

CR 7887

ANNUAL REPORT FOR
EXPLORATION LICENCE 7254

WATERHOUSE RANGE, AMADEUS BASIN,
NORTHERN TERRITORY

FOR PERIOD FEBRUARY 26, 1993 TO
FEBRUARY 25, 1994.

Hermannsburg (SF 53-13), Henbury (SG 53-1),
Rodinga (SG 53-2) Sheets
24° 01' S 133° 25' E

H MUNTANION

FEBRUARY 1994

Tenement EL 7254 is held by:


BHP MINERALS PTY LTD
Level 3
3 Plain Street
EAST PERTH WA 6004

SCANNED

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SUMMARY

The WATERHOUSE RANGE tenement (EL 7254) held by BHP Minerals is located within the Amadeus Basin in the southern extreme of the Northern Territory. It covers part of an anticline of Cambrian and Ordovician sandstone, siltstone and carbonates which may be a favourable setting for base metal mineralization although obvious major faulting is lacking.

Work conducted for the period ending 25 February 1994 consisted of geochemical and geological follow-up of mild base metal anomalies and extension of the 1991 geochemical program. A total of 61 stream sediment, 4 soil and 22 rock chip samples were taken.

Two areas of patchy Cu-carbonate staining about 6 km apart and a few scattered litho geochemical anomalies were located, some of which are exposed in shallow pits. The mineralization which ranges up to 4.9% Cu, 6600 ppm Pb and 7600 ppm Zn is generally associated with Fe and often Mn enriched bands within recessive siltstone and sandstone units. Stream sediment sample results are suppressed but generally show a regional association with the mineralization.

Evaluation of the extent of the mineralized areas is warranted.

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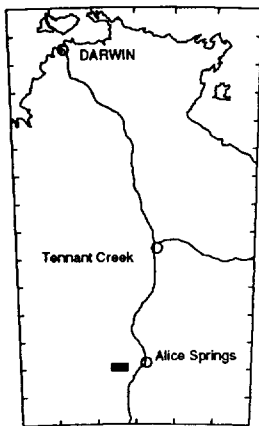
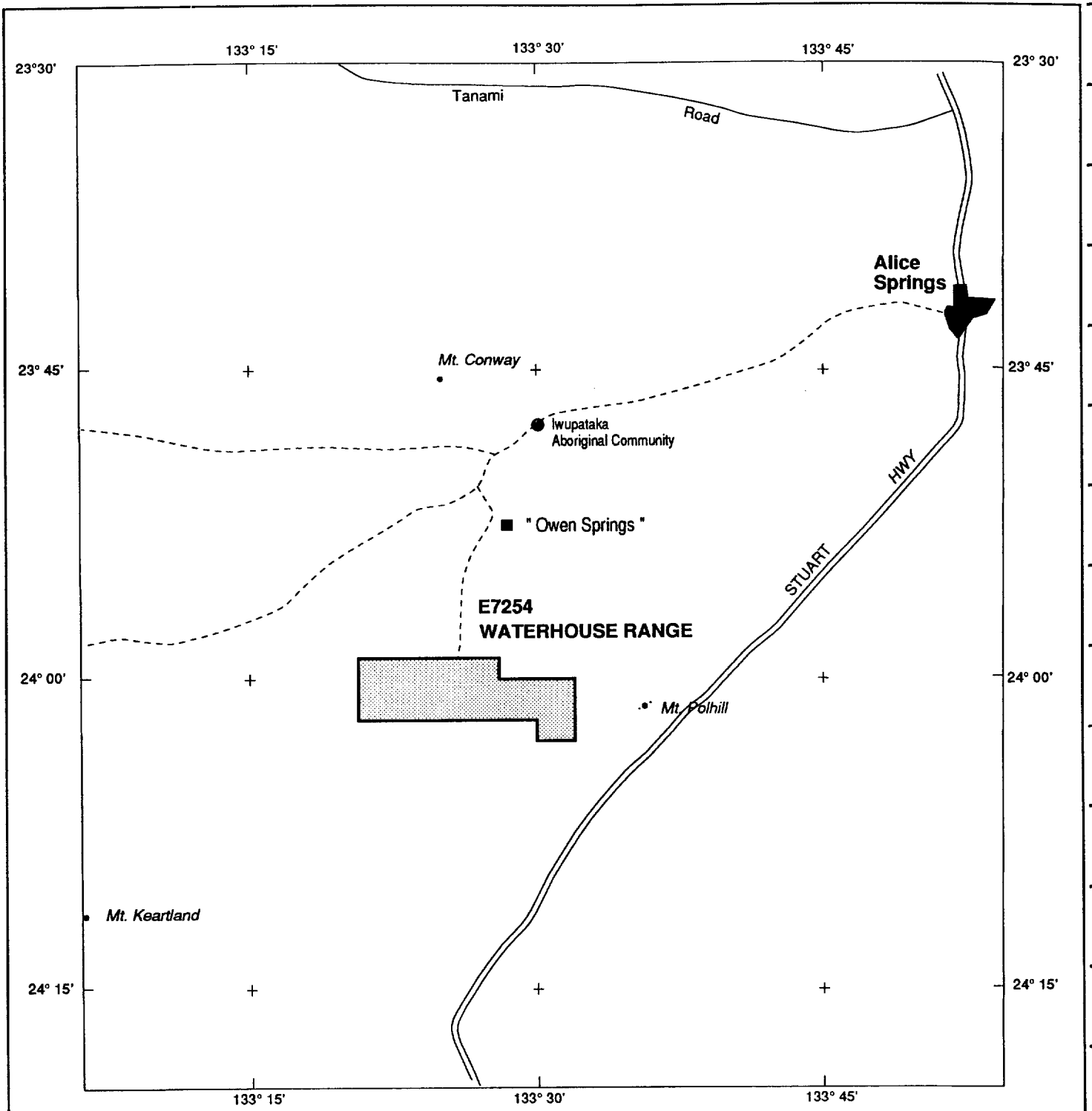
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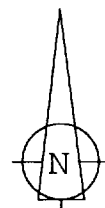
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LOCATION MAP



Scale 1 : 500 000



Microstation

Prepared :
Drawn : S.Shephard
Date : Nov 1992
Revised :


BHP Minerals Limited
 A.C.N. 008 694 782
 AMADEUS PROJECT N.T.
TENEMENT LOCATION
E7254 WATERHOUSE RANGE

Centre : Perth

A4-5454

FIGURE 1

1. **INTRODUCTION**

This report details sediment-hosted base metal exploration carried out by a BHP staff geologist and geological assistant for the year ending 25 February 1994 on the WATERHOUSE RANGE tenement, EL 7254, held by BHP Minerals.

The tenement is located within the Amadeus Basin in the southern extreme of the Northern Territory and covers part of an anticline of Cambrian and Ordovician carbonates, siltstone and sandstones.

The work which was conducted from 20 to 23 May 1993 consisted of geochemical and geological follow-up of anomalous base metal results and extension of a geochemical program conducted in 1991.

1.1 **Location and Access**

The WATERHOUSE RANGE tenement, centred on 24° 01' S latitude and 133° 25' E longitude is located about 50 km SW of Alice Springs (Figure 1). It is covered by the Hermannsburg (SF 53-13), Henbury (SG 53-1) and Rodinga (SG 53-2) 1:250,000 map sheets, the MacDonnell Ranges (5550), Peachy (5649) and James (5549) 1:100,000 topographic map sheets. In this area, 1:50,000 scale topographic maps with a photomosaic base are available (5550-2, 5649-4, 5549-1).

Portions of the tenement area are accessible by vehicle from Alice Springs along the sealed Stuart Highway and four wheel drive tracks. Due to the nature of the program and wet conditions access was by helicopter from Alice Springs.

1.2 Physiography and Climate

The exploration licence lies entirely within the Waterhouse Range which is a rugged east-west trending range of hills with a relief of about 120 m above a clay pan. The range consists of ridge-forming sandstone covered by recessive rock units. Elevations range from 560 m to 760 m.

The range is bisected by the Hugh River and is well drained. Drainages, however, are only poorly developed in the flat areas.

The area is covered by sparse tree growth. The region is arid with an annual rainfall of 245 mm most of which falls between November and March. Daily maximum average temperatures range from 21°C in June and July to 38°C in January.

1.3 Tenement Status

EL 7254, 100% held by BHP, was granted on 26 February 1991. The original tenement comprised 105 blocks. In 1993, it was reduced to 31 blocks (99.2 km²).

On January 1994, an application was made to relinquish an additional 15 blocks. If granted this would reduce the tenement to 51.2 km².

Expenditures for the year ending 24 February 1994 totalled \$17,924 (Appendix 1).

1.4 Previous Work

The area has been mapped by the Bureau of Mineral Resources (BMR) at a scale of 1:250,000 from 1956 to 1964 (Geological Series SF 53-13, SG 53-1, 53-2).

Le Nickel Exploration conducted work in the region in the early 1970's. The Owen Springs Cu prospect, possibly syngenetic in origin, is located in the northeast position of the tenement. Five holes were drilled with disappointing results. No other work appears to have been recorded although a few small costeans were found elsewhere exposing weak Cu oxide mineralization.

The Amadeus Basin has been a focus for oil exploration. Magellan Petroleum conducted widely spaced seismic surveys in 1965 and 1974. The Waterhouse 1 exploration well is located 2 km east of the current tenement boundary.

2. BHP WORK PROGRAMS

2.1 1991 Program

In 1991, BHP conducted a helicopter-supported drainage sampling survey over a number of tenements in the Amadeus Basin. On WATERHOUSE RANGE - 80 mesh samples were taken from 150 sites and BLEG (bulk cyanide leach) samples from 20 sites. Mildly anomalous results of 177 ppm, 130 ppm and 80 ppm Cu, 50 ppm Pb and 58 ppm Zn were obtained.

2.2 1993 Program

A four day field program was undertaken on the reduced WATERHOUSE RANGE tenement by BHP geologist H Muntanion and assistant D Russell. Due to wet conditions, most of the area was accessed by helicopter contracted from Heli Centre Pty in Alice Springs. Part of the southern area was accessed by vehicle.

The purpose of the exercise was to:

1. follow-up 6 low-order base metal anomalies obtained from the 1991 Amadeus Basin stream sediment program;
2. examine some of the geology to put these results in a geological context;
3. extend the survey north and south of the east-west trending anticline to test for the possible presence of bounding faults, although BMR aeromagnetic data do not indicate any faulting.

A total of 61 stream sediments and, 4 soil samples were taken. Most of the 22 rock chip samples exhibited weak Cu mineralization or anomalous Mn or Fe staining.

3. GEOLOGY

3.1 Regional Geology

The WATERHOUSE RANGE tenement is located in the Amadeus Basin, a Late Proterozoic to Carboniferous sedimentary intracratonic basin in central Australia.

It contains an estimated maximum 10,000 metres of shallow marine and continental sediments with minor volcanics. The succession thins westward over an arch of basement rocks to merge with the Canning and Officer Basins (Van de Graaff, 1990). It is deformed by extensive broad folding and thrusts with nappes along its northern and southern margins.

The stratigraphy (Figure 2) consists of a sequence of basal Late Proterozoic shelf, lagoonal and continental sediments interbedded with minor volcanics. There are unconformably overlain by Cambrian continental and shallow-marine sediments

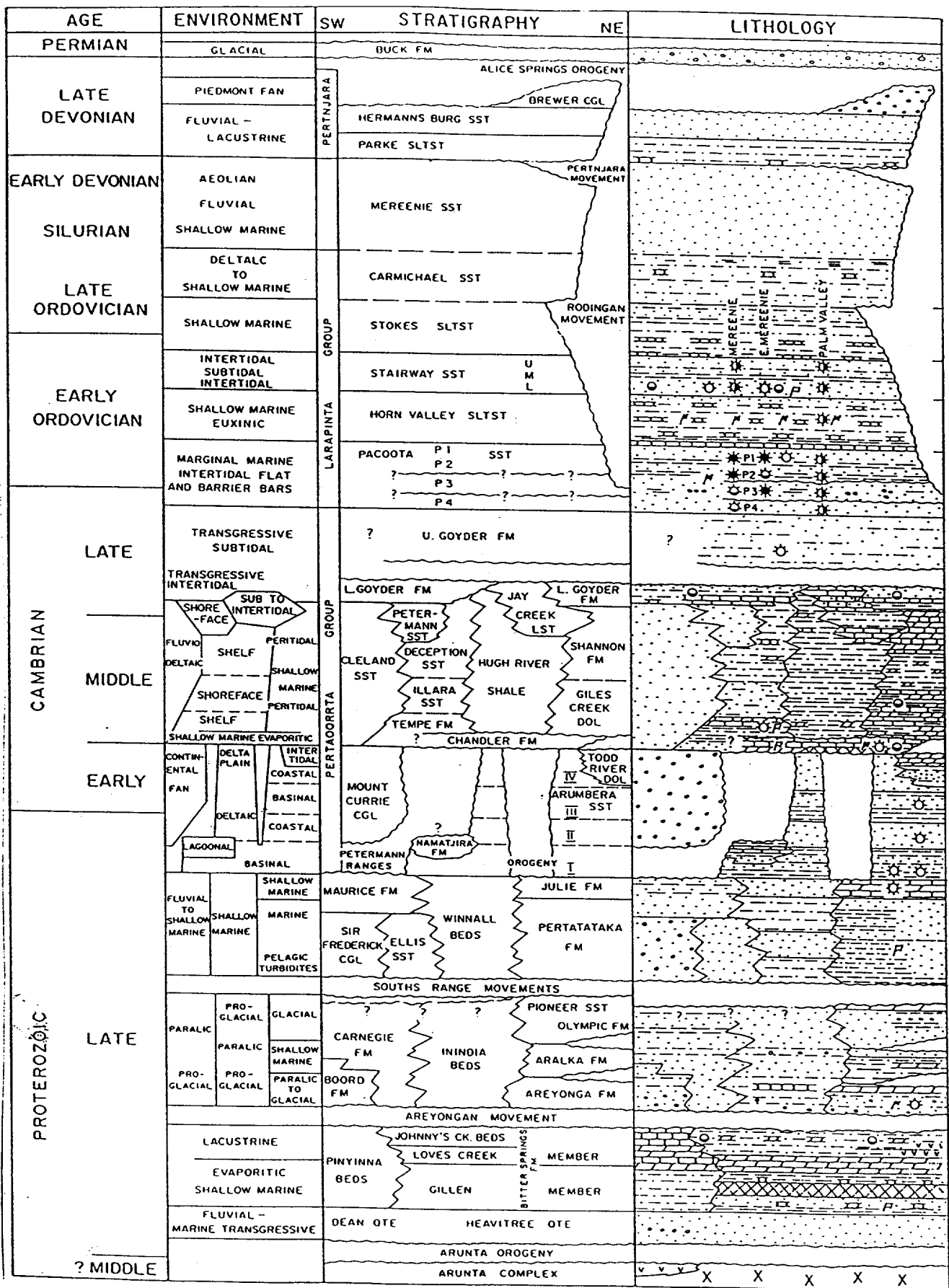


Fig. 2 Composite stratigraphic column of the Amadeus Basin (Weste, 1990).

including carbonates and evaporites. These are overlain in turn by Late Cambrian-Ordovician marine sediments that are unconformably overlain by continental sediments of the Devonian-Carboniferous (Stewart, 1992).

3.2 Waterhouse Range Geology

The local geology of the WATERHOUSE RANGE tenement is illustrated on Plate 1. The tenement covers part of an anticline consisting of ridge forming Cambrian to Ordovician sandstone (Pacoota and Mereenie Formations). The anticline is covered by Cambrian Jay Creek carbonates and Goyder Formation siltstones. The Goyder and Jay Creek Formations would be the most likely hosts for major sediment-hosted base metal deposition. The geology north and south of the anticline is unknown and covered by a clay pan. The strata strike east-west with shallow to moderate dips. No major faults are known or reflected in the aeromagnetic data.

Brief descriptions of the rock formations on the tenement are summarised below from Lindsay and Kennard (1991) and Nicoll et al (1991).

3.2.1 Jay Creek Limestone

The Jay Creek Limestone is a recessive unit and consists of algal and oolitic limestone, dolostone, siltstone and shale with a few interbeds of calcareous sandstone. In the tenement area up to several metres of Mn enrichment and semi-massive concentrations of FeO are exposed within this formation (eg. CV 4654, 4664, 4685).

3.2.2 Goyder Formation

The Goyder Formation is recessive and consists of sandstone, siltstone, algal dolomite and limestone. Although not noted on the tenement, bedding planes often

contain halite pseudomorphs. Fe and Mn enriched beds similar in character to those of the Jay Creek Limestone are also exposed (eg. CV 4609, 4678).

3.2.3 Pacoota Sandstone

The Pacoota Sandstone is gradational with the underlying Goyder Formation. It is unconformably overlain by the Mereenie Sandstone. It is predominantly a coarse-grained quartzose sandstone with thin interbeds of micaceous siltstone. The sandstone is commonly ferruginised, ripple-marked, cross-bedded and locally glauconitic. The siltstone is recessive and locally kaolinised. At sample site CV 4674 concretionary limonite with MnO is exposed in a recessive sandstone bed.

3.2.4 Mereenie Sandstone

The Mereenie Sandstone is fine-grained and strongly cross-bedded. Locally conglomerate lenses occur at the base.

3.3 Mineralization

During the follow-up, two areas of weak Cu-carbonate staining were found. These are about 6 km apart in an ENE-WNW direction and are situated along the inner limb of the anticline (Plate 1).

In the vicinity of 1991 sample site DD 6839 (44 ppm Cu), Cu staining, predominantly chrysocolla, was observed in shallow pits. The mineralisation is hosted by variably calcareous siltstone and fine-grained sandstone of the Jay Creek Formation (CV 4661-4664, Appendix 2). This is probably part of the Owen Springs Cu showing. The weak patchy mineralization is traceable for about 500 m, apparently oblique to bedding, and is associated with limonite and Mn enrichment. Locally Cu occurs as veinlets (CV 4661) and in Fe and Mn-stained

vugs (CV 4662). The Jay Creek Formation is known to be Pb-enriched near the base of the limestone.

Weak Cu staining occurs in glauconitic sandstone-siltstone of the Goyder and Pacoota Formations exposed in a 60 m long trench and in an adjacent showing of undetermined extent or orientation (CV 4649, 4650, 4656). This mineralization occurs upstream from a 130 ppm Cu value obtained in 1991 (DD 6848) near Haunted Tree Bore. Here host rocks are highly weathered and are locally clay altered.

Just south of the Haunted Tree Bore showing, in the core of the anticline, highly recessive Mn-enriched siltstone, interbedded oolitic dolomite and minor black shale occur. Mn and Fe enrichment is up to 8 m thick (CV 4653, 4654).

4. GEOCHEMISTRY

The 1993 geochemical sampling program consisted of 61 stream sediment, 4 soil and 22 rock chip samples collected mostly by helicopter (Plate 2). A number of the stream samples were taken just outside of the tenement but from streams draining the tenement.

A -80 mesh fraction was sieved on site for both stream sediment and soil samples. Approximately 200g was collected in a Kraft packet. Based on the 1991 work this size fraction proved to be more favourable than the -20 mesh. Rock samples averaging about 1 kg in weight were collected in cloth bags and crushed and sieved to -80 mesh in the laboratory.

All samples were analysed by Genalysis Laboratory Services in Perth for Cu, Zn, Pb, Mn and Fe using standard atomic absorption techniques. Results are presented in Appendix 3 and plotted on Plates 3 and 4.

4.1 Rock Chip Results

Of all the sample results, only the rock chip results can be considered highly anomalous. These are from patchy, generally weakly mineralized Cu showings, found as a result of follow-up of the previous stream sediment anomalies. The mineralized zones are described in section 3.3 and individual rock samples are described in Appendix 2.

Four rock chip samples taken across 900 m of Fe-enriched Jay Creek sandstone and siltstone in the Owen Springs showing area (CV 4661-4664) yielded results of 0.26% to 2.95% Cu (Plate 3). Two of the samples are significantly anomalous in Zn (1400 ppm, 2550 ppm) and weakly anomalous in Pb (220 ppm, 400 ppm). Two kilometres to the east the highest Pb and Zn results of 6600 ppm and 7600 ppm, respectively, along with 3500 ppm Cu were obtained from Pacoota sandstone with limonite and Mn concretions (CV 4674). Further to the east results of 1040 ppm Zn, 820 ppm Cu and 300 ppm Pb were recorded from a 3 m wide limonitic bed in Goyder Formation (CV 4678).

At the Haunted Tree showing, 6 km to the west-northwest of the Owen Springs showing, rock chip results of 4.90% Cu, 820 ppm Pb (CV 4656) and 3800 ppm Cu (CV 4649) were obtained. The only other significant lithochemical results were 820 ppm Zn, 380 ppm Pb and 480 ppm Cu across a 10 m width of limonitic Goyder Formation sandstone (38% Fe) from CV 4609 in the eastern extreme of the tenement.

4.2 Stream Sediment Results

Similar to the previous survey, only mildly anomalous results were obtained from the stream sediment survey. Only 3 samples are considered to be anomalous (> 35 ppm). Peak values are 76 ppm Cu and 45 ppm Pb (CV 4652). The highest Zn value is only 26 ppm (Plate 4).

Small clusters of anomalous drainage results are associated with the Owen Springs (DD 6833, 6837-6839) and Haunted Tree showings (DD 6845-6848, CV 4652).

Follow-up was not successful in locating sources for the 177 ppm 1991 Cu anomaly near the northeast tenement corner and the anomalous grouping along the western tenement boundary.

4.3 Soil Sample Results

Three of the 4 soil samples were collected from a trench in highly weathered siltstone in the northeast corner of the tenement (CV 4682-4684, Plate 3). Results are enriched in Fe (6.6%, 7.0%) and weakly elevated in Pb, Zn and Mn with up to 225 ppm, 180 ppm and 520 ppm, respectively. A nearby recessive Jay Creek dolomite and siltstone exposure yielded 42.0% Fe and 8200 ppm Mn (CV 4685).

5. CONCLUSIONS

Two areas of patchy Cu-carbonate staining, about 6 km apart, and a few scattered rock sample anomalies were located during the follow-up of weak drainage anomalies obtained from the 1991 survey. Grab sample results of up to 4.9% Cu, 6600 ppm Pb and 7600 ppm Zn were obtained. The mineralization is generally associated with limonite \pm Mn enriched, recessive siltstone and sandstone units. Continuity of the mineralized zones has yet to be established.

Stream sediment results show a regional association with the mineralized zones but values are suppressed. Peak values obtained during the two sampling campaigns are only 177 ppm Cu and 50 ppm Pb.

Although both the Jay Creek and Goyder Formations can be considered to be prospective hosts for Sedex or stratiform Cu deposits, the potential may be somewhat downgraded because of the apparent lack of a major fault zone.

6. **RECOMMENDATIONS**

Initially, an attempt should be made to trace the extents of the Cu, Pb and Zn mineralization. Restricted soil surveys may be required to explore the recessive areas. If results are positive, selective ground EM and percussion drill testing can be undertaken (Appendix 4).

7. **REFERENCES**

KENNARD, J.M. and LINDSAY, J.F., 1991. Sequence stratigraphy of the latest Proterozoic-Cambrian Pertaoorrta Group, northern Amadeus Basin, central Australia. Geological and geophysical studies in the Amadeus Basin, central Australia. BMR Bulletin 236.

NICOLL, R.S., GORTER, J.D. and OWEN, M., 1991. Ordovician sediments in the Waterhouse Range Anticline, Amadeus Basin, central Australia : their interpretation and tectonic implication. Geological and geophysical studies in the Amadeus Basin, central Australia. BMR Bulletin 236.

STEWART, A.L., 1992. Annual Report for EL 7254 for the period 1 March 1991 to 31 January 1992. BHP Report CR 7430.

APPENDIX 1

E7254 - WATERHOUSE RANGE

26 February 1993 to 25 February 1994

Wages and Salaries	\$7,289
Field Support	2,747
Vehicles	837
Equipment	67
Aircraft Charter	3,131
Geochemistry	577
Surveys	56
Office Expenses	73
In-House Services: Geochemistry	160
Sub-Total	14,937
20% of Total for Corporate Overheads	2,987
TOTAL	\$17,924

APPENDIX 2

APPENDIX 2

Geological Notes

SAMPLE	FORMATION	LITHOLOGY	OBSERVATIONS
CV 4604	Mereenie?	Sandstone	Weakly feldspathic. 4% detrital haematite, MnO. Some Mn on bed planes. Strike 090°/20°S.
CV 4605	Pacoota	Qtzitic sandstone interbeds of fine sandstone	Weak cross-beds. Strike 090°/65°S.
CV 4608	Pacoota	Sandstone	Weak haematite.
CV 4609	Goyder? (Pacoota?)	Sandstone	Strongly haematitic for ~ 10 m width.
CV 4610	Pacoota	Qtzitic sandstones	Fine-medium grain, recessive. 3% glauconite. Fine, interstitial limonite.
CV 4611	Pacoota? Mereenie?	Sandstone (50 m to N is conglomeritic sandstone)	Weathered - some original clay content? Strike 090°/65°S.
CV 4612	Pacoota? Mereenie?	Quartzite Gradational with conglomerate.	4 m width with interstitial haematite.
CV 4615	Goyder	Sandstone	Strongly weathered with clay. 10 cm width of massive haematite.
CV 4616	Pacoota?	Sandstone (Float in creek)	Medium grained. Interstitial MnO.
CV 4633	Goyder	Sandstone	Medium grained ≥ 10 cm thicknesses of semi-massive haematite beds. Some cross-cutting haematite veins.
CV 4649	Pacoota	Sandstone-Siltstone	Heavily weathered from 60 m trench. Cm scale haematite-limonite beds. Glauconitic bed. Clots of acicular malachite. Strike 055°/35°NW.
CV 4650	Pacoota	Sandstone-Siltstone	Same trench as CV 4649. Heavily weathered. Glauconitic.

SAMPLE	FORMATION	LITHOLOGY	OBSERVATIONS
CV 4653	Jay Creek	Interbedded siltstone, oolitic dolomite, quartzitic sandstone, minor black shale	All units recessive Mn, haematite enriched bed 8 m thick. Strike 084°/60°N.
CV 4654	Jay Creek	Black Shale	Very recessive. Haematite enriched.
CV 4656	Goyder	Sandstone? Siltstone?	Highly weathered, recessive, bleached, clay altered. Clots of chrysocolla.
CV 4661 CV 4662	Jay Creek? (Pacoota?)	Sandstone-calcaneous siltstone	From small pit. Ripple marked. Patchy Cu stain (chrysocolla) over 20 m ² area. Mm scale Cu veinlets associated with strong limonitic and MnO veinlets. Strike 090°/50°N.
CV 4663 CV 4664	Jay Creek? Jay Creek? (Pacoota?)	Sandstone	4-5 m wide semi-massive limonite zone with minor MnO. Weak chrysocolla.
CV 4674	Pacoota?	Sandstone	Fine-grained, ripple marked. Recessive. Concretionary limonite with MnO.
CV 4678	Goyder?	?	3 m bed of semi-massive limonite.
CV 4685	Jay Creek	Dolomite Sandstone	Very fine-grained, recessive. Few m wide bed of semi-massive haematite with MnO.

APPENDIX 3

ANALYTICAL RESULTS

ELEMENTS	Mn	Fe	Cu	Zn	Pb
UNITS	ppm	%	ppm	ppm	ppm
DETECTION	1	0.01	1	1	5
METHOD	C/AAS	C/AAS	C/AAS	C/AAS	C/AAS

SAMPLE NUMBERS

1	CV4604-177um	102	1.08	3	14	X
2	CV4606-177um	62	0.86	2	10	10
3	CV4607-177um	70	0.82	3	8	5
4	CV4614-177um	70	1.40	11	18	30
5	CV4617-177um	68	1.00	4	11	5

6	CV4618-177um	155	1.45	4	23	5
7	CV4619-177um	120	1.04	3	12	X
8	CV4620-177um	145	1.06	3	12	X
9	CV4621-177um	94	1.40	4	15	5
10	CV4622-177um	108	1.18	3	15	X

11	CV4623-177um	130	1.30	1	15	X
12	CV4624-177um	120	1.45	7	18	5
13	CV4625-177um	68	0.96	X	7	X
14	CV4626-177um	74	0.96	3	11	5
15	CV4627-177um	72	1.20	3	10	X

16	CV4628-177um	116	1.30	4	17	X
17	CV4629-177um	94	1.16	4	15	X
18	CV4630-177um	400	* 1.55	11	20	30
19	CV4631-177um	116	1.35	3	9	X
20	CV4632-177um	64	0.96	3	11	X

21	CV4634-177um	45	0.88	1	14	X
22	CV4635-177um	140	1.35	8	14	10
23	CV4636-177um	68	1.40	5	10	5
24	CV4637-177um	82	1.12	2	10	5
25	CV4638-177um	102	1.60	2	11	5

26	CV4640-177um	205	1.80	4	23	10
27	CV4641-177um	82	1.02	3	13	X
28	CV4642-177um	90	1.06	2	10	X
29	CV4643-177um	70	1.08	3	9	5
30	CV4644-177um	106	1.25	3	16	5

31	CV4645-177um	155	1.65	11	15	5
32	CV4646-177um	64	1.14	3	7	X
33	CV4647-177um	86	1.30	5	11	5
34	CV4648-177um	86	1.25	1	8	X
35	CV4651-177um	80	1.20	11	15	5

36	CV4652-177um	86	1.12	76	* 18	45
37	CV4655-177um	84	1.30	1	10	5
38	CV4657-177um	86	1.60	9	25	15
39	CV4658-177um	96	1.40	6	12	5
40	CV4659-177um	54	0.98	2	7	X

APPENDIX 4

APPENDIX 4

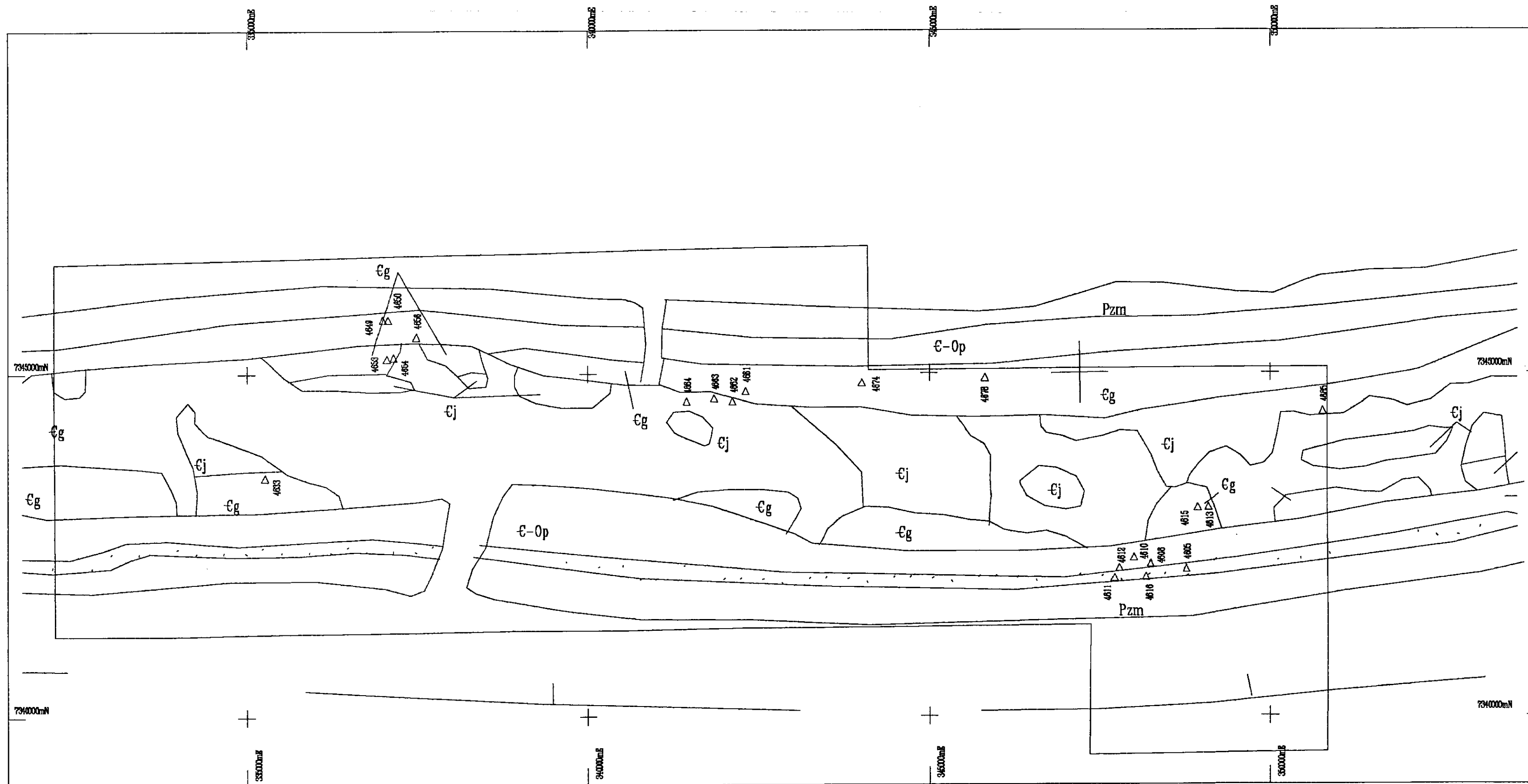
**PROPOSED EXPLORATION EXPENDITURES
for the year Ending February 25, 1995**

Program

1. Geological evaluation of the mineralized areas.
2. Soil Sampling on grids of approximately 300 m x 50 m and selective rock sampling.
3. With positive results, selective ground EM surveys and/or percussion drilling maybe undertaken.

Proposed Expenditure

1.	4 Geological crew days @ 4 days x \$500	\$ 2,000
2.	5 Soil sampling crew days @ 5 days x \$400 200 samples @ \$15	\$ 2,000 \$ 3,000
3.	Helicopter Support 16 hours @ \$300	<u>\$ 4,800</u>
	TOTAL:	\$11,800




▲ Rock Chip Sample

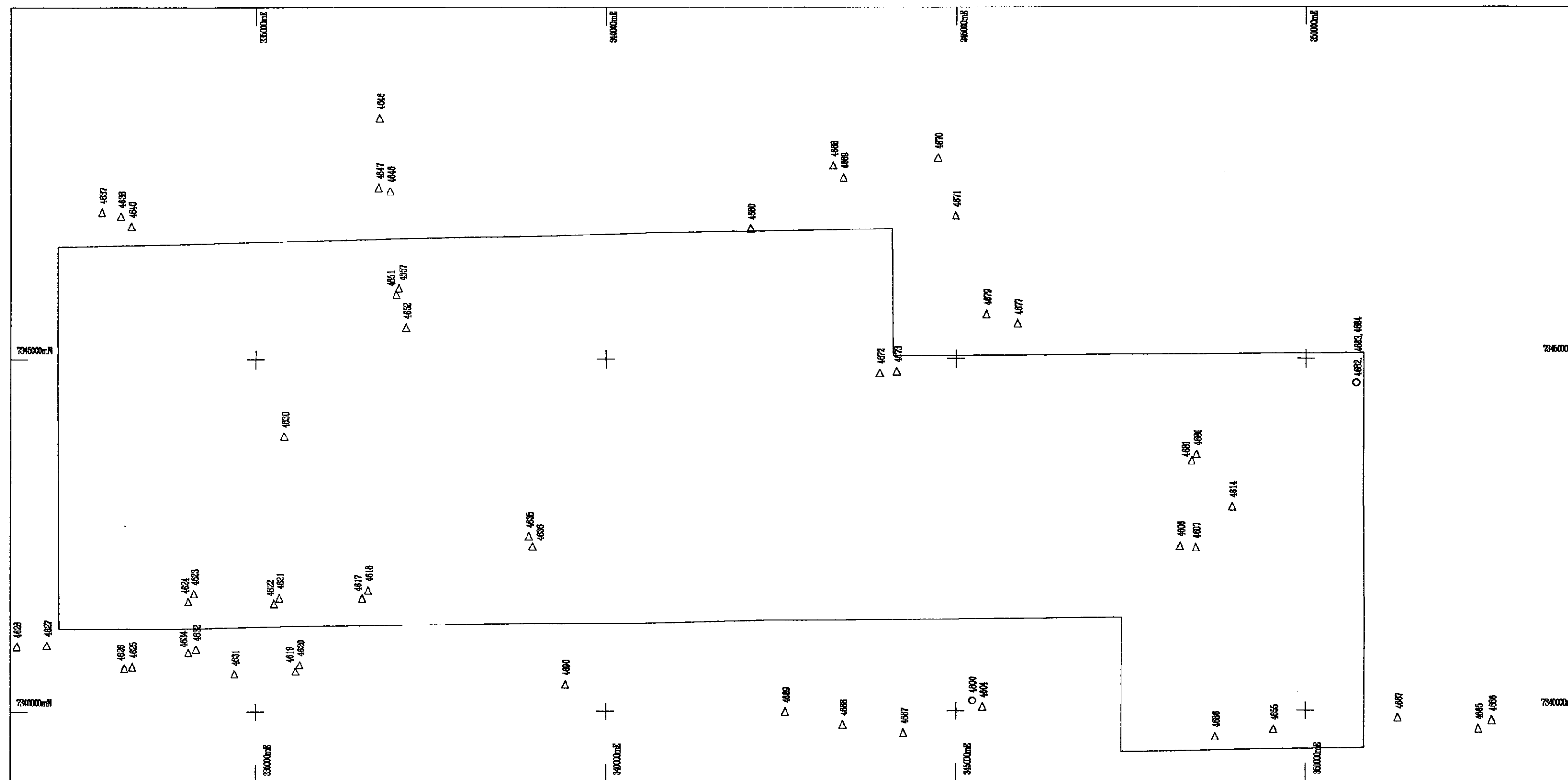
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Universal Transverse Mercator Projection

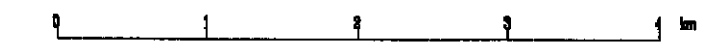
 BHP Minerals Pty. Ltd. A.C.N. 008 694 782	
Carpentaria Group EL 7254 Rock Chip Samples Waterhouse Range Annual report 1993	
Prepared: AJH	Date: 11/03/1994
Drawn: AJH	Revisions: 1
Centre: Perth	Dwg. No: 2
PLATE 1	



○ Soil Sample
 △ Stream Sediment Sample

CR94/259

Scale 1:50000



Universal Transverse Mercator Projection


 BHP Minerals Pty. Ltd. A.C.N. 008 694 782	
Carpentaria Group EL 7254 Stream Sediment & Soil Samples Waterhouse Range Annual report 1993	
Prepared: AJH	Date: 11/03/1994
Drawn: AH	Revisions: 1
Centre: Perth	Dwg. No.: 1

PLATE: 2