350	Nodular ferricrete on ferrug,. clay, sand - outcrop
598	A/A	4050, 2030	soft, brecciated blackshale - outcrop
599	A/A	3610, 2600	ferricrete band in Pioneer sst - outcrop
0600	A/A	3610, 2600	green mica altered fine-med sst - outcrop
0001	A/A	3800, 2070	soft clayey black shale - outcrop
002	A/A	3800, 2070	A/A
003	A/A	3690, 2090	A/A

004	A/A	3690, 2090	A/A
005	A/A	3690, 2090	ferricrete band on laminated black shale - outcrop
006	A/A	3690, 2090	A/A
007	A/A	3630, 2140	ferricrete band in glacial seds near contact - outcrop
008	A/A	3630, 2140	A/A
009	A/A	3630, 2140	Soft clayey black shale - outcrop
010	A/A	3600, 2160	A/A
011	A/A	3770, 2050	ferricrete in glacial gravels - outcrop
012	A/A	3740, 2090	ferricrete in black shale - outcrop
013	A/A	5690, 1630	ferricrete on shale - sst contact - outcrop
014	A/A	3520, 1750	brecciated black shale - outcrop
015	A/A	3520, 1750	A/A
016	A/A	4910, 1490	black shale, vein quartz, minor pyrite - float
017	A/A	4910, 1460	carbonaceous, bioturbated sst - outcrop
018	A/A	4900, 1450	black shale, vein quartz, pyrite - float
019	A/A	4900, 1440	black shale, quartz sphal, galen, pyrite - float
020	A/A	4910, 1420	vein quartz with boxwork texture, trace shale - outcrop
021	A/A	4900, 1400	vein quartz in deformed black shale - outcrop
022	A/A	4890, 1330	brecciated black shale with quartz, pyrite, sphal, galena - outcrop
023	A/A	4890, 1330	A/A
024	A/A	4420, 0910	black shale, weathering to pug - outcrop
025	A/A	3570, 1850	dense ferricrete on ferrug, clays - outcrop
026	A/A	3570, 1850	low density porous ferricrete concretions - outcrop
027	A/A	3560, 1850	blue grey laminated clayey shale - outcrop
028	A/A	3560, 1850	mottled clay, vein quartz under fericrete - outcrop
029	A/A	3540, 1840	ferricrete on clay - outcrop
030	A/A	3520, 1860	mottled laminated clay in nodules, trace copper salts - outcrop

031	A/A	3510, 1900	nodular ferricrete on clay - outcrop
035	Stream sed - (Assay)	4870, 1360	2 litre -2mm pan con.
036	A/A	4870, 1360	A/A
037	A/A	4900, 1440	2 litre -2mm pan con. - 1 speck vis gold.
038	A/A	4900, 1440	2 litre -2 mm BLEG
039	A/A	4900, 1440	2 litre -2 mm wet sieve -40#
040	A/A	4870, 1360	2 litre -2 mm BLEG
041	A/A	4870, 1360	2 litre -2 mm wet sieve -40#
042	A/A	3940, 2900	2 litre -2 mm BLEG
043	A/A	3940, 2900	2 litre -2 mm wet sieve -40#
044	A/A	3940, 2900	2 litre -2 mm pan con - 2 specks vis gold
045	A/A	4030, 3310	2 litre -2 mm wet sieve -40#
046	A/A	4030, 3310	2 litre -2 mm BLEG
047	A/A	4030, 3310	2 litre -2 mm pan con
048	A/A	5100, 2490	2 litre -2 mm wet sieve -40#
049	A/A	5100, 2490	2 litre -2 mm BLEG
050	A/A	5100, 2490	2 litre -2 mm pan con - 1 speck vis gold
051	A/A	4850, 2130	2 litre -2 mm BLEG
052	A/A	4850, 2130	2 litre wet sieve -40#
053	A/A	4850, 2130	2 litre -2 mm pan con
054	A/A	6690, 1510	2 litre -2 mm pan con
055	A/A	6690, 1510	2 litre -2 mm BLEG
056	A/A	6690, 1510	2 litre -2 mm wet sieve -80#
057	A/A	6690, 1510	2 litre -2 mm wet sieve -40#
058	A/A	6850, 1740	2 litre -2 mm pan con
059	A/A	6850, 1740	2 litre -2 mm BLEG
060	A/A	6850, 1740	2 litre -2 mm wet sieve -80#
061	A/A	6850, 1740	2 litre -2 mm wet sieve -40#
062	A/A	4900, 1440	2 litre -2 mm wet sieve -80#

REPORT FILE C0298

PROJECT : MT.LYELL
TYPE : PULP

LABORATORY : PERTH
GEOLOGIST : G.CORDERY
PREP. METHOD : P1
ANALYSIS METHOD : AU3,CU1
TENEMENTS : EL52/94

DATE PRINTED : 01-12-1995
SUBMITTED : 22/11/95
RECEIVED : 27/11/95
STORAGE : WAREHOUSE

MT.LYELL REGIONAL SAMPLES

SAMPLE NUMBER	AU4 PPB	AG1 PPM	AS1 PPM	BA1 PPM	CU1 PPM
1	24	<0.1	95	<50	13
2	8	<0.1	78	<50	156
3	2	<0.1	47	<50	125
4	36	0.60	76	<50	737
5	15	<0.1	109	<50	531
6	5	0.20	48	<50	23
7	1	0.90	392	<50	55
8	3	1.20	294	<50	282
9	3	<0.1	35	<50	30
10	3	0.80	35	<50	26
11	2	1.20	76	<50	46
12	<1	4.30	194	<50	275
13	<1	0.90	56	<50	<1
14	10	2.60	79	<50	55
15	4	3.90	56	<50	34
16	4	3.10	411	<50	18
17	5	2.10	57	<50	24
18	7	<0.1	181	<50	83
19	9	34.80	174	<50	304
20	<1	<0.1	57	<50	54
21	1	<0.1	98	<50	79
22	12	14.30	249	<50	143
23	260	9.80	326	<50	67
24	6	<0.1	73	<50	106
25	15	0.10	60	<50	170
26	1	0.70	68	<50	1048
27	1	<0.1	85	<50	758
28	24	0.60	1007	<50	1775
29	2	0.50	149	<50	20870
30	1	1.70	131	<50	14810
31	2	1.70	108	<50	34800
570	9	0.50	95	<50	152
571	7	1.50	99	<50	87
572	7	<0.1	98	<50	129
573	<1	<0.1	131	<50	92
574	<1	<0.1	86	<50	156
575	<1	<0.1	113	<50	225
576	1065	<0.1	159	<50	170
577	23	<0.1	75	<50	188
578	9	<0.1	60	<50	166
579	8	<0.1	132	<50	202
580	<1	<0.1	109	<50	178
581	9	<0.1	140	<50	180
582	4	<0.1	171	<50	136
583	1	<0.1	166	<50	4
584	<1	<0.1	58	<50	<1

REPORT FILE C0298

PROJECT : MT.LYELL
TYPE : PULP

LABORATORY : PERTH
GEOLOGIST : G.CORDERY
PREP. METHOD : P1
ANALYSIS METHOD : AU3,CU1
TENEMENTS : EL52/94

DATE PRINTED : 01-12-1995
SUBMITTED : 22/11/95
RECEIVED : 27/11/95
STORAGE : WAREHOUSE

MT.LYELL REGIONAL SAMPLES

SAMPLE NUMBER	MN1 PPM	MO1 PPM	PB1 PPM	ZN1 PPM
1	15	17	31	40
2	15	10	338	27
3	18	6	26	36
4	14	88	77	62
5	13	29	59	18
6	8	<1	26	16
7	11	25	8	37
8	22	5	22	70
9	13	29	39	14
10	15	<1	21	9
11	18	<1	11	30
12	18	34	44	1084
13	50	51	205	157
14	12	44	1794	26
15	11	<1	3108	24
16	28	55	1109	11730
17	20	<1	25	389
18	20	35	77	28570
19	24	52	4647	211000
20	37	42	943	1475
21	29	<1	4370	134
22	17	57	3968	211000
23	20	85	1248	152500
24	41	55	28	343
25	90000	51	22	4400
26	3610	89	56	4370
27	175	48	47	260
28	242	20	956	2266
29	21970	52	56	5350
30	954	38	194	776
31	27710	36	163	4390
570	216	61	14	33
571	130	63	11	31
572	68	56	18	59
573	86	9	11	38
574	13	24	20	43
575	26	67	27	194
576	431	55	76	629
577	74	65	19	53
578	108	39	13	29
579	278	78	23	55
580	186	25	11	30
581	231	45	18	53
582	20	71	182	587
583	19	37	451	811
584	511	10	12	33

REPORT FILE C0299

PROJECT : MT.LYELL
TYPE : ROCK

LABORATORY : PERTH
GEOLOGIST : G.CORDERY
PREP. METHOD : P1
ANALYSIS METHOD : AU3,CU1
TENEMENTS : EL52/94

DATE PRINTED : 01-12-1995
SUBMITTED : 22/11/95
RECEIVED : 27/11/95
STORAGE : WAREHOUSE

MT.LYELL REGIONAL SAMPLES

SAMPLE NUMBER	AU4 PPB	AG1 PPM	AS1 PPM	BA1 PPM	CU1 PPM
35	1	5.05	122	<50	<1
36	<1	0.50	63	<50	<1
37	52	0.80	81	<50	<1
39	1	<0.1	235	<50	655
41	<1	<0.1	182	<50	<1
43	<1	<0.1	136	<50	<1
44	2	<0.1	159	<50	7
45	2	<0.1	159	<50	44
47	24	<0.1	146	<50	3
48	1	<0.1	210	<50	<1
50	<1	<0.1	180	<50	<1
52	5	<0.1	174	<50	<1
53	<1	<0.1	196	<50	16
54	320	<0.1	233	<50	26
56	100	<0.1	188	<50	24
57	4	<0.1	192	<50	15
58	<1	<0.1	221	<50	10
60	5	<0.1	164	<50	44
61	1	<0.1	174	<50	22
62	4240	<0.1	173	<50	15

NUMBER OF SAMPLES REPORTED : 20

Rob Gregory
CHIEF CHEMIST

REPORT FILE C0299

PROJECT : MT.LYELL
TYPE : ROCK

LABORATORY : PERTH
GEOLOGIST : G.CORDERY
PREP. METHOD : P1
ANALYSIS METHOD : AU3,CU1
TENEMENTS : EL52/94

DATE PRINTED : 01-12-1995
SUBMITTED : 22/11/95
RECEIVED : 27/11/95
STORAGE : WAREHOUSE

MT.LYELL REGIONAL SAMPLES

SAMPLE NUMBER	MN1 PPM	MO1 PPM	PB1 PPM	ZN1 PPM
35	10	23	9	3830
36	10	4	2	469
37	49	28	10	2011
39	25	28	13	258
41	7	37	9	365
43	9	45	<1	6
44	19	<1	3	<1
45	9	22	2	3
47	13	29	<1	10
48	8	<1	1	4
50	10	<1	1	9
52	9	15	1	5
53	9	8	<1	1
54	200	1	23	55
56	190	90	26	65
57	206	53	16	57
58	70	55	19	15
60	50	3	4	17
61	36	27	12	5
62	32	56	16	663

NUMBER OF SAMPLES REPORTED : 20

Rob Gregory
CHIEF CHEMIST

REPORT FILE C0273

PROJECT : MT.LYELL
TYPE : PULP

LABORATORY : PERTH
GEOLOGIST : G.CORDERY
PREP. METHOD : P1
ANALYSIS METHOD : AU2
TENEMENTS : 1M/95

DATE PRINTED : 08-11-1995
SUBMITTED : 02/11/95
RECEIVED : 02/11/95
STORAGE : WAREHOUSE

MT.LYELL, ROCK SAMPLES

	SAMPLE NUMBER	AU2 PPB	AS1 PPM
* C	541	1	<5
* C	542	<1	8
* C	543	<1	<5
C	546	<1	22
C	547	<1	5
C	548	<1	31
C	549	<1	22
C	550	<1	<5
C	551	<1	103
C	552	<1	73
C	553	<1	6
C	554	<1	32
C	555	<1	104
C	558	<1	14
C	559	<1	7
C	561	1	21
* C	562	<1	18

NUMBER OF SAMPLES REPORTED : 17

Rob Gregory
CHIEF CHEMIST

REPORT FILE C0273

PROJECT : MT.LYELL
TYPE : PULP

LABORATORY : PERTH
GEOLOGIST : G.CORDERY
PREP. METHOD : P1
ANALYSIS METHOD : AU2
TENEMENTS : 1M/95

DATE PRINTED : 08-11-1995
SUBMITTED : 02/11/95
RECEIVED : 02/11/95
STORAGE : WAREHOUSE

MT.LYELL ROCK SAMPLES

		SAMPLE NUMBER	CU1 PPM	PB1 PPM	ZN1 PPM	AG1 PPM
*	C	541	7	8	3	<0.1
*	C	542	41	22	3	<0.1
*	C	543	8	6	1	<0.1
	C	546	8	105	17	<0.1
	C	547	12	75	28	<0.1
	C	548	7	106	15	<0.1
	C	549	7	398	188	<0.1
	C	550	18	13	7	<0.1
	C	551	13	516	160	<0.1
	C	552	47	253	404	<0.1
	C	553	15	8	72	<0.1
	C	554	19	135	86	<0.1
	C	555	17	143	90	<0.1
	C	558	20	38	7	<0.1
	C	559	6	4	9	<0.1
	C	561	99	7	<1	<0.1
*	C	562	82	4	<1	<0.1

NUMBER OF SAMPLES REPORTED : 17

Rob Gregory
CHIEF CHEMIST

* NOT ON EL 52/94

REPORT FILE C0298

PROJECT : MT.LYELL
TYPE : PULP

LABORATORY : PERTH
GEOLOGIST : G.CORDERY
PREP. METHOD : P1
ANALYSIS METHOD : AU3,CU1
TENEMENTS : EL52/94

DATE PRINTED : 01-12-1995
SUBMITTED : 22/11/95
RECEIVED : 27/11/95
STORAGE : WAREHOUSE

MT.LYELL REGIONAL SAMPLES

SAMPLE NUMBER	AU4 PPB	AG1 PPM	AS1 PPM	BA1 PPM	CU1 PPM
* 585	6	35.70	<5	<50	97000
586	<1	<0.1	36	<50	56
587	<1	<0.1	9	<50	<1
588	<1	<0.1	14	<50	<1
589	<1	<0.1	43	<50	<1
590	<1	<0.1	<5	<50	<1
591	<1	<0.1	11	<50	<1
592	1	<0.1	70	<50	<1
593	<1	<0.1	29	<50	<1
594	1	<0.1	56	<50	<1
595	1	<0.1	54	<50	<1
596	7	<0.1	63	<50	<1
597	1	2.80	262	131	18
598	2	0.10	17	<50	<1
599	<1	1.30	173	<50	1750
600	1	<0.1	63	82	634

NUMBER OF SAMPLES REPORTED : 62

Rob Gregory
CHIEF CHEMIST

* NOT ON EL 52/94

REPORT FILE C0298

PROJECT : MT.LYELL
TYPE : PULP

LABORATORY : PERTH
GEOLOGIST : G.CORDERY
PREP. METHOD : P1
ANALYSIS METHOD : AU3,CU1
TENEMENTS : EL52/94

DATE PRINTED : 01-12-1995
SUBMITTED : 22/11/95
RECEIVED : 27/11/95
STORAGE : WAREHOUSE

MT.LYELL REGIONAL SAMPLES

SAMPLE NUMBER	MN1 PPM	MO1 PPM	PB1 PPM	ZN1 PPM
* 585	111	24	25	117
586	44	24	8	3
587	42	76	<1	1
588	34	24	1	2
589	42	34	<1	<1
590	41	72	<1	<1
591	42	66	4	1
592	38	59	2	12
593	44	19	4	4
594	44	63	3	2
595	45	32	6	10
596	19	48	12	13
597	50930	51	14	2229
598	83	85	26	13
599	3819	77	72	618
600	74	23	22	17

NUMBER OF SAMPLES REPORTED : 62

Rob Gregory
CHIEF CHEMIST

ANALABS

ANALYTICAL DATA

CLIENT PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	104075.60.11328	03/11/95	C 0276	1 OF 3

SAMPLE	Cu GA140	Pb GA140	Zn GA140	Ag GA140	Au GG309	As HA140	As GA140	Al2O3 OX408	SiO2 OX408
0563	62	32	1065	<1	<0.008	>50.0	55	-	-
0564	22	319	235	<1	<0.008	11.0	-	-	-
0565	42	51	2135	<1	<0.008	>50.0	86	-	-
* 0566	-	-	-	-	-	-	-	0.52	2.56
* 0567	-	-	-	-	-	-	-	0.46	1.94
* 0568	-	-	-	-	-	-	-	0.56	3.23
DETECTION	2	3	2	1	0.008	0.5	50	0.05	0.05
UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	%

* NOT ON EL 52/94

322194

APPENDIX 4

PALYNOLOGY & ORGANIC CARBON DATA

322195

Palynology report

Seven samples were supplied for palynological processing. In each case a small amount of the sample was packaged and sent to Laola Pty Ltd in Western Australia for slide preparation. All samples contained some organic material, and the following report is based on that.

Five samples were effectively barren of palynomorphs, although some of these contained recognisable organic remains that may prove to be diagnostic. This will not be certain until more samples have been examined. All of these samples contained a very high proportion of black amorphous material. The sample numbers were 0544, 0545, 0556, 0557 and 0569. Among these, 0569 contained only black amorphous material, but upon cross checking this was the sample that had been finely crushed, and it may be that the recognisable organic fragments are present here but were destroyed by that process. Sample 0544 contained rare angiosperm pollen grains, but it is likely that this represents contamination and is not indicative of the age of the sample.

Sample 0557 contained abundant and diverse pollen and other plant remains and is clearly Quaternary sediment. Sample 0560 is similar, but not quite as diverse or abundant. Both samples are easily distinguished from the other five samples. There may be some modern contamination in these samples, but the abundance and diversity of pollen and other plant material is so high that any contamination would be undetectable.

In conclusion, these samples are relatively easily divided into two groups, which are best characterised as Quaternary (samples 0557 and 0560) and older (but so far of indeterminable age; samples 0544, 0545, 0556, 0557 and 0569). This latter group of five samples may be possibly further subdivided, but that would require further sampling and may still give a negative result.

R.S. Hill

95-3804

LINDA ANNUAL REPORT 1995-96 EL 52/94
COPPER MINES OF TAS, MORRISON K C,
WILLS K A J, CORDERY G R, **VOL 5 OF 5**

Analabs
Analabs Pty. Ltd.
ACN 004 591 664
52 Murray Road, Welshpool
Western Australia 6106
P.O. Box 210, Bentley, W.A. 6102
Telephone : (61 9) 4587999
Facsimilie: (61 9) 4582922

Order No: LA666
Project Code:
Report Date: 17/11/95
Report Status: Final
Page: 2 of 2

Job No: PE011371

ANALYTICAL DATA

Sample	P	Rb	TOC
* S41	275	33.2	--
* S42	421	110	--
* S43	<30	36.8	--
S46	--	--	1.50
S47	--	--	1.88
S48	--	--	2.92
S49	--	--	1.66
S50	--	--	0.11
S51	--	--	2.07
S52	--	--	2.20
S53	--	--	0.015
S54	--	--	1.77
S55	--	--	7.21
S58	--	--	3.38
S59	--	--	0.16
S61	--	--	4.20

* NOT ON EL 52/94

Method	GI201	GS201	OM618
Units	ppm	ppm	%
Detection Limit	30	0.05	0.005

Notes:
N.A. = not analysed
-- = element not determined
I.S. = insufficient sample
L.N.R. = listed not received