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SML 321 AND ML 5076

JUBILEE RANGE

PROGRESS AND FINAL REPORTS TO LICENCE SURRENDER FOR THE PERIOD 16/6/1969 TO 27/9/1970

Submitted by
Noranda Australia Ltd
1970

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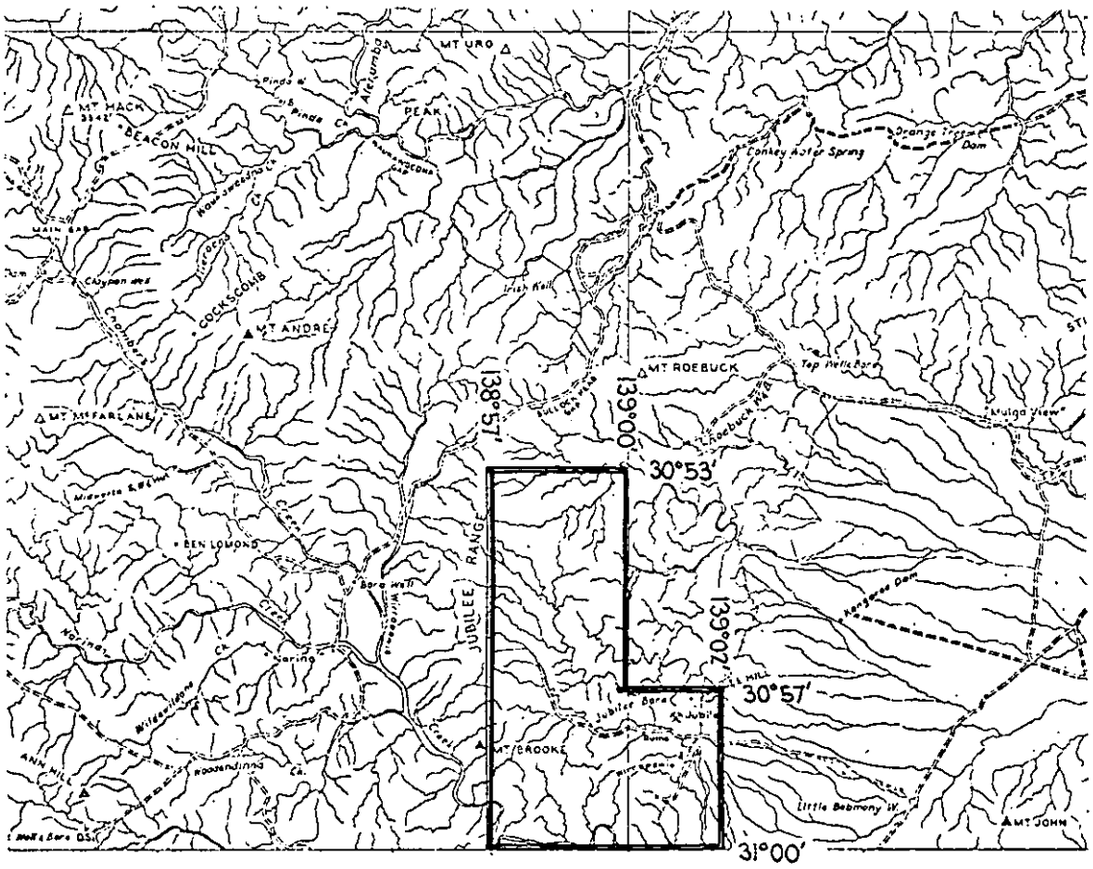

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NORANDA AUSTRALIA LTD.

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LOCALITY

S.M.L. No. 321 EXPIRY DATE 15·6·70

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TENEMENT: S.M.L. 321

TENEMENT HOLDER: Noranda Australia Ltd.,
Jubilee Range.

REPORTS:

ENV 1194

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NORANDA AUSTRALIA LIMITED

SPECIAL MINING LEASE NO, 321

JUBILEE RANGE, SOUTH AUSTRALIA

Report for six months ended January 16, 1970

1. INTRODUCTION

Special Mining Lease No. 321 of 35 square miles was granted to Noranda Australia Limited for a period of 12 months from June 16, 1969. The Lease covers an area in the Flinders Ranges on the immediate eastern flanks of the Jubilee Range. A condition of the lease was that full technical reports would be furnished every six months.

This report outlines the progress made with exploration of the area in the period of six months ended January 16, 1970.

Interest was aroused in the area after a routine inspection was carried out of the Pindar Springs Lead Mine on Mineral Lease No. 5076 owned and worked by Mr. A. Winckel, of Blinman. Mr. Winckel is handpicking high grade lead ore from a narrow east dipping transgressive fault vein within dolomitic siltstones and shales of the Wonoka Formation. The vein can be traced for a length of several hundred feet in a north-south direction and contains lenticular developments of coarse galena in a quartz matrix. Vein widths vary from two to a maximum of 18 inches. Within the same mineral lease but a little north of the lead workings Mr. Winckel has dug a shallow pit on a small gossanous outcrop containing a well-defined boxwork structure after galena. Assays of the material gave values of 17 to 29 per cent zinc, and the zinc silicate, willemite, was recognised as a narrow seam in one section. The boxwork and mineralisation are within a narrow vein structure in khaki-coloured shales.

While the extent of the veins at the Pindar Springs Mine is very limited, it was decided to carry out a regional geochemical survey to evaluate the general potential of the beds in this area for base metals.

2. WORK CARRIED OUT

Work commenced in late December 1969 when preparations were made for two students to carry out the geochemical survey under the supervision of Noranda geological staff in the New Year.

A geochemical orientation survey was carried out by company geologist Mr. A.C. Dunlop. He collected 34 samples of stream sediment material from creeks draining the vicinity of the Pindar Springs Lead Mine. The results are shown on the accompanying sketch plan, 14 samples being taken downstream from the zinc mineralisation (sample numbers prefixed JW) and 20 samples downstream from the lead workings.

Samples were sent to McPhar Geophysics Pty. Ltd. in Adelaide for size and geochemical analysis for copper, lead and zinc.

Since the Christmas break camp has been set up near the Jubilee Bore, two miles south of the Pindar Springs Mine, and regional geochemical stream sediment sampling has been commenced.

It is also proposed to map the geology of the area on photo scale, in sufficient detail to permit interpretation of the geochemical results.

3. ORIENTATION GEOCHEMISTRY

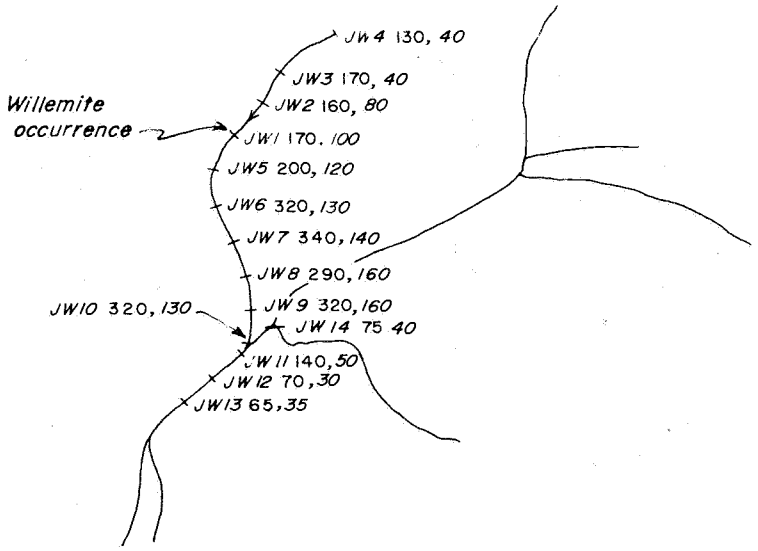
The main purpose of the preliminary sampling was to determine the best mesh size through which to sieve the stream sediment samples. Department of Mines work in the Adelaide Hills (Binks) had previously drawn attention to the dominance of mechanical weathering and transport over chemical solution and dispersal of base metals, particularly of copper.

The sample results obtained at Pindar Springs do not shed much light on the behaviour of copper, as no anomalous copper situation appears to occur there. However, anomalous values were obtained for both zinc and lead. The metal train from both willemite and galena occurrences extends for not less than 1000 feet, and it appears likely that a regional sample interval along subsidiary creeks of 1000 feet would rate an excellent chance of picking up any anomalous metal indications of significance.

For zinc the maximum metal occurs in the coarser sieve fractions from 20 to 80 mesh size suggesting that the minerals present may well be the harder zinc silicates - values for fine mesh fall away rapidly. Lead on the other hand reports very markedly in the finest mesh sizes, presumably by result of mechanical disintegration of the very brittle mineral. A lower but still anomalous lead level obtains in the coarse mesh sizes so it was decided to take all samples and sieve to -20 plus 80 before pulverisation and geochemical analysis. When following up any anomalous zinc area, the -80 mesh sample could then be retained.

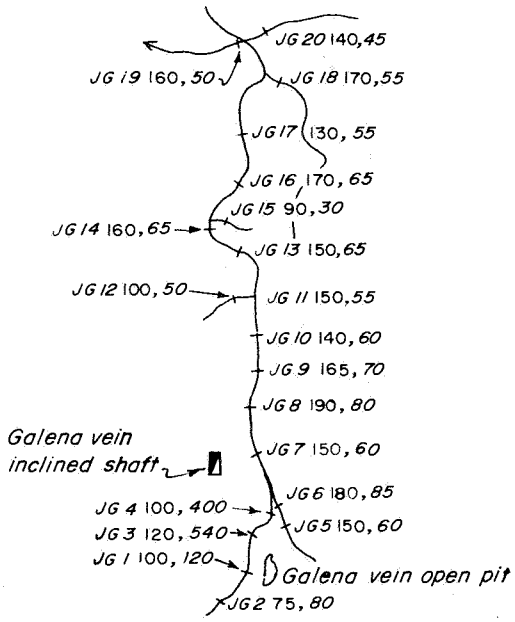
G. C. Batty
for A. Thomas
Staff Geologist

AT:MC
13/1/70



WILLEMITE BEARING MINERALISATION

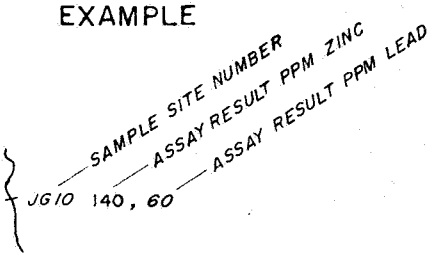
SCALE : 1" = 1000 ft.
(Approx.)



GALENA VEIN LOCALITY

SCALE : 1" = 1000 ft.
(Approx.)

EXAMPLE



NORANDA AUSTRALIA LIMITED		
SML 321 JUBILEE RANGE South Australia		
ORIENTATION GEOCHEM. SURVEY		
Date: Jan. '70	Geochem: A.Dunlop	Drawn: G.C.
Approved: T.A.R.		Dwg. No. 321-E-201

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SPECIAL MINING LEASE NO. 321

JUBILEE RANGE, SOUTH AUSTRALIA

REPORT FOR SIX MONTHS ENDED JUNE 16, 1970.

Report No. 146 August 1970

By

A.C. DUNLOP
C.P. DUNLOP

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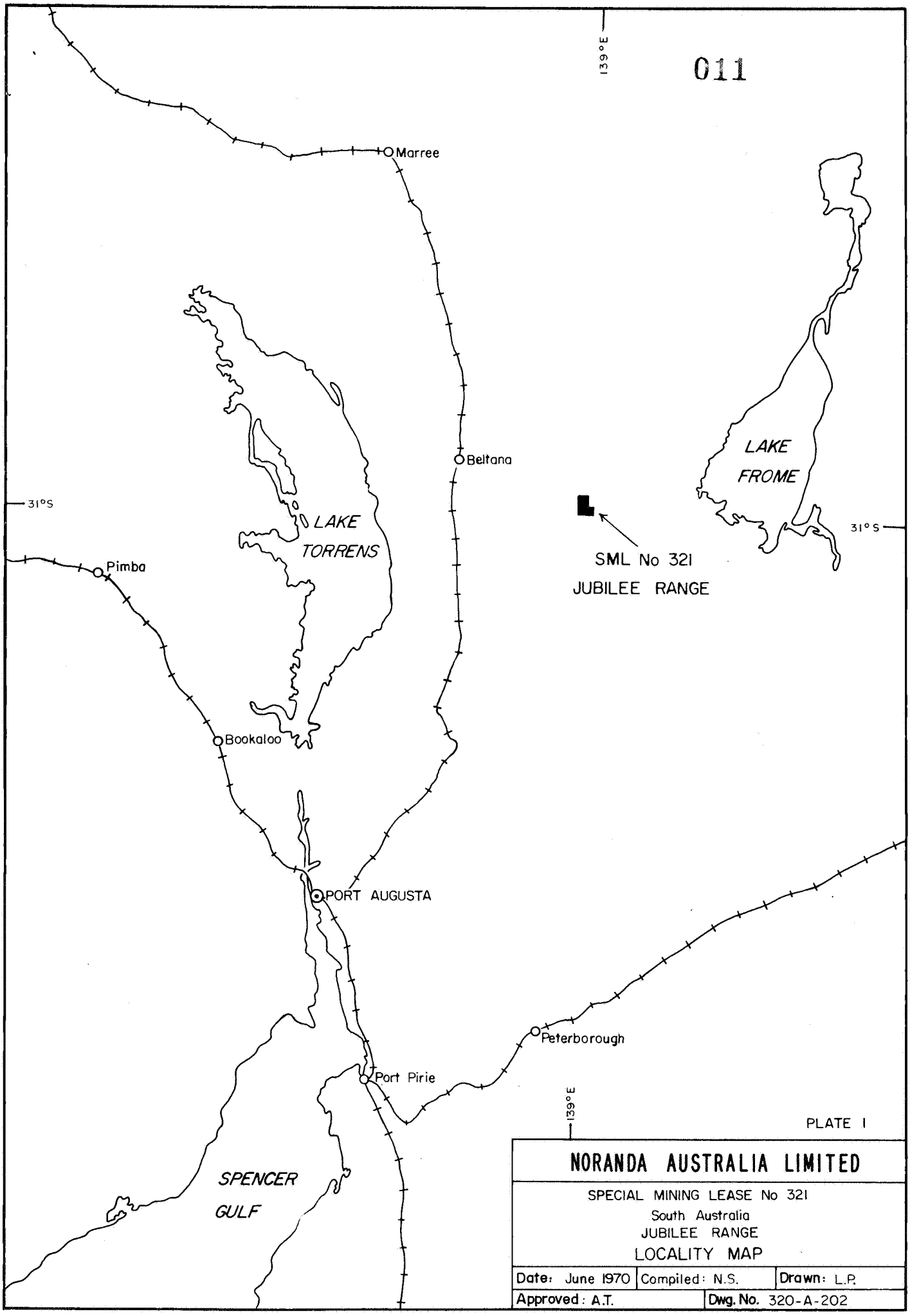

PLATE I

NORANDA AUSTRALIA LIMITED

SPECIAL MINING LEASE No 321
South Australia
JUBILEE RANGE
LOCALITY MAP

Date: June 1970	Compiled: N.S.	Drawn: L.P.
Approved: A.T.	Dwg. No. 320-A-202	

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SUMMARY

1. A geochemical stream silt sampling programme was carried out over Special Mining Lease 321.

2. Regional mapping of the area was undertaken.

3. Sixteen Copper, Lead or Zinc anomalies were located and prospected.

4. Mineralisation is restricted to small veins and fissures (often associated with small scale faulting) with small disseminations in adjacent sediments.

5. No anomalies represented mineralisation of economic quantity.

6. It is recommended that S. M. L. 321 be relinquished.

1. INTRODUCTION

1.1 Location

Special Mining Lease No. 321 is 'L' shaped and covers 35 square miles. It lies approximately 35 miles east-north-east of Blinman and is accessible by a maintained road through Angorigina, Point Well, Narina and Pinda Springs. A track branching from this road about two miles east of Pinda Springs homestead runs south through the length of the lease and provides easy vehicle access.

1.2 Physiography

The area consists of a series of hills trending in a north-south direction but sweeping round to an east-west direction in the south. The type of hill varies with the rock type. On the far south-west and on the west beyond the lease boundary the Pound Quartzite produces particularly rugged and resistant high hills (Mt. Brooke) whilst the underlying Wonoka limestones form rugged dissected hills though not so high. These two series of hills form the eastern edge of the Jubilee Range. Dividing this range from the wide series of high, but less rugged, hills formed on the east by the A. B. C. Range equivalent is a central area of low, rolling hills which become taller in the south.

The drainage in the area is dominantly west to east, commencing as frequent, narrow, steeply gullied creeks in the Jubilee Ranges. These converge in the central area of low relief, into less frequent streams with few tributaries and broader valleys. These streams have cut through the eastern hills and are joined by the numerous tributaries draining from the hills. The main creek has a steep sided valley and a wide valley floor containing large boulders which suggest that at times these creeks must be strong and rapid. All drainage continues to the east and eventually drains into Lake Frome.

The climate of the area is characterised by hot, dry summers when the maximum temperature is often well over 100°F, and hot, dry winds blow from the north and west. The climate during the winter months is moderate with cold nights and warm days. Strong winds are again common but usually cold and dry. Rain generally comes in the form of short storms resulting in fast flowing creeks, though these soon subside once the rain stops.

Vegetation is generally sparse except for short sticky trees with little foliage which grow on the quartzite and shales. Along stream courses there are tall eucalypts and dense stands of short, scrubby

bushes. Small mobs of sheep find sufficient grasses and short feed. Surface water is extremely rare but two bores provide suitable drinking water for stock. Rainfall results in particularly fast re-growth of short fleshy herbage and grasses though these usually die off unless further rain follows.

1.3 Initial Investigation

The attention of Noranda Australia Limited was first directed towards this area by Mr. A. Winckel who invited us to examine his mineral claim (No. 5076) which occurs over the Pinda Springs lead mine. On April 11, 1969, Staff Geologist Mr. A. Thomas visited and inspected the prospect. He concluded that the mine itself would be too small to interest Noranda but noted the presence of high grade zinc silicates similar to those at the Beltana prospect. He then recommended that application be made for a Special Mining Lease surrounding the mine and extending southwards to the Jubilee Copper Mine group. Subsequently Noranda Australia Limited was granted Special Mining Lease No. 321 for the purpose of exploration for base metals.

1.4 Present Investigation

Following an orientation stream silt sampling survey it was decided to undertake a similar comprehensive survey over the whole area in order to determine any anomalous copper, lead or zinc zones. At the same time two geologists prepared a detailed regional map of the area, to be used in conjunction with the geochemical results and also inspected any previously known mineral occurrences. Anomalous zones of interest were then followed up and examined.

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2. GEOLOGY.

2.1 Previous Geological Work

SML 321 has been mapped by the S. A. Mines Department and is covered by the Arrowie and Cadnia 1 mile sheets.

2.2 Current Geological Work

The area has been mapped at a scale of 0.4 miles to the inch. The resultant map is in broad agreement with the South Australian Mines Department Geological Survey mapping. The stratigraphic nomenclature has been drawn up following Dalgarno and Johnson J.E. (1964).

2.2.1 Stratigraphy

Table.

				Stratigraphic Nomenclature for S.M.L.
Cainozoic	Quarternary		Recent Pleistocene	Alluvium and outwash. Gravels and Silts.
Palaeozoic		Lower Cambrian	Hawker G.P.	Wilkavillina Limestone. Parachilna Formation.
Proterozoic		Marinoan	Wilpena G.P.	Pound quartzite (equivalent) Wonoka Formation. Bunyeroo Formation. A.B.C. Range quartzite. Brachina Formation.

Brachina Formation - this formation outcrops in the north-east point of S.M.L. 321 and consists of green, purple ripple marked shales, with minor quartzites and brown siltstones.

A.B.C. Range Quartzite - typical A.B.C. Range Quartzite is absent in this area but its stratigraphic equivalent occurs forming a belt of low hills on the eastern side of the road. It contains brown laminated siltstones and ripple marked micaceous shales with narrow arkosic quartzite bands and a thick prominent quartz sandstone at the top.

Bunyeroo Formation - this formation has mild relief forming a valley between the A.B.C. Range quartzite and the overlying Wonoka Formation. It contains green, grey and khaki shales and siltstones and red and purple finely laminated shales. The wearing dolomite also occurs within this formation. This member contains a narrow dolomite band (<2' thick). This dolomite band contains blebs of chalcopyrite within the dolomite and in the networks of calcite veins. The dolomites are set in green shales and siltstones. The wearing dolomite member is under and over lain by purple shales. Both the dolomite and the enclosing shales suffer local lensing out. The upper purple shales grade into the Wonoka Formation.

Wonoka Formation - this formation forms a steep belt of hills in the west and south west of the area. It contains calcareous purple and grey green shales with flaggy grey and purple dolomitic limestones (finely laminated) becoming dominant higher in the formation. Some limestones are weakly pyritic.

Pound Quartzite - this quartzite forms rugged strongly outcropping hills which make up the core of Jubilee Range. It contains purple cross bedded felspathic sandstones grading into massive red and white quartzite at the top.

Parachilna Formation - this formation outcrops poorly on the south margins of S.M.L. 321. It takes the form of a fine friable sandstone with shale lenses.

Wilkawillina Limestone - This formation outcrops strongly forming rugged hills in the far south of the S.M.L. It consists of massive blue grey limestones, with a sandy basal unit.

2.2.2. Structure

The Wilpena and Hawker Group sediments in this area have not suffered any form of metamorphism and are relatively underformed. The sediments generally dip to the west at 15 - 30 degrees. There is an anticlinal structure and a minor associated synclinal structure in the south portion of the area. The huge area of the anticlinal structure has been strongly faulted along the north east - south west axis with distinctive offsets of the pound quartzite (which forms the anticlinal core. Elsewhere minor transgressive faults generally in a north east - south west direction with occassional east south east - west north west) with small offsets, can be seen in the Banyeroo and Wonoka Formations.

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3. MINERALISATION

Three particular localities within Special Mining Lease No. 321 have at some stage been worked for minerals. These are the Pinda Springs silver lead mine, the Jubilee copper mine and the old Wirrapowie copper mine.

Pinda Springs Mine - Exploration has revealed that the two main mineral occurrences are on two north east - south west faults.

Jubilee Mine - This mine occurs in the south east portion of S. M. L. 321. The mine consists of a shaft and several shallow pits which have been sunk on several narrow transgressive veins in shales of the Bunyeroo Formation. The main vein contains quartz, siderite and chalcopyrite while smaller veinlets carry quartz and galena. These Cu and Pb occurrences are too small to be of interest.

Wirrapowie Mine - This mine occurs in the south of S. M. L. 321 south east of Mt. Brooke. At the mine two inclined shafts have been sunk to a depth of 140 feet, and five shallow pits have been dug in a steeply dipping mineralised quartz vein. These diggings occur over a length of about 2, 000 feet and are associated with a major fault structure between the Pound Quartzite and the Wonoka Formation. The mineralised vein varies from 6 inches to 18 inches in width with some secondary dispersion of malachite and azurite into the adjacent shales and quartzites. Mineralisation along the fault structure is very eratic with only a small proportion of the 2, 000 feet mineralised (as far as can be seen at the surface). Mineralisation is of the quartz chalcopyrite type with the development chalcocite and malachite and azurite round cores of chalcopyrite (suggesting miners hand picked secondary chalcocite). Water was encountered at 140 feet in lower grade chalcopyrite and operations ceased. Records suggest that gold and silver may be present in minor proportions. This copper occurrence is of no economic interest.

As well as the three worked mines there are two other mineral occurrences associated with particular rock types - the Wearing Dolomite and the Wonoka Formation.

The Wearing Dolomite - the Wearing Dolomite member represents an example of weak stratiform copper mineralisation which although interesting is of no economic significance.

A persistant, narrow (<2 feet) dolomite horizon consistently contains blebs and veinlets of chalcopyrite and pyrite far below economic grade. In many areas there has been migration of copper into the shales immediately adjacent to the cupriferous dolomite horizon, giving rise to a malachite coating in joints and parting planes (there is no evidence of any primary mineralisation).

The Wonoka Formation - In some areas adjacent to faults the dolomitic limestones and calcareous shales of the Wonoka Formation contain minor copper mineralisation in the form of pyrite chalcocite (primary?) and chalcopyrite. The copper mineralisation occurs mainly as blebs but occasionally as veinlets. The limited size and grade precludes this type of prospect from economic interest. The best example of this type of Cu occurrence occurs on the northern most north east - south west fault which passes through the zinc lode of the Pinda Springs Mine. The Cu occurs in the Wonoka Formation 3/4 mile west of the mine.

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4. GEOCHEMISTRY

4.1 Stream Sediment Sampling

4.1.1 Orientation Survey

On December 17, 1969 an orientation survey was conducted to obtain information for a general stream silt sampling programme. Two stream systems were sampled, one draining a small willemite vein occurrence, and the other draining the main galena veins at the Pinda Springs Ag-Pb mine. Both are worked by Mr. A. Winckel, who allowed sampling within his mineral claims. Silt samples were collected at 200 feet intervals adjacent to mineralised areas, till a confluence with a major stream was reached. Small streams draining nearby barren rocks were also sampled.

All samples were forwarded to McPhar Geophysics in Adelaide. From each original silt sample 7 samples were taken representing all fractions and +20, -20, -40, -80, -120 and -200 mesh fractions. Each sample was then analysed for Cu, Pb and Zn by atomic absorption spectrometry following a hot 25% HNO_3 leach for one hour on a 0.25 gm sample. The results are shown for
(a) Willemite occurrence (Area 1) - Tables 1, 2 & 3 and Fig. 2
(b) Galena occurrence (Area 2) - Tables 4, 5 &6 and Fig. 4.

These results indicate -

(i) Willemite mineralisation is reflected in stream silt samples to confluence with major streams.

(ii) The coarser size fractions are most effective, indicating a mechanical transport of metal content as suggested by Binks (1969) and others for this arid type of environment. Though the -200 mesh Pb values show marked increase over other size fractions, particularly about the main galena vein at the Pinda Springs mine, this may be a solution effect associated with the mine workings. As testing of other Pb anomalies in the Special Mining Lease showed no enrichment in the -200 fraction and have low cold extractable Pb/total Pb ratios.

(iii) Though minor Cu carbonate minerals can be observed in the mineralised veins, there is no reflection in the copper content of the stream silt.

(iv) That tributary streams only should be sampled because of dilution.

(v) That the sample fraction showing maximum contrast is -20 +80.

4.1.2 Work Content

From 3.1.70 to 8.2.70 two geology students from the South Australian Institute of Technology collected a total of 704 samples within the Special Mining Lease. The location of each sample was noted on an overlay of the enlarged aerial photographs to the scale of 1" = 1000'. The -20 +80 mesh fraction was then sent to McPhar Geophysics for A.A.S. analyses for Cu, Pb, Zn.

4.1.3 Results

The results have been plotted on three 1" = 2000' drainage plans (one each for Copper, Lead and Zinc.)

(a) Copper Results (Plate 4)

Examining the area as a whole the overall copper background is approximately 20 ppm, and excluding the 760 ppm sample collected below the old Wirrapowie mine the highest copper value was 110 ppm. The main features shown by the map are:

(1) Consistently low background in the pound quartzite and A.B.C. Range equivalent.

(2) Generally higher background level of 30 ppm in the Brachina Formation in the north-east.

(3) The higher results obtained in streams draining from the Wearing Dolomite and occasionally along north east-south west faults.

(4) The absence of any groups of anomalous copper readings.

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(b) Lead Results (Plate 5)

Examining the area as a whole it appeared that there was a difference in background in the northern and southern areas - the far south and south-west areas being particularly low at 30-35 ppm while the central northern and central western area had a background of 70-75 ppm. The main features noted from this map are:-

(1) The differences in background over the area.

(2) The fact that these differences transgress particular rock units of A. B. C. Range equivalent.

(3) The extremely low values in the Pound quartzite (background 20 ppm).

(4) Generally high values in the upper purple shale member of the Bunyeroo Formation.

(5) The presence of a broad anomalous area just over 1 mile south east of the Pinda Springs mine, and a smaller area on the west edge of the Brachina Formation.

(c) Zinc Results (Plate 6)

Again for zinc there was a difference in background over the area, with the lower background of 45-50 ppm in the south south west, south and central east and in a thin band along the western border. A background of 80-85 ppm covers the remainder of the area. The main features noted from the map were:-

(1) Differences in background.

(2) Difference in background within one stratigraphic group.

(3) Low background of the Pound quartzite (20 ppm).

(4) Higher background in purple shales and Wearing Dolomite.

(5) Higher background in Brachina Formation (130 ppm).

(6) Presence of a broad anomalous area just over one mile south east of the Pinda Springs Mine and a smaller anomalous area on west edge of the Brachina Formation. (Both of these roughly conform with Pb anomalies).

4.2 Follow-up and Conclusions

It was decided to consider the highest two groups of values for each metal, as first and second order anomalies respectively.

	Copper	Lead	Zinc
1st Order	> 61 ppm	> 131 ppm	> 161 ppm
2nd Order	41-60 ppm	91-130 ppm	120-160 ppm

These anomalous values (or groups of anomalous values) were plotted on a geological map of the area for interpretation. From this, 16 anomalous areas were delineated - these areas were prospected for their metal sources.

The only significant anomalies were several groups of high Pb-Zn values east of the Pinda Springs Lead Mine, in the Brachina Formation and the equivalent to the A. B. C. Range Quartzite. The anomalous values are derived from a series of minor, narrow, sporadically mineralised north-east trending faults, formed in response to regional folding. These faults may carry small quartz siderite veins with small amounts of galena, sphalerite and barytes. As these veins commonly occur along ridge lines, they give rise to anomalous values in several streams.

Isolated high anomalous values were found to be due to single small sulphide bearing veins of no significance. Other groups of

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anomalous values, particularly the lower order anomalies were found to be related to high geochemical backgrounds in particular stratigraphic units, such as the Wearing Dolomite.

No zinc silicate mineralisation or any other economic mineralisation was detected in the follow-up of this geochemical survey.

5. CONCLUSION

No anomaly examined was due to any economic amount of copper, lead or zinc mineralisation. In general there are two main sources of anomalies - (i) small quartz veins carrying primary mineralisation and sometimes giving rise to minor disemminations in adjacent sediments. (ii) high background areas.

It is recommended that no further work is warranted and that S.M.L. 321 be relinquished.

Sample No.	Pulverised	+ 20	- 20	- 40	- 80	- 120	- 200
JW1	25	30	30	25	25	20	25
JW2	25	30	30	30	25	20	25
JW3	20	20	25	25	20	15	25
JW4	20	20	25	25	20	20	25
JW5	35	30	35	35	35	20	20
JW6	25	25	30	30	25	15	25
JW7	30	30	30	30	25	15	20
JW8	30	30	30	30	25	20	25
JW9	30	25	25	30	25	20	15
JW10	25	30	30	30	20	15	20
JW11	25	30	30	25	15	15	20
JW12	25	25	25	30	10	15	20
JW13	25	20	30	20	10	10	20
JW14	20	20	20	15	15	15	25

TABLE 1 - ORIENTATION STREAM SILT SAMPLING AREA 1 - RESULTS FOR Cu IN ppm.

Sample No.	Pulverised	+ 20	- 20	- 40	- 80	- 120	- 200
JW1	100	170	140	160	170	180	420
JW2	180	60	50	60	60	60	70
JW3	40	40	50	50	60	40	40
JW4	40	40	50	50	50	30	40
JW5	120	120	220	140	140	85	100
JW6	130	120	200	320	240	140	200
JW7	140	140	160	210	210	140	160
JW8	160	140	160	200	180	120	130
JW9	160	170	160	220	210	160	120
JW10	130	120	100	180	160	100	120
JW11	50	50	70	100	60	50	60
JW12	30	30	35	35	20	25	50
JW13	35	30	40	30	20	30	60
JW14	40	30	35	35	45	60	75

TABLE 2 - ORIENTATION STREAM SILT SAMPLING

AREA 1 - RESULTS FOR Pb IN ppm.

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Sample No.	Pulverised	+ 20	- 20	- 40	- 80	- 120	- 200
JW1	170	170	170	170	130	110	150
JW2	160	160	150	150	130	85	95
JW3	170	130	140	120	95	65	80
JW4	130	130	110	120	100	70	95
JW5	200	200	210	220	210	120	150
JW6	320	320	380	450	340	210	330
JW7	340	300	350	370	310	180	240
JW8	290	270	290	330	250	170	200
JW9	320	270	300	320	280	180	140
JW10	320	300	410	310	240	160	150
JW11	140	130	160	180	110	70	100
JW12	70	70	60	90	30	35	65
JW13	65	75	70	40	20	25	55
JW14	75	80	70	70	80	90	110

TABLE 3 - ORIENTATION STREAM SILT SAMPLING AREA 1 - RESULTS FOR Zn IN ppm.

Sample No.	Pulverised	+ 20	- 20	- 40	- 80	- 120	- 200
JG1	55	15	15	20	20	20	20
JG2	15	15	15	15	15	10	15
JG3	25	40	20	20	15	15	20
JG4	25	20	20	20	15	15	25
JG5	20	25	25	25	20	15	20
JG6	25	30	25	25	20	15	25
JG7	25	25	25	25	20	15	25
JG8	25	25	25	30	25	20	30
JG9	25	25	25	25	15	25	20
JG10	20	25	25	20	20	20	20
JG11	25	30	25	25	20	15	15
JG12	25	30	30	30	20	20	25
JG13	25	25	25	25	20	15	15
JG14	25	30	30	30	25	15	15
JG15	20	20	20	20	15	10	15
JG16	25	25	25	25	20	15	15
JG17	20	20	25	25	15	15	15
JG18	30	30	35	35	25	15	25
JG19	30	30	30	30	25	15	20
JG20	25	25	30	30	25	15	25

TABLE 4 - ORIENTATION STREAM SILT SAMPLING AREA 2 - RESULTS FOR Cu IN ppm.

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Sample No.	Pulverised	+ 20	- 20	- 40	- 80	- 120	- 200
JG1	120	120	150	120	120	140	260
JG2	80	80	120	80	60	45	60
JG3	540	580	480	450	440	400	660
JG4	400	380	520	500	420	460	700
JG5	60	60	70	60	50	30	50
JG6	85	90	90	95	100	170	240
JG7	80	60	50	85	310	730	870
JG8	80	50	60	85	95	370	490
JG9	75	70	85	100	80	170	700
JG10	60	55	70	75	65	70	270
JG11	55	55	65	85	70	50	100
JG12	50	50	50	50	40	45	60
JG13	65	65	80	85	60	60	100
JG14	65	55	75	90	70	55	95
JG15	30	30	30	40	40	40	50
JG16	65	60	65	70	60	60	60
JG17	55	50	60	70	55	40	60
JG18	55	50	65	60	50	45	60
JG19	50	55	60	75	65	60	170
JG20	45	40	60	70	85	180	500

TABLE 5 - ORIENTATION STREAM SILT SAMPLING AREA 2 - RESULTS FOR Pb IN ppm.

030

Sample No.	Pulverised	+ 20	- 20	- 40	- 80	- 120	- 200
JG1	100	100	85	85	65	55	85
JG2	75	95	90	75	70	60	75
JG3	120	120	120	90	65	55	80
JG4	100	100	95	100	70	75	90
JG5	150	170	170	160	110	65	80
JG6	180	170	200	180	150	110	130
JG7	150	140	150	140	110	100	120
JG8	190	160	170	190	160	140	190
JG9	160	170	190	190	130	80	95
JG10	140	160	170	150	130	85	85
JG11	150	150	190	170	140	80	80
JG12	100	110	100	95	65	60	75
JG13	150	150	170	180	110	65	65
JG14	160	160	180	180	150	80	70
JG15	90	90	85	75	70	50	60
JG16	170	150	190	180	120	70	70
JG17	130	140	150	150	100	65	95
JG18	170	140	180	190	140	75	80
JG19	160	160	170	170	170	70	80
JG20	140	150	170	170	120	70	90

TABLE 6 - ORIENTATION STREAM SILT SAMPLING AREA 2 - RESULTS FOR Zn IN ppm.

139°00'E

PINDA SPRINGS MINES
Zn
Pb
Ag

JUBILEE BORE

BORE

Cu
JUBILEE MINES

WIRRAPOWIE MINES
Cu

31°00'S

139°00'E

REFERENCE

CAINOZOIC	QUARTERNARY	Recent		*Alluvium, outwash on plains*
		Pleistocene		*Gravels and Silts*
PALAEOZOIC	LOWER CAMBRIAN	Hawker Group	WILKAWILLINA LIMESTONE	*Massive limestones*
			PARACHILNA FORMATION	*Argillaceous sandstone*
			POUND QUARTZITE	*Felspathic quartzite*
PROTEROZOIC	MARINOAN	Wilpena Group		*Purple sandstone with Silt and Shale bands*
			WONOKA FORMATION	*Blue limestone*
				Cream dolomite with malachite stains
			BUNYEROO FORMATION	*Purple shales*
				Grey green shales and dolomites
			EQUIVALENT OF A.B.C. RANGE QUARTZITE	*Grey brown siltstones, shales, minor arkose and quartzite*
			BRACHINA FORMATION	*Green and Purple shales*

LEGEND

- Track
- Geological Boundary
- Fault
- Trend lines
- 40 — Strike and Dip
- Mine
- Syncline and Anticline
- Cu. Pb. — Copper, Lead
- Ag. Zn. — Silver, Zinc
- Bore

Env 1194

PLATE 2

NORANDA AUSTRALIA LTD.

SPECIAL MINING LEASE Nº 321
JUBILEE RANGE
South Australia

GEOLOGICAL MAP

SCALE
2000 0 2000 4000
FEET

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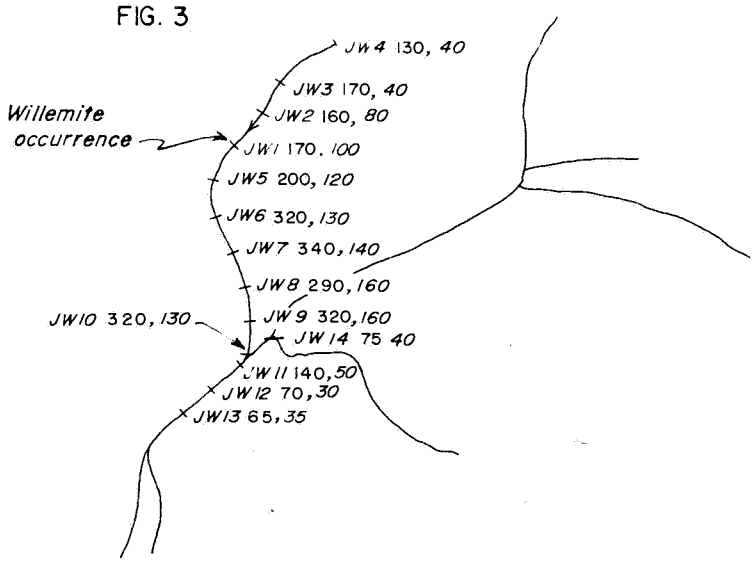
1194

DATE: JUNE 1970	GEOLOGY: A. and C. Dunlop	DRAWN: N.W.
APPROVED: A.T.	DRAWING Nº 320-C-202	

ENV 1194-1

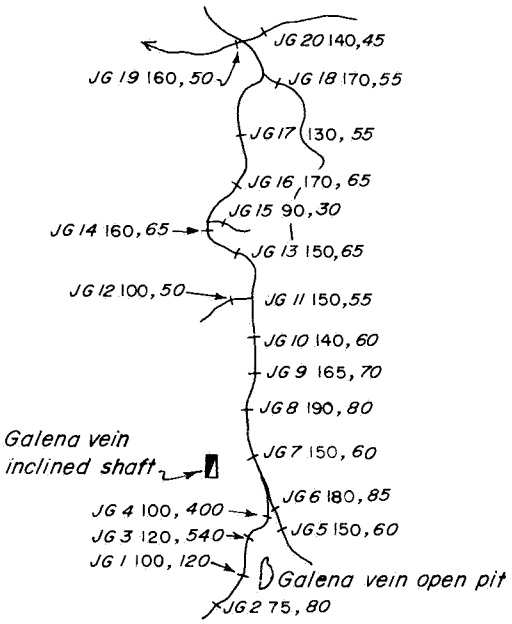
FIG. 3



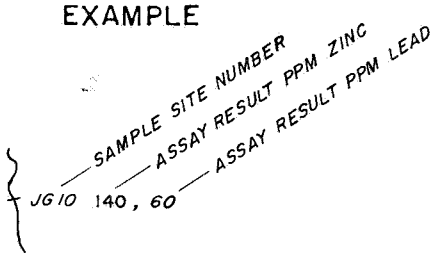
WILLEMITE BEARING MINERALISATION

SCALE : 1" = 1000 ft.
(Approx.)

FIG. 4



EXAMPLE



GALENA VEIN LOCALITY

SCALE : 1" = 1000 ft.
(Approx.)

Em 1194

PLATE 3

NORANDA AUSTRALIA LIMITED		
SML 321 JUBILEE RANGE South Australia ORIENTATION GEOCHEM. SURVEY		
Date: Jan. '70	Geochem: A.Dunlop	Drawn: G.C.
Approved: T.A.R.	Dwg. No. 320-E-201	

139°00'E

31°00'S

WIRRAPOWIE CREEK

LEGEND

Boundary of Special Mining Lease.

Stream Sediment Site with assay result. (Results shown are p.p.m. — copper).

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PLATE 4

NORANDA AUSTRALIA LTD.

SPECIAL MINING LEASE No 321
JUBILEE RANGE
South Australia

STREAM SILT SAMPLING
GEOCHEMICAL MAP — COPPER

SCALE
2000 0 2000 4000
FEET

DATE: June 1970	GEOCHEMISTRY: A and C Dunlop	DRAWN: L.P.
APPROVED: A.T.	DRAWING No. 320-E-	

ENV 1194-2

139°00'E

WIRRAPOWIE CREEK

31°00'S

LEGEND

Boundary of Special Mining Lease.

Stream Sediment Site with assay result.
(Results shown are p.p.m. - lead).

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Env 1194

PLATE 5

NORANDA AUSTRALIA LTD.

SPECIAL MINING LEASE No 321
JUBILEE RANGE
South Australia

STREAM SILT SAMPLING
GEOCHEMICAL MAP —— LEAD

SCALE
2000 0 2000 4000
FEET

DATE: June 1970	GEOCHEMISTRY: A and C Dunlop	DRAWN: L.P.
APPROVED: A.T.	DRAWING No. 320-E-	

ENV 1194-3

139°00'E

WIRRAPOWIE CREEK

31°00'S

139°00'E

LEGEND

Boundary of Special Mining Lease

Stream Sediment Site with assay result.
(Results shown are p.p.m. - zinc).

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DEPT. OF MINES
REGISTRY
1194

Em 1194

PLATE 6

NORANDA AUSTRALIA LTD.

SPECIAL MINING LEASE No 321
JUBILEE RANGE
South Australia

STREAM SILT SAMPLING
GEOCHEMICAL MAP —— ZINC

SCALE
2000 0 2000 4000
FEET

DATE: June 1970	GEOCHEMISTRY: A and C Dunlop	DRAWN: L.P.
APPROVED: A.T.	DRAWING No. 320-E-	

ENV1194-4