64/24
C.3

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD No. 1964/24

LIONTOWN GEOPHYSICAL SURVEY, QUEENSLAND 1959

by

M.J. O'CONNOR and J. HORVATH

RECORD No. 1964/24

LIONTOWN GEOPHYSICAL SURVEY,

QUEENSLAND 1959

by

M.J. O'CONNOR and J. HORVATH

CONTENTS

ILLUSTRATIONS

SUMMARY

A geophysical survey, using mainly the Turam electromagnetic method, was made over an area of about 400 acres around the mining area at Liontown, Queensland. Diamond-drilling recommended on the basis of a previous test geophysical survey had intersected lead-zinc ore of payable grade and the Queensland Department of Mines requested a more-extensive geophysical survey to assist in planning further drilling.

The electromagnetic work showed a large number of good-conducting bodies that could be orebodies in the area around Liontown. Of special interest were the anomalies close to, and south of, the mining area. Seventeen drill holes were recommended to test the electromagnetic anomalies.

Subsequent drill holes put down by the Mines Department tested several of these anomalies but intersected no mineralisation of economic interest. From the drilling results it is considered that the electromagnetic anomalies are probably due mainly to pyritic mineralisation occurring in shear zones.

1. INTRODUCTION

The Liontown area, known also as the Carrington Goldfield, is situated about 28 miles south-west of Charters Towers, Queensland. Early in the century (1905-1911) Liontown was a small centre for mining and smelting of copper-gold ore. The occurrence of galena in the workings was reported at that time but was not considered to be of economic importance (Levingston, 1952). Interest in the area was revived in 1951 by the discovery of oxidised lead ore at the surface by G. Parsons and R. Jansen. This was followed by shallow prospecting work which proved lead mineralisation over a length of several hundred feet. Two inclined shafts, the Liontown and New Queen shafts, were put down to work the oxidised ore.

In 1952 the Bureau of Mineral Resources, Geology and Geophysics made a test geophysical survey (Horvath, 1953) of a small area surrounding the lead deposit to determine whether the electromagnetic or self-potential methods could be used to trace the lead mineralisation. A fairly strong electromagnetic anomaly with an easterly strike was recorded in a position coinciding with the orebody exposed in the Liontown and New Queen shafts. A stronger electromagnetic anomaly, continuing over a distance of 600 ft and also striking east, was recorded about 300 ft south of the known orebody. The self-potential survey showed only one anomaly of interest. This was situated between the two electromagnetic anomalies and was thought to be due to a gold-quartz reef carrying pyrite and chalcopyrite (Horvath, 1953).

Subsequent drilling by the Queensland Department of Mines and Broken Hill South Ltd disclosed lead orebodies at depth. A hole drilled to test the stronger electromagnetic anomaly intersected a lode formation 12 ft thick, including 4 ft of lead-zinc ore of payable grade. In 1959, the Bureau was asked by the Department of Mines to do further geophysical work over a wider area around Liontown for the purpose of finding additional drilling targets.

The geophysical survey was made during September and October 1959. The party consisted of M.J. O'Connor (party leader), R.C. Stubbs (geophysicist), W.F. Darch (surveyor of the Department of the Interior), four field assistants, and a cook.

2. GEOLOGY

The geology of the Liontown area has been described by Levingston (1952). The geological information shown on Plate 2 is based on a map by Levingston and Wyatt of the Queensland Department of Mines.

Most of the area over which the geophysical survey was made is covered by soil. Oaky Creek, which runs from north to south through the surveyed area, has extensive alluvial flats adjoining the western bank, and also the eastern bank in the northern part of the area. There is little detailed geological information available about the area because of the scarcity of outcrops. The main workings in the Liontown area occur along the top of a low ridge of mica schists. The lead ore, as shown by the mine workings, apparently occurs in lenticular form along a line of lode over a length of 550 ft striking east, with a dip of about 60 degrees to the south. The ore deposits appear to be conformable with the surrounding quartz-sericite and chlorite schists which are probably of Silurian or Cambrian age.

Near the Tigertown shaft in the western part of the area quartzites and schists crop out. The quartzites strike north-west. South and west of Tigertown shaft there is a large area of porphyry. A smaller area of porphyry showing some schistosity occurs about 1000 ft north of Tigertown shaft.

At the time of the 1959 geophysical survey, the only mining activity was that of a small party working the New Queen lease.

3. GEOPHYSICAL METHODS USED

Electromagnetic

The electromagnetic method was the more successful of the geophysical methods previously used in the Liontown area. The method depends on the principle that a primary electromagnetic field will induce electric currents in a nearby conducting body. The induced currents in turn give rise to a secondary field, which depends on the strength and frequency of the energising current, the size, the shape, the dip and conductivity of the body, and the relative conductivity of the surrounding material.

A buried sulphide orebody may be detected as a good conductor. However, other good conductors besides sulphide orebodies are graphitic schists, pyritic schists, mineralised shear zones, and saline ground water. It must be realised therefore that a strong electromagnetic anomaly only indicates a zone of good conductivity and not necessarily a metalliferous deposit.

In the Turam method the primary field was created by a motor-generator passing alternating current through a large rectangular loop of insulated wire laid out on the ground. The long sides of the rectangle were laid out approximately parallel to the main strike of the known lode formation and at right angles to the traverses. Along these traverses, outside of the loop, measurements were made of the vertical electromagnetic field. With induction coils kept at constant separation (50 ft or 100 ft) along the traverses, the ratio of, and the phase difference between, the electromagnetic fields at two observation points were measured with a Turam compensator, using an amplifier and headphone as indicating instruments. These measurements were corrected for the primary field over a homogeneous ground, and the resulting ratios and phase differences were plotted. From these profiles, contours of ratio and phase difference were constructed (Plates 2 to 8).

The Turam results can also be shown in the form of ratio/phase diagrams (Plate 9). The reduced ratio is plotted as ordinate and the phase difference as abscissa. When the observation points for a traverse are plotted, closed curves occur in the anomalous sections. Wait (1951) showed that the response of a conductive sphere in a uniform alternating magnetic field is a function of the conductivity (σ), permeability (μ), radius of the sphere (r), and the frequency of the alternating field (ω). The slope of the main axis of the closed curve in a ratio/phase diagrams will be proportional to the induction factor θ where $\theta = (\sigma\mu\omega)^{\frac{1}{2}}r$. Neglecting the magnetic permeability and considering only one frequency, the slopes of the curves of the ratio/phase diagrams will be proportional to the conductivity and the size of the conductor causing the anomaly. A very steep slope (large ratio, small phase-difference anomalies) indicates the presence of a very good conductor; a flat slope (small ratio, large phase-difference anomalies) indicates a moderate conductor. Intermediate slopes indicate medium induction factors that could be due to small bodies of good conductivity or to large bodies of medium conductivity.

With the Turam method, the selected frequency of the primary field can be either 440 or 880 c/s. It was found that 440 c/s was the more-suitable frequency in the Liontown area because :

(a) large, well-defined indications were obtained with either frequency but with 440 c/s there was less shielding caused by conducting bodies closer to the primary cable. This meant that reliable measurements could be made at greater distances from the cable when using the lower frequency.

(b) the measurements with the lower frequency were less affected by near-surface irregularities.

Self-potential method

In the self-potential (S-P) method, measurements are made of small potential differences between points on the ground surface. The potential difference is measured between a movable, non-polarising electrode and a stationary one by means of a vacuum-tube voltmeter.

If a sulphide body is being oxidised, electrochemical action creates electric potentials in the body and around it. The strongest negative potential values are found above the body and these constitute an S-P anomaly. However, not all S-P anomalies are due to sulphide bodies.

In the 1952 survey the observations were somewhat erratic owing to the local surface conditions. The method was used only on selected traverses in the 1959 survey.

Magnetic

Measurements were made of variations in the Earth's vertical magnetic field along selected traverses. Local anomalies in the Earth's field can be caused by buried magnetic minerals.

The magnetic method was used on this survey to see whether any magnetic minerals are associated with the electromagnetic anomalies.

4. WORK DONE AND RESULTS OBTAINED

Electromagnetic

Using the frequency of 440 c/s, an area of about 400 acres was covered by 35 traverses spaced 200 ft apart with readings along these traverses generally every 25 ft, but in some featureless areas this distance was increased to 50 ft. In some of the more-interesting areas, intermediate traverses were also surveyed, using the 440-c/s frequency. Six different primary loops were needed to cover the whole area.

The results for the whole area are shown as reduced ratio contours (Plate 2), phase-difference contours (Plate 3), and ratio/phase diagrams (Plate 9). More-detailed contour plans of ratio and phase difference for Areas A and B are shown on Plates 4 to 7. The anomalies are numbered 1 to 19. In all cases the ratios and phase-differences shown are for coil separations of 100 ft. Over much of the area, the results for coil separations of 100 ft have been computed from measurements taken with coil separations of 50 ft, and over some anomalies, with coil separations of 25 ft.

Plate 8 shows the contours of phase difference, using a frequency of 880 c/s, over the major part of Area A. With the higher frequency, the amplitudes of the Turam anomalies are greater than with the 440-c/s frequency.

In the area south of 400S and east of about 1600W, the electromagnetic readings showed the effect of a high general ground conductivity, which is attributable to the presence of saline ground-water. The reduced ratios and phase differences have been corrected for this effect. However, in the south-eastern corner of the area, the general ground conductivity was too high to be allowed for and no results are shown. The area thus affected was somewhat larger for 880 c/s (Plate 8) than for 440 c/s (Plate 4).

Self-potential

The S-P method was used over portions of 11 traverses crossing some of the larger electromagnetic anomalies. The self-potential profiles showed very few features and there were no anomalies that could be correlated with the electromagnetic anomalies, with the possible exception of one along Traverse 1200W. However, the S-P measurements along this traverse were very erratic and not much reliance can be placed on them. Therefore, the S-P results are not shown in this Record.

Magnetic

Magnetic measurements were made over several short sections of traverses over the main Turam anomalies. Some fairly large anomalies were found that are obviously caused by surface or near-surface effects; these anomalies cannot be correlated with the Turam anomalies. Along Traverses 5200W and 5300W in the vicinity of 100N, a magnetic anomaly was detected that may have some relation to the Turam anomalies. This anomaly was found at the completion of the survey and further magnetic work would be needed before the magnetic and electromagnetic results could be correlated. The magnetic anomaly may be associated with the contact of the schists and porphyry. The magnetic results are not illustrated in this Record.

5. INTERPRETATION OF RESULTS

The electromagnetic results presented in Plates 2 to 8 show a considerable number of anomalies. The strikes of the anomalies are generally westerly or north-westerly. West of 4600W the tendency to a north-westerly strike increases. The area of the mine workings shows relatively weak anomalies, whereas much stronger anomalies occur in other parts of the survey area.

The ratio and phase-difference contours in Area A (Plates 4 & 6) show a weak anomaly, viz. No. 6 between 500S and 600S on Traverses 00 to 800W, which coincides in position with the known lead orebody. As could be expected on theoretial grounds, the anomaly is more-pronounced when the higher frequency of 880 c/s is used (Plate 8). The 1952 electromagnetic survey covered the area bounded by 100S, 1000S, 200E, and 550W, and disclosed two anomalies corresponding to Anomalies 6 and 7 of the 1959 survey. In the earlier survey the anomaly due to the known orebody was relatively stronger than Anomaly 6 of the later survey.

Anomaly 7 was found by both surveys to be strong and well-defined. It extends from about 800E/950S to 400W/850S and has been partly tested by the diamond drilling carried out by the Queensland Department of Mines and by Broken Hill South Ltd. The results of this drilling are referred to below in the discussion of Plate 10.

A large area bounded roughly by 800S, 1800S, 00W, and 2000W has some very strong anomalies that indicate the presence of good conductors. As this area is adjacent to the main area of lead mineralisation, the anomalies should warrant testing by diamond drilling.

Anomaly 15 in Area B (Plates 5 & 7) is on the alluvial flats west of Oaky Creek. Water pumped from a depth of 50 feet in a nearby bore at 3700W/50S has an appreciable salt content and the presence of saline water in a shear zone must be considered as a possible cause of the high conductivity causing this anomaly.

Several strong anomalies were recorded in Area B north of Tigertown shaft. These anomalies cover a considerable area and could be caused by mineralised bodies. The electromagnetic results suggest that the area south of Tigertown shaft is unmineralised.

In Area A (Plates 4 & 6) Anomaly 12, which appears as a very strong phase-difference anomaly but only as a minor ratio anomaly, indicates a moderate conductor, probably a shear zone. A conductor of this type probably also accounts for Anomaly 5.

The remaining anomalies numbered on the plans are due to good or very good conductors. This is shown by the ratio/phase diagrams, examples of which are given in Plate 9. The main axes of the closed curves have nearly the same slope in all these examples; the slope suggests that the anomalies arise from good or very good conductors.

Plate 10 shows the Turam ratio and phase-difference profiles, together with diamond-drilling information, along Traverses 00W, 300W, and 400W. The idealised orebodies have been constructed from the drilling results, the known outcrops, and previous mining operations. It appears that there are two bodies causing the anomalies along Traverses 00, both bodies dipping steeply to the south. The known orebody that crops out near the new Queen workings consists of lead carbonate in the workings down to at least 100 ft. The small amplitude of the Turam anomaly No. 6 associated with this orebody suggests that the primary ore is not a very good conductor and is relatively narrow.

The stronger anomaly No. 7 centred about 860S is apparently due to the orebody intersected in the primary zone by diamond-drill hole BHS3 drilled by Broken Hill South Ltd. Diamond-drill hole NS12 drilled by the Department of Mines might possibly have intersected the same body in the oxidised zone. A complete geological log of BHS3 is not available. Some uncertainty exists regarding the inclination of the drill hole; it is assumed that the hole was drilled at an inclination of 60 degrees. Core assays for the section 412 ft to 424 ft were supplied by the Department of Mines. Between 412 ft and 420 ft, 9 inches of core was recovered and assayed 0.6 percent Pb, 6.2 percent Zn, and 0.39 percent Cu. The core between 420 ft and 424 ft assayed 6.55 percent Pb, 22.2 percent Zn, and 1.33 percent Cu.

Along Traverses 300W and 400W, the Turam profiles show good correlation between Anomaly 6 and the known orebody, which was intersected in drill holes NS2, NS8, and NS5. However, drill holes NS6 and NS9 did not intersect any ore that could be correlated with Anomaly 7. These holes have only tested the western end of the anomaly and were probably too far west to intersect the orebody revealed by BHS3. Drill holes NS9 and NS11 intersected an orebody that appears to be the cause of the small Turam anomaly centred about 750S on 400W. Drill hole NS6 intersected the same orebody but the electromagnetic profiles along 300W show only a minor feature that could possibly be attributed to this orebody.

6. CONCLUSIONS AND RECOMMENDATIONS

The electromagnetic results presented in the form of Turam ratio and phase-difference contours show at least 19 anomalies, most of which indicate good to very good conductors. Anomaly 6 coincides in position with the lead orebody which was worked in the Liontown and New Queen shafts and was intersected in several diamond-drill holes. Anomaly 7 has been only partially tested. Although this anomaly can be correlated with the lead-zinc orebody intersected in BHS3, the holes drilled near its western end failed to disclose an orebody. When considering the possible significance of the electromagnetic anomalies it must be recognised that other geological features besides orebodies, e.g. fissures filled with saline water, could cause high electrical conductivity. Hence it cannot be assumed that the conductors revealed by the electromagnetic survey are necessarily orebodies. However, in view of the encouraging results of the testing based on the 1952 survey, it was considered that further drilling should be done to test these anomalies.

The positions of 17 recommended drilling targets are given below:

Recommended drilling target	Position of drilling target on geophysical grid	
1	1200E,	315N
2	750W,	415N
3	350E,	900S
3a	600E,	900S
4	1150W,	1050S
5	750W,	1325S
5a	500W,	1375S
6	1200W,	1480S
6a	1000W,	1535S
7	3900W,	150N
8	4800W,	475N
9	5400W,	285N
10	4900W,	00
11	5425W	185S
12	5400W,	565S
13	1600W,	00
14	3600W,	1325S

The geophysical interpretation suggests that the most-suitable target depths are between 150 and 300 ft below the surface. Targets No. 3a, 5a, and 6a should be included only if targets No. 3, 5, and 6 respectively are mineralised. The suggested locations of the drill collars, assuming an angle of depression of 60 degrees, are shown in Plates 4, 5, 6, and 7.

7. DIAMOND DRILLING

The above drilling recommendations were conveyed to the Department of Mines on completion of the survey. Between August 1960 and November 1961 diamond-drill holes No. NS 13 to 21 were put down by the Department to test seven of the recommended targets. The positions of these drill holes are shown on Plates 2 to 7 and have been taken from plans accompanying the report by Levingston (1963). Detailed geological logs of the drill holes have been supplied to the Bureau of Mineral Resources.

The drill holes passed through quartz-sericite schist, sericite-cordierite schist, shale, mudstone, and metamorphosed porphyry, all of which are normally non-conducting. Mineralisation mainly in the form of blebs and films of pyrite in bands parallel to schistosity was encountered in nearly all of the drill holes; mineralisation of economic interest was not encountered in any of the drill holes. In some of the drill holes, especially in NS 19 and NS 21, pyrite was accompanied by subordinate amounts of galena and chalcopyrite. Although the amount of sulphides is too small be to of real interest, the sulphides are considered to be the cause of the electromagnetic anomalies for two reasons:

(a) the drill holes start and finish in barren country and according to the geological logs the mineralisation increases near the target zone and then decreases again, and

(b) the mineralisation occurs mainly in strongly sheared and brecciated zones. Shearing gives the mineral particles a preferred orientation in the direction of shearing and hence increases the electrical conductivity. Also, shear zones are commonly more permeable and, as the water in the presence of sulphides becomes mineralised, the shear zones may be good conductors even if only minor amounts of sulphides are present.

Table 1 gives the particulars on drill holes NS 13 to 21 and includes geological information about the portions of the drill holes that are considered to be the zones of good conductivity. These zones can be correlated with the electromagnetic anomalies.

Electrical logging of the drill holes would have been useful for determining the zones of high conductivity. Logging, which can only be done in uncased holes, was not possible at Liontown where in general the boreholes collapse when the casing is withdrawn.

The results of the drilling show the limitations of the electromagnetic method as a means of locating additional lead-zinc orebodies at Liontown. It appears that the method is not capable of distinguishing between the compact lead-zinc orebodies and the shear zones containing sparse sulphide mineralisation. Also, the presence of saline water in shear zones cannot be excluded as a possible cause of some of the electromagnetic anomalies.

It has been found elsewhere that shear zones can cause high electrical conductivity if mineralised water is present, and that the electromagnetic method is limited as a means of locating economic orebodies within conducting mineralised shear zones because it is unable to discriminate between metallic and electrolytic conductors. In the Liontown area, it is possible that additional information could be gained by using the induced polarisation (IP) method to check the electromagnetic anomalies. The IP method should show whether the anomalies arise mainly from the electrolyte in the shear zones or from metallic conductors represented by the mineralisation; thus any anomalies that are not due mainly to mineralisation might be eliminated. However, it would not be possible to determine whether zinc or lead ore occurred in addition to pyrite, as galena has a much lower conductivity than pyrite and sphalerite is usually not a good conductor.

8. REFERENCES

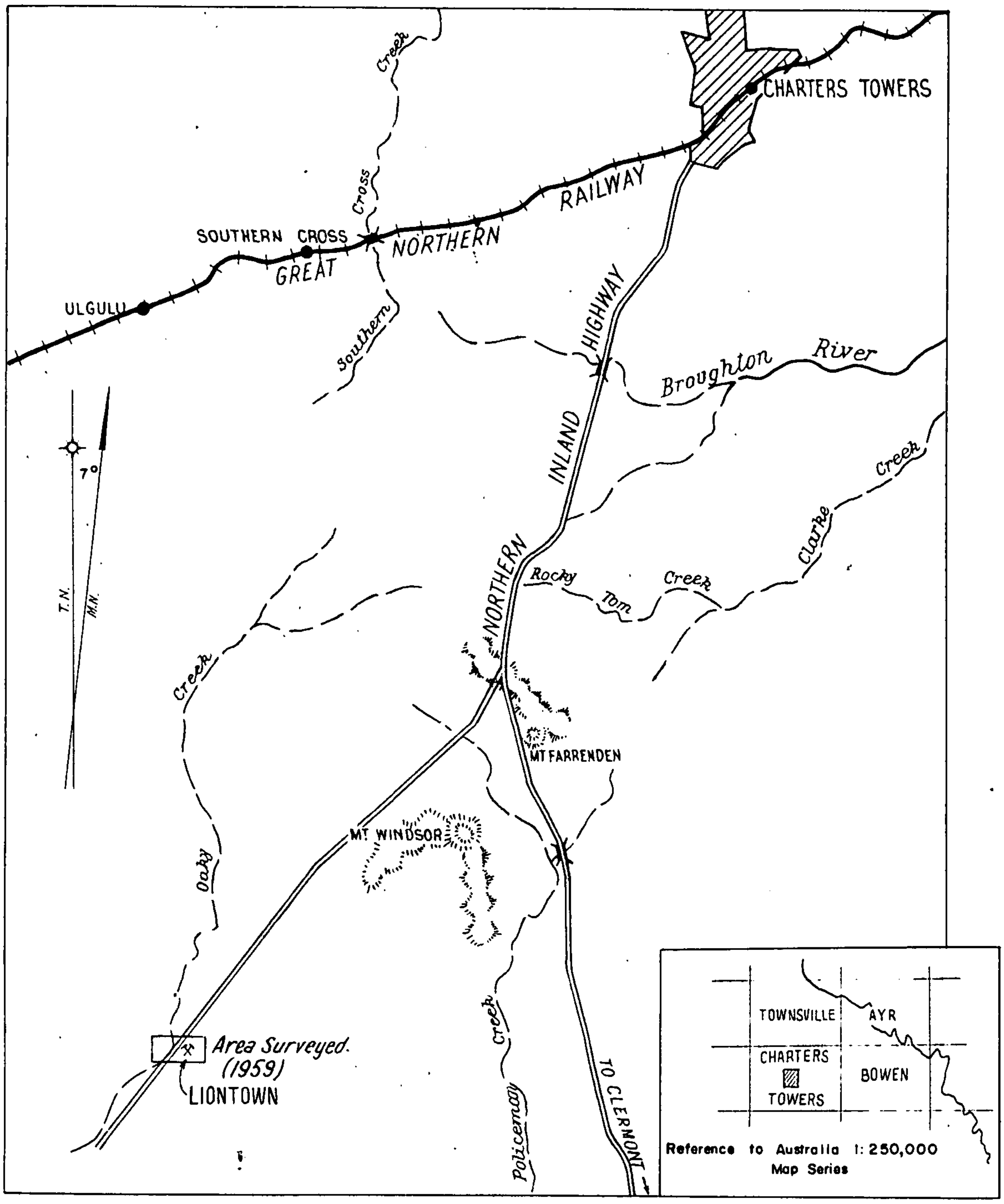
HORVATH, J.	1963	Geophysical test survey at Liontown, near Charters Towers, Queensland. <u>Bur. Min. Resour. Aust. Rec</u>. 1953/15 (unpubl).
LEVINGSTON, K.R.	1952	Silver-lead discovery, Liontown area. <u>Qld Govt Min. J</u>. 53, 492-493.
LEVINGSTON, K.R.	1963	Departmental diamond drilling, Liontown. <u>Ibid</u>. 64 (742), 533-539.
WAIT, J.R.	1951	A conducting sphere in a time varying magnetic field. <u>Geophysics</u> 16 (4), 666-672.

TABLE 1

LIONTOWN DRILLING RESULTS

(All holes drilled with 45° depression).

Drilling target No.	Drill hole No.	Drill site geophysical grid co-ords.	Length of Hole (ft)	Direction relative to geophysical grid	Remarks
1	NS 14	1200E/165N	314	00	Lode matter, quartz, pyrite, limonite (183-256 ft).
6	NS 13	1200W/1630S	421	00	Numerous fine pyrite films in shale and sandstone along schistosity (315-378 ft).
6	NS 20	1200W/1300S	376	180	No mineralisation reported.
8	NS 15	4800W/325N	300	00	Gossanous iron oxides (188-196 ft, 215-216 ft, 219-220 ft and pyrite in vugs (258-260 ft) in sheared porphyry.
8	NS 21	4800W/675N	301	180	Abundant specks and blebs of pyrite (116-128 ft) with galena (161-166 ft) and chalcopyrite (206-227 ft) in quartz-sericite schist.
9	NS 18	5480W/165N	309	030	Pyrite blebs (165-180 ft) in sericite-cordierite schist.
10	NS 16	4900W/150S	300	00	Disseminated pyrite (236-245 ft).
11	NS 17	5500W/325S	310	030	Pyrite blebs (205-279 ft) in sheared and brecciated quartz phyllite.
12	NS 19	5400W/700S	307	00	Abundant specks and blebs of pyrite in bands parallel to schistosity and associated blebs of granular galena (147-268 ft).



GEOPHYSICAL SURVEY AT LIONTOWN (CHARTERS TOWERS) QUEENSLAND

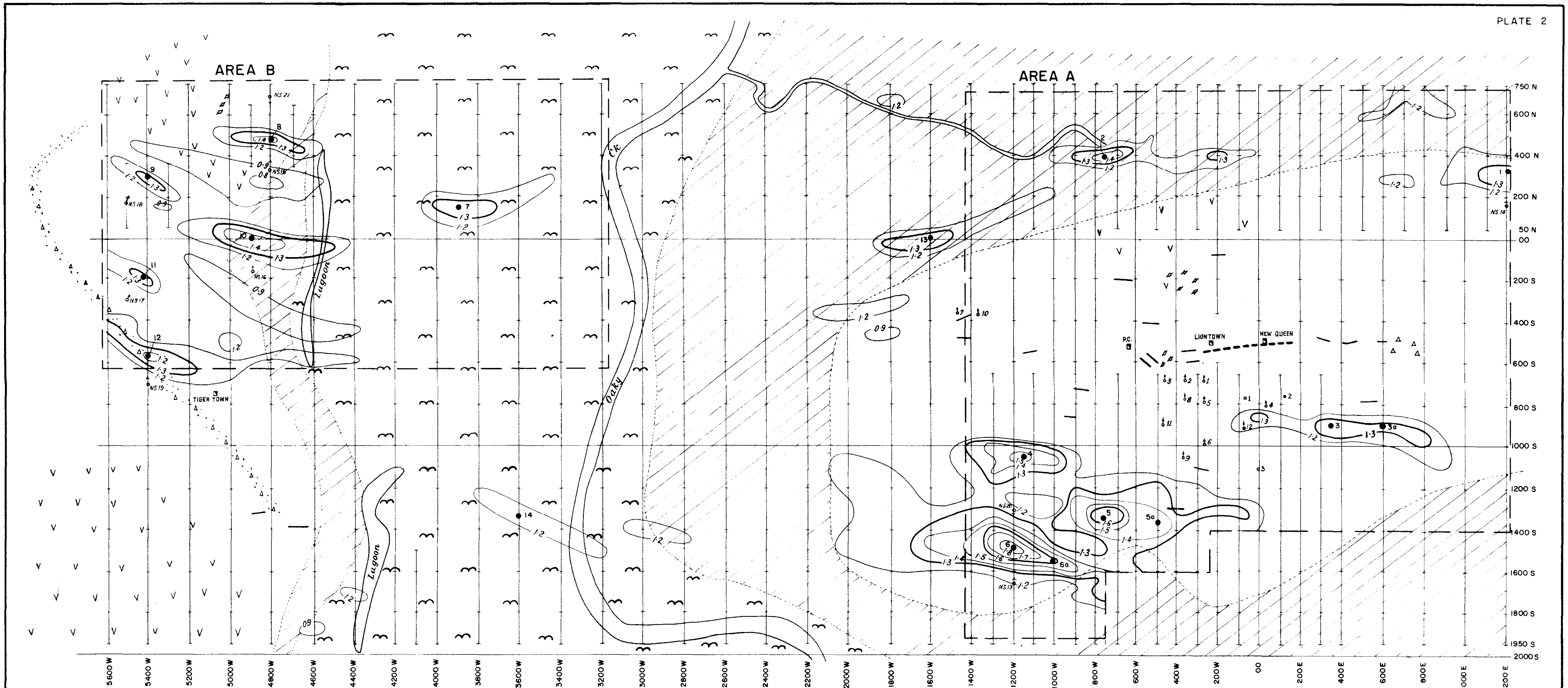
LOCALITY MAP

MILES

4 0 4 8

GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS F55/B 7-10

TO ACCOMPANY RECORD No 1964/24



TRAVERSES, GEOLOGY, AND TURAM RATIO CONTOURS

SCALE IN FEET
400 0 400 800 1200

LEGEND

- AREA OF OUTCROP, OR SLIGHT SOIL COVER
- " " NO OUTCROP, COMPLETE SOIL COVER (Prob. grading into alluvium)
- ALLUVIUM
- SCHISTS – SEDIMENTARY ORIGIN.
- " – MANGANESE STAINED
- " – SILICIFIED.
- PORPHYRY
- LEAD VEIN.
- STRIKE LINE.
- GEOPHYSICAL TRAVERSE.
- 1·3 / 1·2 TURAM RATIO CONTOURS (440 cycles/sec, 100-ft coil separation).
- ● 5 RECOMMENDED DRILLING TARGET.
- 6 DIAMOND – DRILL HOLE. (Mines Department).
- ∘ 3 " " " (Broken Hill South).
- MINE SHAFT.
- CONTOURS WITHIN THESE BOUNDARIES SHOWN IN MORE DETAIL IN PLATES 4 AND 5

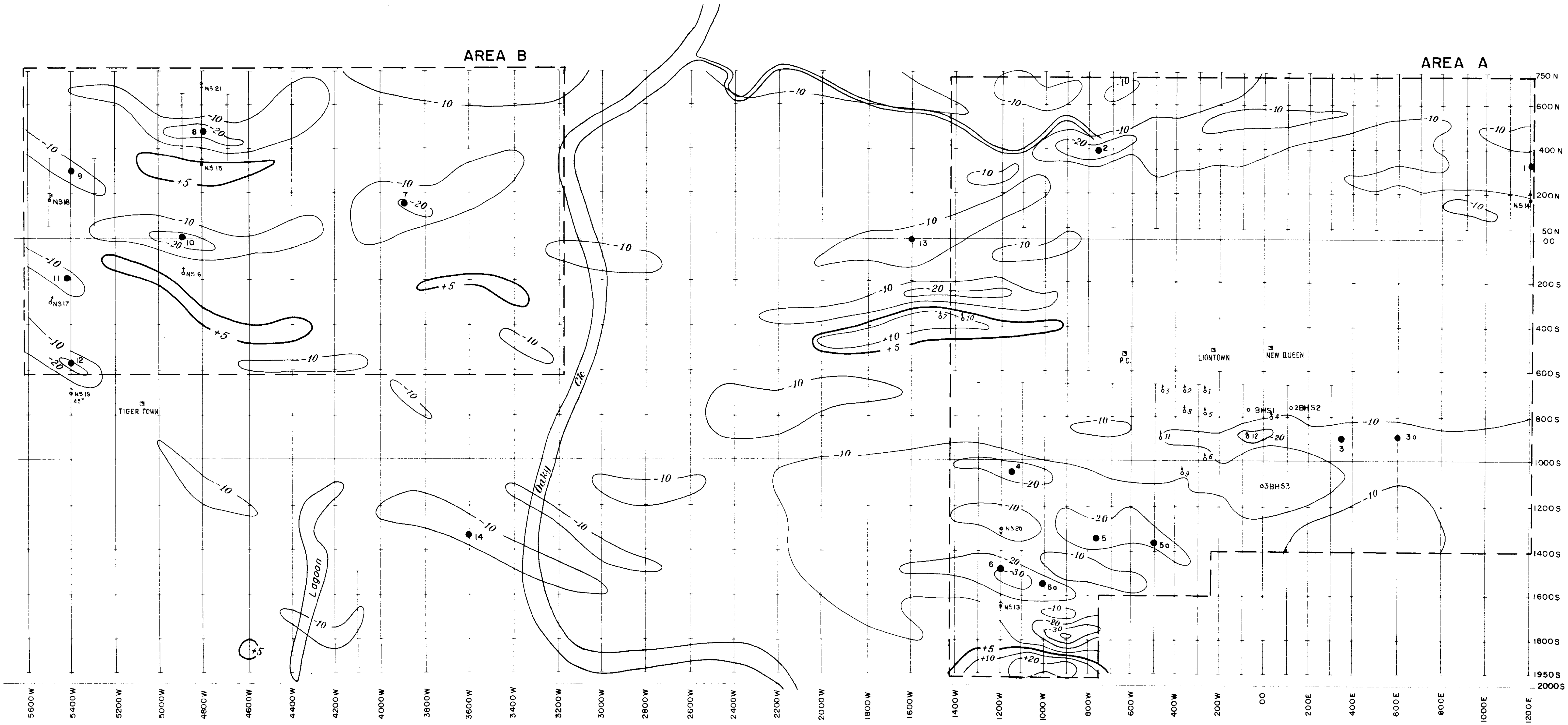
T.N. M.N. 7°

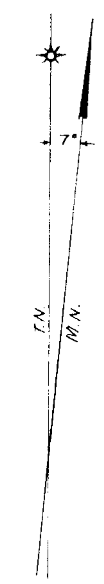
GEOLOGY AND DDH POSITIONS AFTER QUEENSLAND MINES DEPT. (K.R.L. AND D.H.W.)
TRAVERSES AND SURFACE FEATURES AFTER DEPT OF INTERIOR SURVEY MAP (W.F.D.)

LIONTOWN, QLD.

TO ACCOMPANY RECORD No 1964/24

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. F55/B7-11





TRAVERSES AND TURAM PHASE - DIFFERENCE CONTOURS

440 CYCLES / SEC., 100-FT COIL SEPARATION

SCALE IN FEET

400 0 400 800 1200

DIAMOND-DRILL HOLE POSITIONS AFTER INFORMATION FROM QUEENSLAND MINES DEPT

TRAVERSES AND SURFACE FEATURES AFTER DEPT OF INTERIOR SURVEY MAP (W.F.D.)

LEGEND

GEOPHYSICAL TRAVERSE.

+5 +10 TURAM PHASE-DIFFERENCE CONTOURS.

8 DIAMOND-DRILL HOLE (Mines Department)

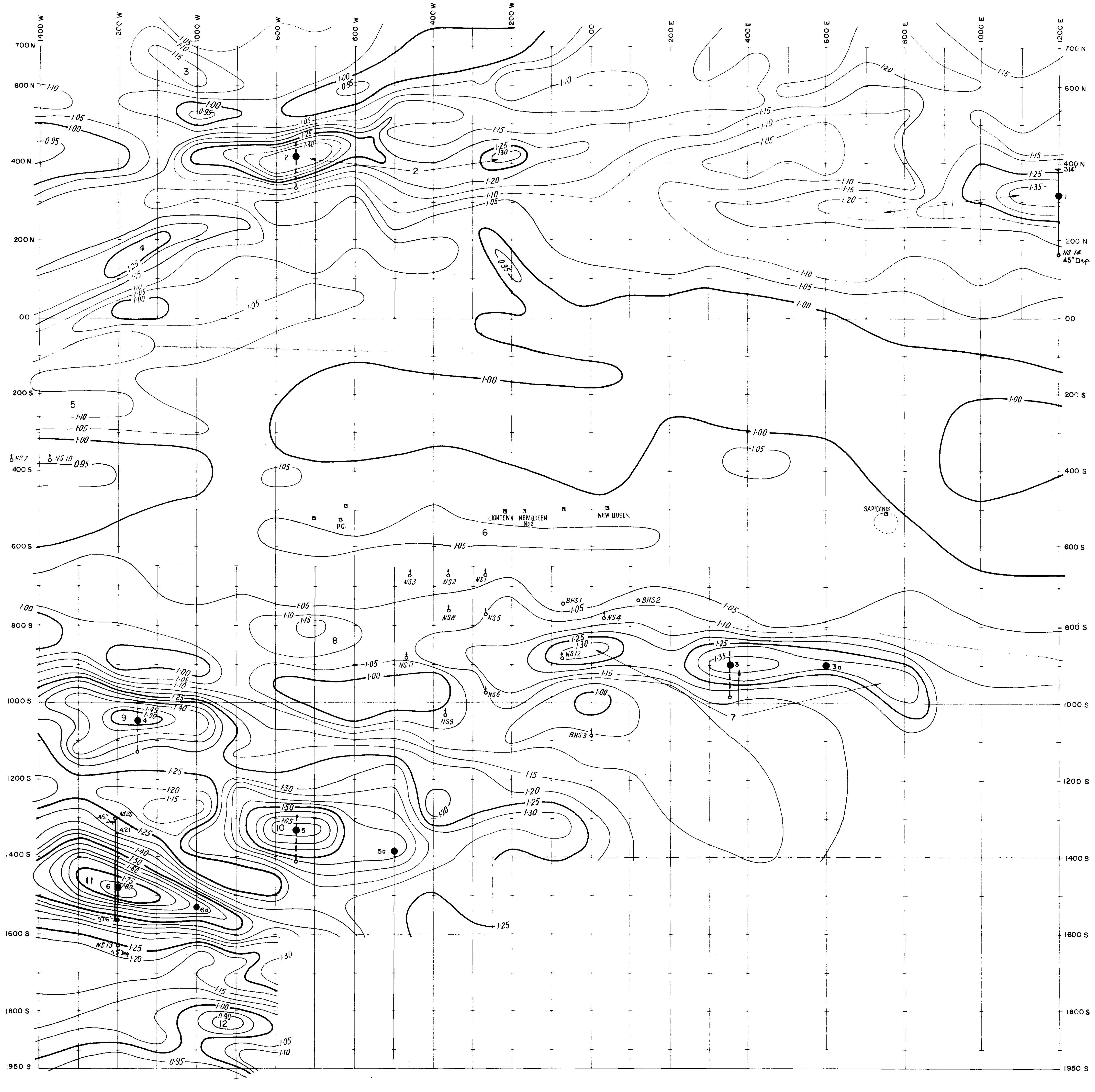
BHS3 " " " (Broken Hill South)

2 RECOMMENDED DRILLING TARGET.

MINE SHAFT.

CONTOURS IN THESE AREAS SHOWN IN MORE DETAIL ON PLATES 6 AND 7

LIONTOWN, QLD.



AREA A
TURAM RATIO CONTOURS
(AFTER CORRECTION FOR GROUNDWATER INFLUENCE)

440 CYCLES PER SEC, 100-FT COIL SEPARATION

SCALE IN FEET

200 0 200 400 600

CONTOUR INTERVAL 0·05 RATIO

LEGEND

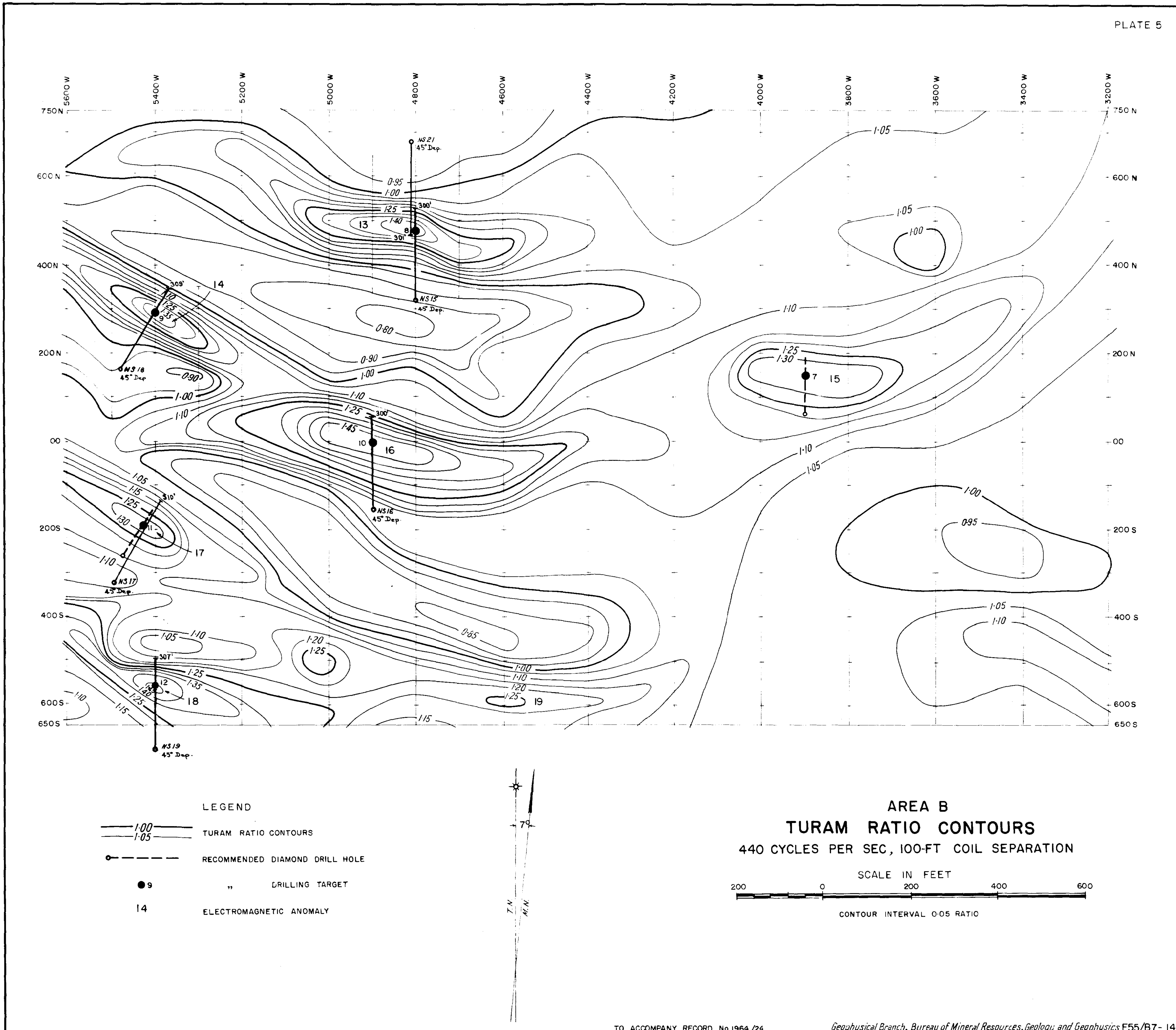
- 1·00 / 1·05 — TURAM RATIO CONTOURS
- NS 6 — DIAMOND-DRILL HOLE (DEPT OF MINES)
- BHS2 — " " " (BROKEN HILL SOUTH)
- RECOMMENDED D D H
- 2 — " DRILLING TARGET
- 5 — ELECTROMAGNETIC ANOMALY
- MINE SHAFT

TO ACCOMPANY RECORD No 1964/24

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics F55/B7-13

LIONTOWN, QLD.

PLATE 5



AREA B
TURAM RATIO CONTOURS
440 CYCLES PER SEC, 100-FT COIL SEPARATION

SCALE IN FEET

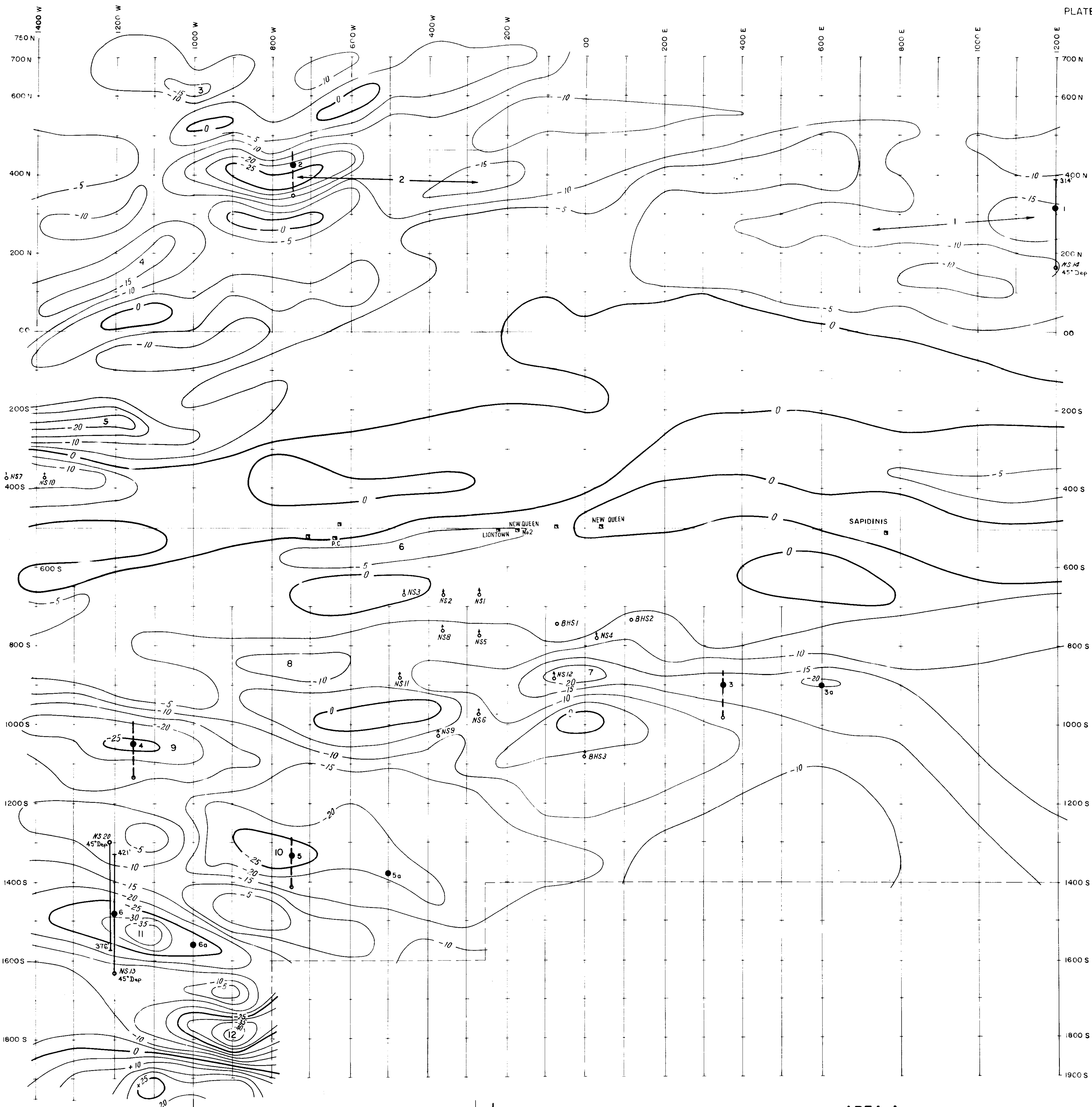
CONTOUR INTERVAL 0·05 RATIO

TO ACCOMPANY RECORD No 1964/24

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics F55/B7-14

LIONTOWN, QLD.

PLATE 6



AREA A

TURAM PHASE-DIFFERENCE CONTOURS

440 CYCLES PER SEC, 100-FT COIL SEPARATION

SCALE IN FEET

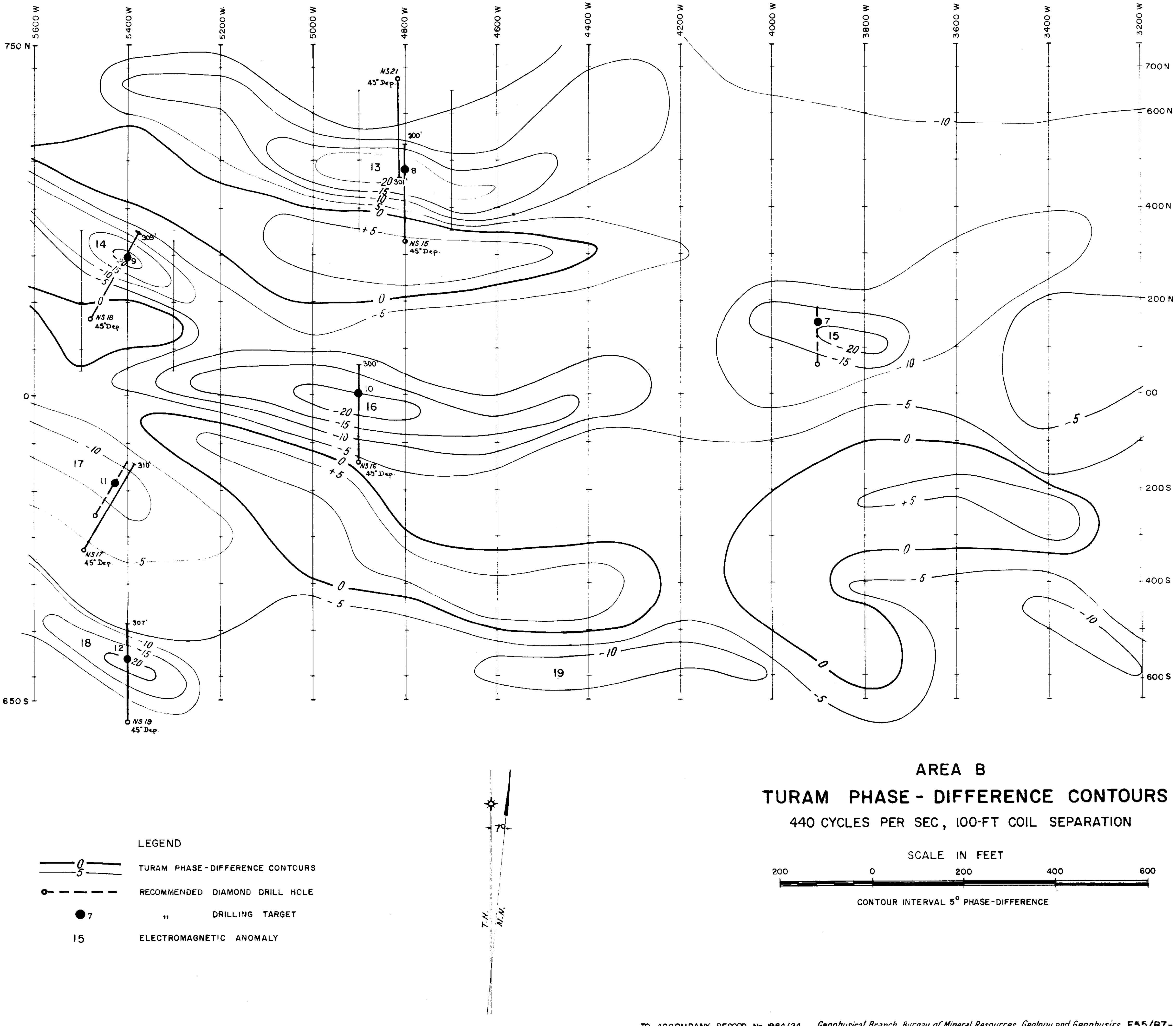
CONTOUR INTERVAL 5° PHASE-DIFFERENCE

LEGEND

- 0, 5 — TURAM PHASE-DIFFERENCE CONTOURS
- NS5 — DIAMOND-DRILL HOLE (DEPT OF MINES)
- BHS2 — " " " (BROKEN HILL SOUTH)
- RECOMMENDED DIAMOND-DRILL HOLE
- 6 — " DRILLING TARGET
- 10 — ELECTROMAGNETIC ANOMALY
- MINE SHAFT

TO ACCOMPANY RECORD No 1964/24 *Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics* F55/B 7-15

LIONTOWN, QLD.



AREA B

TURAM PHASE - DIFFERENCE CONTOURS

440 CYCLES PER SEC, 100-FT COIL SEPARATION

SCALE IN FEET

200 0 200 400 600

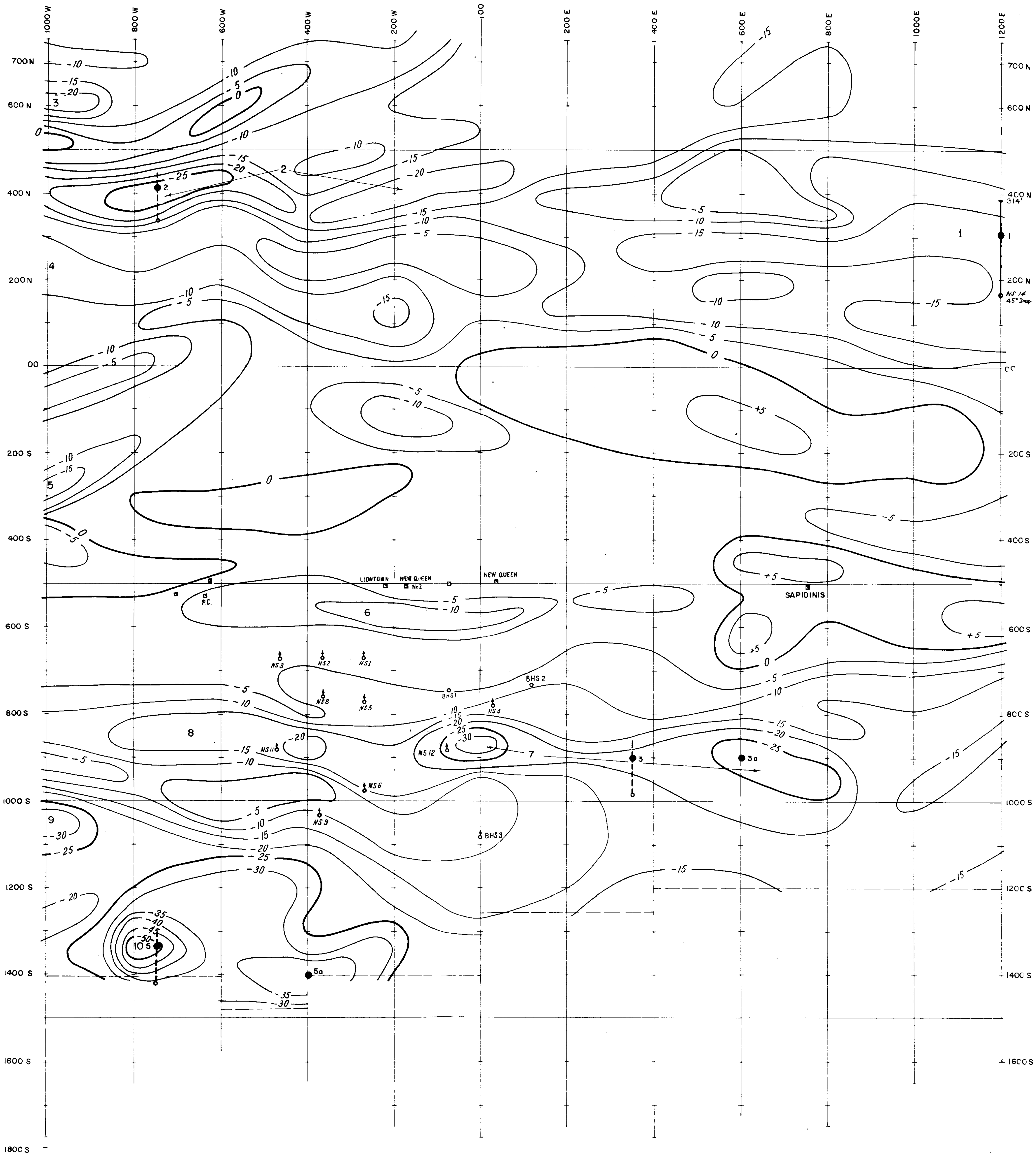
CONTOUR INTERVAL 5° PHASE-DIFFERENCE

LEGEND

0 / 5	TURAM PHASE - DIFFERENCE CONTOURS
o- - - -	RECOMMENDED DIAMOND DRILL HOLE
● 7	„ DRILLING TARGET
15	ELECTROMAGNETIC ANOMALY

LIONTOWN, QLD.

PLATE 8



LEGEND

—0— —5—	TURAM PHASE-DIFFERENCE CONTOURS
NS5	DIAMOND-DRILL HOLE (DEPT OF MINES)
o BHS2	,, ,, ,, (BROKEN HILL SOUTH)
o- - - - -	RECOMMENDED D D H (BUREAU OF MINERAL RESOURCES)
● 2	,, ,, TARGET
6	ELECTROMAGNETIC ANOMALY
▫	MINE SHAFT

TRAVERSES 1200E TO 1000W.

TURAM PHASE-DIFFERENCE CONTOURS

880 CYCLES PER SEC, 100-FT COIL SEPARATION

SCALE IN FEET

200 0 200 400 600

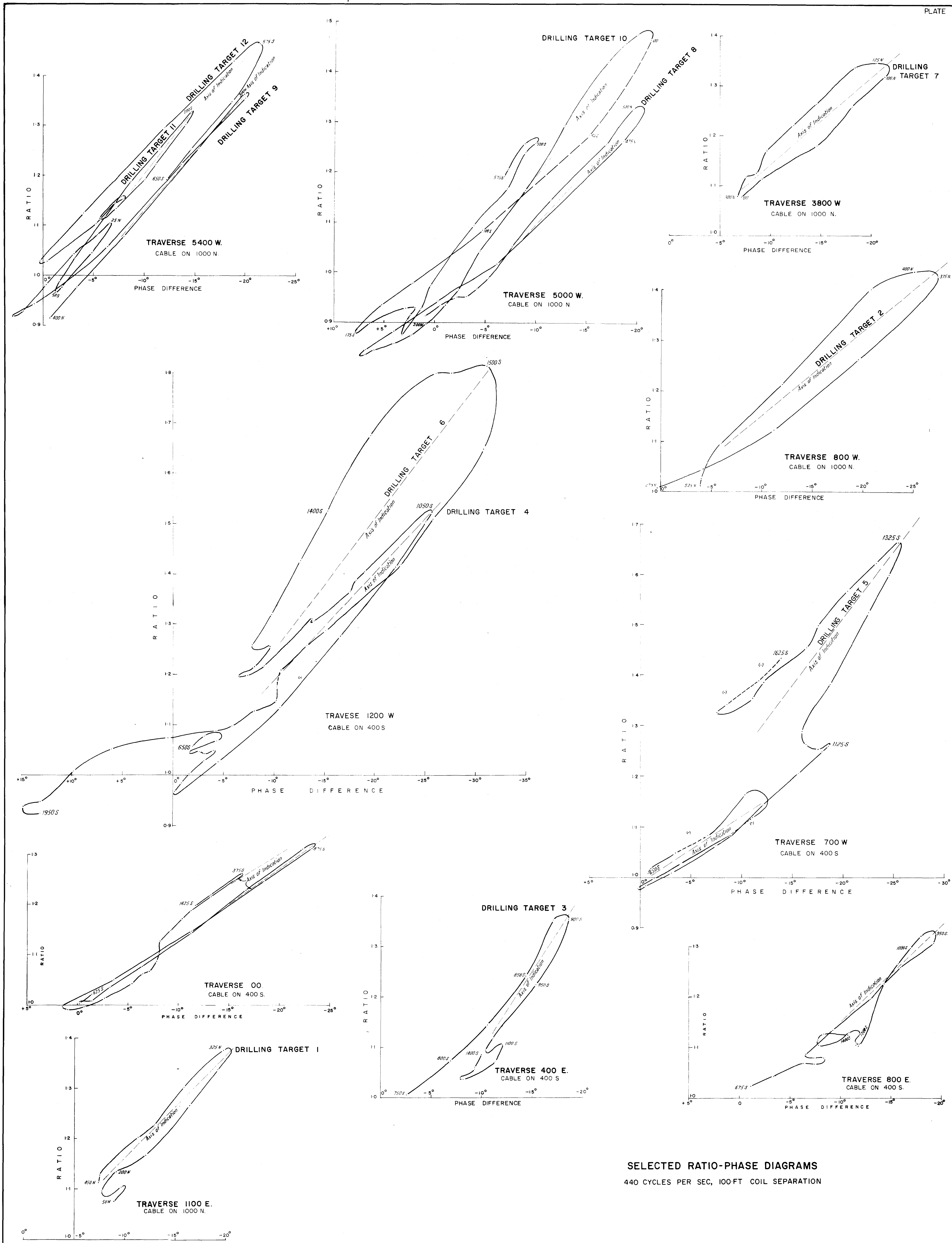
CONTOUR INTERVAL 5° PHASE-DIFFERENCE

T.N. M.N. 7°

TO ACCOMPANY RECORD No 1964/24

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. F55/B 7-17

LIONTOWN, QLD

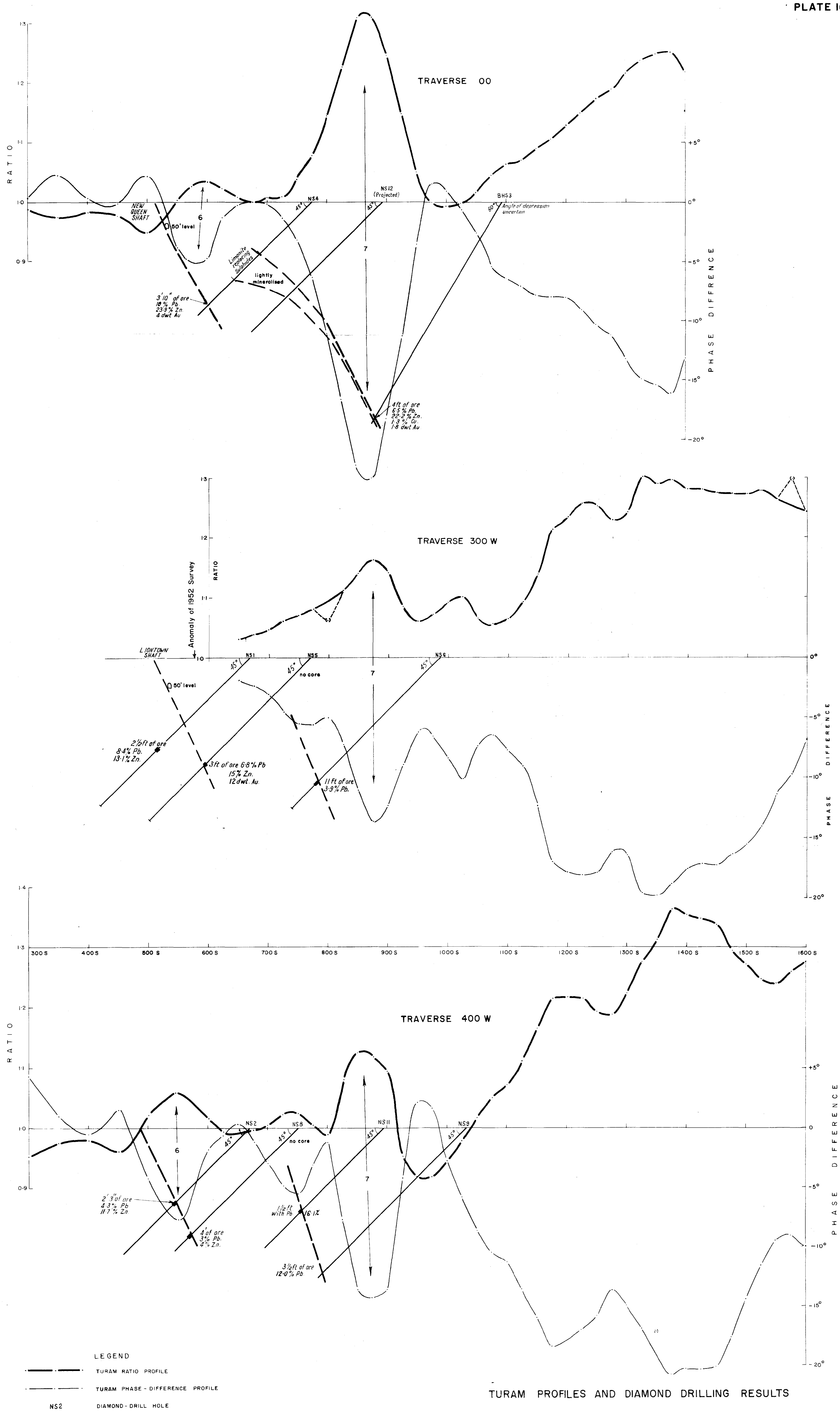


SELECTED RATIO-PHASE DIAGRAMS

440 CYCLES PER SEC, 100 FT COIL SEPARATION

LIONTOWN, QLD.

PLATE 10



TURAM PROFILES AND DIAMOND DRILLING RESULTS

TO ACCOMPANY RECORD No 1964/24

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics F55/B7-19

LIONTOWN, QLD, 1959