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BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD No. 1964/147

KIKOIRA / GIBSONVALE GEOPHYSICAL SURVEYS FOR ALLUVIAL TIN, NSW 1963

by

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CONTENTS

ILLUSTRATIONS

SUMMARY

Geophysical surveys, using gravity, seismic, and resistivity methods, were made by the Bureau of Mineral Resources in three areas in the Kikoira/Gibsonvale district with the purpose of delineating alluvial channels that could assist the Aberfoyle Tin Development Partnership in their exploration programme.

In the area near Gibsonvale, results were inconclusive and work was limited to testing only.

In the area near Kikoira, gravity and resistivity methods gave useful results, but the seismic refraction work appeared to be only partly successful. The results indicate that the Kikoira lead may split into two branches, one of which may be tin-bearing, as its course is near several old lode tin workings. Drilling recommendations were made.

In the area south-east of Gibsonvale, gravity and seismic methods gave no useful results, but the resistivity method showed a small resistivity 'high' flanked by resistivity 'lows', which may indicate the course of the lead. This interpretation, however, is empirical and needs confirmation by test drilling, for which recommendations were made.

1. INTRODUCTION

The Kikoira/Gibsonvale alluvial tinfield is situated south-east of the village of Kikoira in central western New South Wales. Kikoira is on the Ungarie-Naradhan railway line, 18 miles west of the township of Ungarie, which is about 370 miles west of Sydney (Plate 1).

Lode tin, of little economic value, has been known to exist in the Kikoira district since 1906. Early exploration of shallow alluvial ground near the tin lodes is recorded, but the results of this are not known. Rich alluvial tin deposits were found under the roadway between portions 23 and 29 (Plate 2) at Gibsonvale by Gibson in 1938. Over 5000 tons of cassiterite concentrates was produced in the period between 1938 and 1955. Since 1955, production declined gradually as the richer ground was worked out. The present production is very small.

Since 1961, the Aberfoyle Tin Development Partnership (ATDP) has held an option over most of the old leases and is conducting a vigorous exploration campaign in an endeavour to revive mining activities in the district.

Previous geophysical work in the Gibsonvale area consisted of a detailed gravity survey over an area of about 450 acres south-east of Gibsonvale (Plate 2) made by geophysicists of the Geological Survey of NSW (Pegum & Emerson, 1962), and several test traverses surveyed with a Geophysical Specialties Co. Model MD-1 refraction seismograph by the firm of mining consultants, R. Hare and Associates of Melbourne, in 1962.

The geophysical surveys described in this Record were requested by ATDP and had the support of the Department of Mines, NSW. The object of the surveys was to define the bedrock topography as a guide to the boring operations and so reduce exploration costs. Five promising areas were suggested for survey. Of these the Bureau of Mineral Resources undertook to survey Areas 1, 2, and 3 (see Plate 2).

The Bureau's geophysical field work, employing gravity, seismic, and resistivity methods, was done between 25th July and 15th November 1963. The field party consisted of E.C.E. Sedmik (party leader), J.P. Williams and R.H. Andrews (geophysicists), and five field-hands.

The topographical survey was made by surveyor W. Timbs from the private firm Timbs and Britten of Fairfield, NSW under contract to the Department of the Interior, Canberra.

The assistance of ATDP in supplying drilling information relevant to the interpretation of results is gratefully acknowledged.

2. GEOLOGY

The geology of the Kikoira/Gibsonvale district has been described by Jaquet (1906), Harper (1907), and Booker (1939). Sullivan (1944) investigated the tinfield's potentiality as a dredging proposition, but his report was unfavourable. Later, South Broken Hill Ltd carried out boring operations in the area to investigate its possibilities as a dredging ground, and came to the conclusion that the area was too low-grade for dredging purposes at the prices then ruling.

More recently, Westner (1961) has made a detailed geological investigation for ATDP in an attempt to find additional tin-bearing grounds, which, if proved by drilling, could make dredging economically possible.

The oldest rocks in the district are Ordovician sediments ranging from argillaceous slate, mudstone, and siltstone to sandstone and arkose. The general strike of these formations is about 330°; the dip is steep and predominantly to the south-west. The rocks show evidence of shear folding, with many transverse fractures normal to the folding axes. During the Silurian period, the older formations were intruded by granite and tin-bearing reefs, and veins were formed in both granite and sediments near their contact. The granite is a medium-to coarse-grained porphyritic type that often contains cassiterite. It shows practically no contact metamorphism. Westner believes that the main body of the Kikoira granite is a continuous intrusive sheet dipping steeply to the south-west.

Most of the primary deposits in the Kikoira/Gibsonvale area were exposed, and in places deeply eroded, during the post-Silurian period. The present topography of the area is one of low relief with a maximum elevation between creek bottom and hill crest of about 100 ft. Prolonged weathering of rocks *in situ* caused accumulation of a deep layer of soil, large areas of which are under cultivation for wheat. Rock outcrops are few, thus making geological mapping difficult.

The cassiterite freed by weathering was transported into stream channels, where it was sorted and concentrated. Alluvial tin has been proved in two leads - the Kikoira and the Gibsonvale leads. The maximum width of the leads is about 250 ft. The tin-bearing alluvial material (wash) is from about one to six feet thick and is covered by from 20 ft to 100 ft of overburden of partly-consolidated sand and clay.

The upper reaches of the alluvial channels in the Kikoira/Gibsonvale district suggest the existence of youthful topography under humid conditions at the time of deposition of the alluvial tin. Creeks were fast-flowing during this period and were shifting considerable quantities of gravel and sand. This is suggested by the shape of the quartz pebbles actually mined, many of which were approaching an axial ratio of 1:1:1 suggesting that considerable rolling and rotation of the alluvial material took place over a large distance. At that time the erosional channels were deep and narrow, emphasising vertical, rather than lateral, erosion. The alluvial channels became wider towards the lower reaches of the lead where the creeks reached maturity. Here lateral erosion prevailed with the formation of meandering courses, which were gradually filled with water-worn detrital material transported from the surrounding higher ground. Local hard-pan horizons in the overburden suggest several changes in climate from humid to arid conditions.

Westner believes that the general course of the Gibsonvale lead follows the present drainage system and continues in an east-north-east direction towards Humbug Creek.

3. METHODS AND EQUIPMENT

Gravity method

The gravity method depends on the detection of variations in the Earth's gravitational field due to uneven distribution of rocks of different densities in the subsurface. Before being useful as possible indications of subsurface conditions, the observed gravity values must be corrected for instrumental drift, latitude, elevation, and sometimes for terrain effects.

The gravity method can be used to estimate the thickness of overburden over buried valleys under certain conditions: flat topography, homogeneous bedrock, and marked density-contrast between bedrock and overburden. Under these conditions gravity profiles show a negative anomaly, the general shape of which is similar to the bedrock profile.

Gravity observations were made with a Worden gravity meter (No.260), which is a quartz-type meter capable of measuring differences of gravity of about 0.01 milligals. The calibration factor of the meter was 0.10865 milligals.

Seismic method

The seismic refraction method of exploration is based on the contrast between the velocities of seismic waves in different rock formations. Hard unweathered rocks have higher velocities than their weathered counterparts, while these in turn have generally higher velocities than soil and unconsolidated deposits.

The applicability of the seismic refraction method to the location of alluvial channels is described by Urquhart (1956).

The 'method of differences' (Heiland 1946, p. 548) was used to determine the vertical travel time at each geophone station. These were later converted into actual depths by using the conversion-factor technique as described by Hawkins (1961). The best results were obtained with geophone spacings of 25 ft, and with shot-points at 12.5 ft, 262.5 ft, and 512.5 ft from both ends of the spread.

The equipment used in the seismic survey was a South-western Industrial Electronics Co. 12-channel refraction seismograph with Technical Instruments Co. geophones of natural frequency 20 c/s.

Resistivity method

The electrical resistivity method depends upon the resistivity contrast between adjacent strata. In this method current is supplied to the ground at two points and the potential is measured between two other points. The ratio of potential to current, multiplied by a spacing factor, gives what is known as apparent resistivity.

The average resistivity of overburden is lower than that of bedrock. Thus generally, a buried alluvial channel will appear as a resistivity 'low'. However, changes in resistivity within the overburden often cause anomalies, which may not be due to alluvial channels.

The Wenner configuration - four electrodes equally spaced in a straight line - was used during the present survey. The resistivity method was used as resistivity profiling, where the electrode system was moved as a whole along lines, keeping the distance between electrodes constant, and as depth probing, where the electrode spacing was varied. In depth probing, apparent resistivity is plotted against electrode spacing, using logarithmic scales. Interpretation is carried out by fitting theoretical two-layer type curves to the observed curves. The multi-layer problem is treated as a succession of two-layer problems using Hummel's principle (Hummel, 1932).

An Evershed and Vignoles Geophysical Megger (Serial No. 929395) was used for the resistivity work.

4. FIELD WORK AND RESULTS

Geophysical work commenced with a gravity survey in Area 1 along Lines 0, 1000N, and 2000N. This was followed by regional gravity surveys along a north-south road and along an east-west road to establish the regional gravity trends over a greater area. The location of the regional gravity lines is shown in Plate 2. The interval between stations was half a mile.

All gravity observations were referred to a base station near peg zero on Line 1. Elevation corrections (combined free-air and Bouguer corrections) were calculated assuming a density of 2.1 g/cm^3 for the material above a reference datum of 800 ft above sea level. A latitude correction of 1.206 milligals per mile was applied to compensate for the change of gravity with latitude.

Difficulties were encountered in surveying Area 1 as large parts of it were under cultivation and no entry permit could be secured at the time of the survey. From the limited amount of work done in this area it became evident that the gravity profiles obtained were affected by a strong regional effect, and that they could not delineate the course of the alluvial channel with sufficient accuracy. Doubts about the usefulness of the gravity method in searching for alluvial channels in the Gibsonvale area had arisen at the conclusion of the drilling programme carried out by ATDP in the southern portion of the area previously surveyed by the Geological Survey of NSW. Before embarking on a systematic survey of any specific area, it was decided to make further tests of the applicability of the gravity method by surveying along Lines 1, 2, 4, 5, 38, and 40, where the position of the lead was known from actual boring.

Lines 1, 4, 5, and 38 were also surveyed by the seismic refraction method in the hope of tracing a refractor showing correlation with the weathered bedrock surface. However, the interpretation of seismic results proved more difficult than anticipated because the intermediate velocities obtained from time/distance curves were unusually low, generally between 2500 ft/sec and 5000 ft/sec. A distinction could not be made without ambiguity between the seismic velocities representing weathered bedrock and overburden; velocities as low as 2900 ft/sec were measured in weathered granite (peg 600 on Line 38), while in some boreholes velocities up to 4500 ft/sec were measured in the alluvial overburden, thus making the task of distinguishing between bedrock and alluvial overburden impossible. Only occasionally were seismic velocities observed which could be attributed with some certainty to weathered bedrock, but these refractors could be followed for only short distances along the traverses. On Lines 4 and 5 (Plate 6) it was possible to trace a refractor that appeared to have some connexion with the lead although the depth calculated for it was much shallower than that obtained by drilling.

Seismic work was also done along Lines 3 and 6. The results (Plate 5) indicated well-defined depressions on several refractors, which generally agreed in position with depressions obtained from gravity results.

The results of these test surveys suggested that further geophysical work was warranted only in Areas 2 and 3. The situation was discussed at a meeting between representatives of ATDP and the Bureau. It was agreed that the geophysical results should be tested, and ATDP undertook to have further drilling done for this purpose. Targets were selected mainly in Area 2 and the drilling was done by Monier Earth Drilling Pty Ltd of Sydney, using a two-foot diameter "Caldwell" drill. As a result of the test drilling, it was decided to confine the geophysical survey mainly to gravity and seismic work in Area 2, seismic work in Area 3, and resistivity work in both areas.

The resistivity method was tested over the known lead in Area 2 (Lines 7, 38, and 40) after a period of heavy rain. The apparent-resistivity profiles obtained appeared to delineate the course of the lead better than any of the other methods employed. The resistivity work was later extended to Area 3 and Line 1. The work consisted mainly of resistivity profiling along individual traverses using several electrode-spacings. Resistivity depth probes were also made at selected sites in Areas 2 and 3 in the hope that they would assist in the interpretation of resistivity profiling results. Generally the resistivity results obtained from depth probing indicated a high-resistivity layer close to the surface, underlain by a layer of low resistivity, which in turn was underlain by a layer of higher resistivity, but the results gave no reliable indication of the depths to weathered bedrock.

The results obtained during the initial testing period of the different geophysical methods over lines where the position of the leads was known from drilling or actual mining are presented in Plates 3, 4, 5, and 6. Some typical examples of seismic cross-sections on lines other than these are presented in Plate 7.

The resistivity results are shown as an apparent-resistivity contour map for Area 2 in Plate 10 and for Area 3 in Plate 11. Resistivity depth probes in Areas 2 and 3 are shown in Plate 8.

Gravity results in Area 2 are contoured in Plate 9.

5. DISCUSSION OF RESULTS

Area 1 and Line 1

Only about one quarter of Area 1 was available for geophysical surveying as the other part was under cultivation. Three short gravity lines were surveyed in the uncultivated area but the geophysical work was abandoned because the available area was found to be too small to give useful results. The results of this work are not shown in this Record.

The results of test surveys made along Line 1 are shown in Plate 3. The Gibsonvale lead crosses Line 1 twice, first between pegs 1400 and 2400, where it follows the contact between slate and granite, and again between pegs 7000 and 9000, where the lead is entirely in granite. None of the three geophysical methods appears to indicate the position of the lead.

The gravity results along Line 1 and the eastern regional line show a wide gravity 'low' of about 5 milligals, roughly corresponding in width to the granite body. Small gravity 'lows' are present on the profile but they appear to correlate with the unweathered bedrock surface (as shown by the seismic cross-section) rather than with the weathered bedrock surface, in which the alluvial channels are located. A similar wide gravity 'low' over the granite was found along the Naradhan-Ungarie railway line by Pegum and Emerson (1962), who attributed it to the sialic root of the Kikoira granite.

The seismic cross-section of Line 1 shows the unweathered bedrock surface determined as accurately as possible from the seismic data. The heterogeneous nature of overburden along this line is indicated by the many changes in velocities observed on the time/distance curves. A differentiation between overburden and weathered bedrock could not be made because they do not seem to have distinguishing seismic velocities. There is strong evidence of higher-velocity material underlain by lower-velocity material and this may influence the accuracy of the seismic calculations.

The section between pegs 10,800 and 14,000 along Line 1 was surveyed with the seismic refraction method but the results of this work proved to be too difficult to interpret and are not shown.

Resistivity profiles obtained with electrode spacings of 50, 100, and 150 ft along Line 1 did not reveal features that could be associated with the Gibsonvale lead.

Area 2

The results of test surveys made along Lines 38 and 40 in Area 2 are shown in Plate 4. Both lines cross the Kikoira lead where its locations are known from drilling.

The gravity profiles of Line 38 and 40 show 'lows' which appear to indicate the position of the Kikoira lead. However, it is quite possible that these may be caused by positive anomalies due to the weathered granite that crops out east of the lead. If the gravity 'low' along Line 38 is due to the bedrock depression associated with the Kikoira lead, the deepest part of the alluvial channel would appear to be at about peg 2500. Recent drilling at pegs 2500, 2400, and 2300 did not discover any additional wash although it is quite possible that in some holes drilling may have been stopped too soon.

The seismic cross-section of Line 38 shows three refractors, none of which appears to indicate the position of the alluvial channel. Velocity logging at pegs 2500, 2400, and 2300 (see Plate 4) shows velocities of from 2500 to 3500 ft/sec for the alluvial material above the weathered bedrock surface. These velocities do not differ from those obtained over weathered granite outcrops east of peg 1600, thus making impossible the use of seismic work for differentiation between weathered bedrock and overburden. A direct determination of seismic velocity in weathered bedrock was made in a shaft near peg 600. The weathered granite above the bottom of the shaft, which was 41 ft deep, showed a velocity of 2900 ft/sec, which agreed well with the velocity obtained from time/distance curves. There is a distinct change in velocity in the unweathered bedrock east of peg 1600. Velocities of from 14,000 to 17,500 ft/sec may correspond to granite, while velocities of from 10,000 to 12,000 ft/sec are considered to correspond to Ordovician sediments. The lead is situated close to the contact between granite and slate.

The seismic cross-section of Line 40 suggests that the base of the lead is at the interface between the refractors with velocities 2000-2600 ft/sec and 3000-3800 ft/sec. The change in seismic velocity in the unweathered bedrock east of peg 2300 probably indicates the contact between granite and slate.

The apparent-resistivity profiles for lines 38 and 40 indicate high resistivity over the area where the granite crops out. A well-defined resistivity 'low', coinciding in position with the alluvial channel, is shown on Line 40. It is possible that the resistivity 'low' indicated between pegs 1200 and 1400 on Line 40 may be caused by a branching of the Kikoira lead.

The results of geophysical work along Lines 3 and 6 are shown in Plate 5. These lines were drilled on a recommendation based on a preliminary interpretation of seismic and gravity results. All the holes drilled were subsequently velocity-logged, and the results obtained were compared with those obtained from time/distance curves.

The seismic results of Line 3 show three refractors. The interface profile between the 3500-ft/sec and the 4500-ft/sec refractors shows similarity to the bedrock-surface profile obtained from drilling, but the correlation is rather poor. Calculated depths to this interface for DH No. 1 and DH No. 2 were correct, but those for the other drill holes were wrong. Velocity logging of DH No. 3 and DH No. 4 indicated that the seismic velocity in the overburden above the weathered granite surface is 2600 ft/sec. This velocity was not indicated on the time/distance curves, and was not taken into consideration in depth calculations.

There is good correlation between geophysical results obtained with the three different methods. The position of the lead is best determined by the resistivity method. However, the information obtained from resistivity results is only qualitative and no reliable information can be given as to depth, width, or shape of the lead.

Drilling on Line 3 proved that there is a depression in the weathered bedrock at the suggested location, but that it contains no alluvial tin. This is rather puzzling as lode tin can be seen in quartz veins that crop out about 500 ft north of these drill sites.

The seismic results of Line 6 show four refractors. The general shape of these refractors is rather flat, thus presenting difficulties in the selection of drilling targets based on seismic results. Drilling targets were recommended, however, by taking into consideration the deepest points of each seismic interface in conjunction with the gravity results. Subsequent drilling showed poor correlation between drilling and geophysical results although traces of cassiterite were found in DH No. 1 and DH No. 4. All these holes were drilled until weathered laminated slate was reached, this being considered as definite bottom by the drillers and by the representatives of ATDP. However, this slate may not be the true bottom of the alluvial overburden; it was found to be underlain by granite in several holes on Line 3, and similar conditions may exist along Line 6. Velocity logging of drill holes along this line showed great variations in overburden velocity, but failed to indicate any change in velocity when the overburden changed from sand and clay to soft weathered slate or hard laminated slate. There does not appear to be any correlation between the laminated slate and the calculated interface between the 2800-ft/sec and the 3800-ft/sec refractors, the calculated interface being much deeper.

The apparent-resistivity profile for Line 6 indicates a well-defined resistivity 'low' at peg 4600, which has not yet been tested by drilling.

Portions of Lines 2, 15, and 16 in Area 2 were surveyed with the seismic method but the results were inconclusive and are not presented.

The results of three resistivity depth probes in Area 2 are shown in Plate 8. Interpretation of the probe at peg 2200 on Line 7 indicated an interface depth of 45 ft, which agreed closely with the depth to weathered bedrock from drilling. The probe at peg 11,200 on Line 2 indicated a depth of 33 ft to a layer that is probably weathered bedrock. The interpretation of the depth probe at peg 2000 on Line 16 is doubtful, as the observations appear to have been affected by surface irregularities.

The Bouguer gravity contour map of Area 2 presented in Plate 9 indicates a continuous gravity 'low' extending from peg 2000 on Line 38 to peg 2850 on Line 21. Between lines 38 and 14B, this 'low' closely follows the course of the alluvial channel (Kikoira lead) as determined from previous workings, but further north it diverges slightly from the known course of the workings and splits into two branches, one of which heads north; the other roughly follows the Kikoira-Ungarie railway line to the east. The Bouguer gravity contour map shows a strong regional effect, with the gravity values decreasing sharply from south-west to north-east. There is a well-defined gravity 'high' near the lode workings in Ordovician slate near peg 6000 on Line 6.

The map showing contours of apparent resistivity obtained by profiling with an electrode spacing of 50 ft (Plate 10) shows resistivity 'lows' corresponding roughly to the previously mentioned gravity 'lows'. The resistivity map shows a better correlation with the actual workings in the section between Lines 14B and 15B; all the known lode workings are indicated as areas of high resistivity.

Area 3

The results of the geophysical surveys made along Lines 4 and 5 are shown in Plate 6. These lines cross a southern tributary of the Gibsonvale lead. The northern course of this tributary lead is known from actual exploration; the southern extension is thought to be in Area 3.

Line 4 was selected along Bethune's Boreline 13 and Line 5 was selected along ATDP Boreline 65. Logs of these holes are not available, and it is assumed that they were drilled to reach weathered bedrock. Both lines were selected with the aim of testing the applicability of geophysical methods in Area 3.

Plate 6 suggests that the gravity results cannot be employed to determine the alluvial channel.

The seismic refraction results show an intermediate refractor having a velocity of from 3250 to 3900 ft/sec on Line 4 and of from 4000 to 4600 ft/sec on Line 5. This refractor could be helpful in determining the course of the lead.

The resistivity method, which seemed to delineate the course of the alluvial channel in Area 2, appears to indicate the position of the lead as a small resistivity 'high' flanked by resistivity 'lows'. However, this interpretation is empirical, and no satisfactory explanation could be found for the different behaviour of electrical resistivity of the overburden in Area 3. It is possible that the alluvial overburden contains some formation (possibly cemented gravel), which is less porous than the overburden and the weathered granite bedrock. Most of the resistivity work was made using the profiling method, but fifteen depth probes were also surveyed at various locations in Area 3 in an endeavour to determine the thickness of the alluvial overburden.

The apparent-resistivity contour map of Area 3 is shown in Plate 11. Electrode spacings of 50, 100, and 150 ft were used during this survey, but only the results obtained with 100-ft spacing were contoured. Interpretation of resistivity results in this area proved to be rather difficult because the lead does not appear to correspond to a resistivity 'low'. The course of the alluvial channel in Area 3 may be associated with a small resistivity 'high' extending from peg 1450 on Line 5 to peg 2500 on Line 13, but this interpretation is uncertain. The position of the lead beyond Line 13 is rather doubtful. Scattered granite outcrops in the area west and south of this line suggest that the alluvial channel may turn to the east, crossing Line 22 near peg 3900. The resistivity 'low' near peg 1800 on Line 22 may be caused by a different channel, which meets the main tributary channel near peg 2800 on Line 10B.

The high resistivity values measured in the western and southern portion of Area 3 are attributed to granite outcrops. The resistivity 'high' starting from peg 3300 on Line 12 and extending to peg 3000 on Line 22 appears also to be caused by granite outcrops. The results of drill holes at pegs 2800 and 2600 on Line 5 and the presence of scattered granite boulders indicate that the resistivity 'high' over the eastern part of Line 5 and the northern end of Line 22 is due to granite at shallow depth.

The results of resistivity depth probes in Area 3, together with histograms correlating the resistivity and seismic results, are shown in Plate 8. The depth probes failed to give the depths to weathered bedrock, partly because no pronounced resistivity discontinuity existed, between overburden and weathered bedrock and partly because the unhomogeneous nature of the overburden produced resistivity discontinuities that were not related with the depths to the weathered bedrock. The high resistivity close to the surface is interpreted as being caused by a hard lateritic layer. The bottom section of relatively high resistivity may be attributed, in some cases, to weathered bedrock and, in other cases, to various intermediate cemented layers within the overburden. The low-resistivity section is generally considered to be caused by the overburden. However, there are cases, e.g. peg 2800 on Line 5, where low-resistivity layers are due to much-weathered granite bedrock located close to the surface.

Seismic refraction work along Lines 10, 11, and 12 (Plate 7) failed to produce results useful in locating the alluvial channel in Area 3. However, the existence of a low-velocity layer underlying the 3800 to 4500-ft/sec layer, at peg 2400 on Line 11 and peg 3000 on Line 12 (Plate 7), may be interpreted as indicating areas where weathered granite comes to the surface. It follows that the alluvial channel may be located between these pegs, which agrees with the interpretation of the resistivity results.

6. CONCLUSIONS AND RECOMMENDATIONS

Surveys made with gravity, seismic, and resistivity methods in three areas in the Kikoira/Gibsonvale district indicate that the usefulness of geophysical prospecting in this district is limited.

In Area 1 none of the methods gave conclusive results and the position of the alluvial channel could not be located by geophysical methods. Similar results had been obtained independently by two previous surveys in the main Gibsonvale area.

In Area 2 the gravity and resistivity results appear to delineate the general course of the Kikoira lead quite well. Both the gravity and the resistivity results indicate branching of the Kikoira lead north of Line 16, with one branch continuing to the north while the other follows the Kikoira-Ungarie railway line to the east. The northern branch promises to be tin-bearing, because it is located near old lode workings indicated by numerous shafts.

Seismic results appear to show an intermediate refractor of 3800 to 4500-ft/sec velocity, which may indicate the weathered bedrock topography of the buried channel. Drilling carried out along Line 6 has not intersected the alluvial channel. However, drilling along this line was stopped in weathered laminated slate. It is possible that this weathered slate is not the true bottom of the alluvial overburden.

It is recommended that the two alluvial channels indicated in Area 2 be systematically drilled, starting in the south, where the position of the channel is known, and proceeding to the north. It is suggested that drilling on Line 7 should be continued to the south until definite high ground is reached. Drilling along Line 15B (between pegs 1000 and 1800) and Line 15C(between pegs 1400 and 2000) should follow. These will give a clear indication of the usefulness of the geophysical results.

A drill hole at peg 4600 on Line 6 is also recommended. This hole should be drilled to a depth of roughly 60 ft, irrespective of the depth at which laminated slate is reached, to test whether the weathered laminated slate is true bedrock or not.

In Area 3 gravity and seismic results did not indicate the position of the alluvial channel, while the resistivity results appear to indicate a small resistivity 'high', flanked by resistivity 'lows', which may delineate the course of the lead. Based on this interpretation, the course of the lead may continue in a south-easterly direction passing through pegs 2900 (on Line 11), 2600 (on Line 12), and 2500 (on Line 13). Beyond Line 13 the lead appears to change its course towards the east, intersecting Line 22 at peg 3900. However, this interpretation is empirical and uncertain, being based solely on a comparison of resistivity and drilling results along Lines 4 and 5 (Plate 6).

A limited amount of drilling to test the usefulness of the resistivity interpretation is recommended in Area 3 prior to any large-scale exploration. Test drilling along Line 12, for instance, could prove whether the resistivity 'high' indicated at peg 2600 has any connexion with the position of the alluvial channel. It is suggested that drilling be done on this line starting from peg 3000, where shallow bedrock is expected, and continuing systematically until shallow bedrock is reached in the west. A distance of 100 ft between drill holes is suggested. Any additional drilling in this area should be considered only after assessment of drilling results along Line 12.

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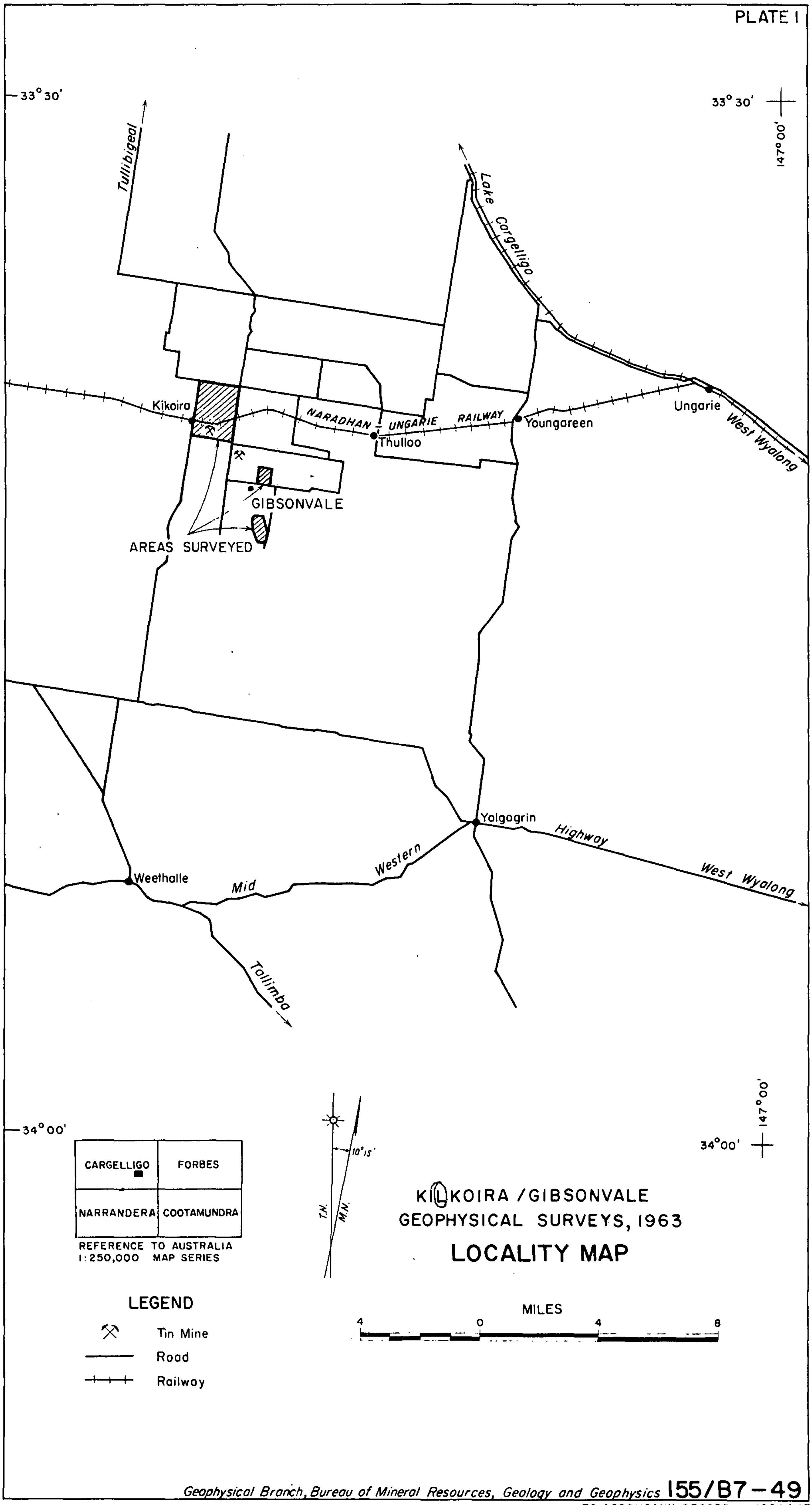
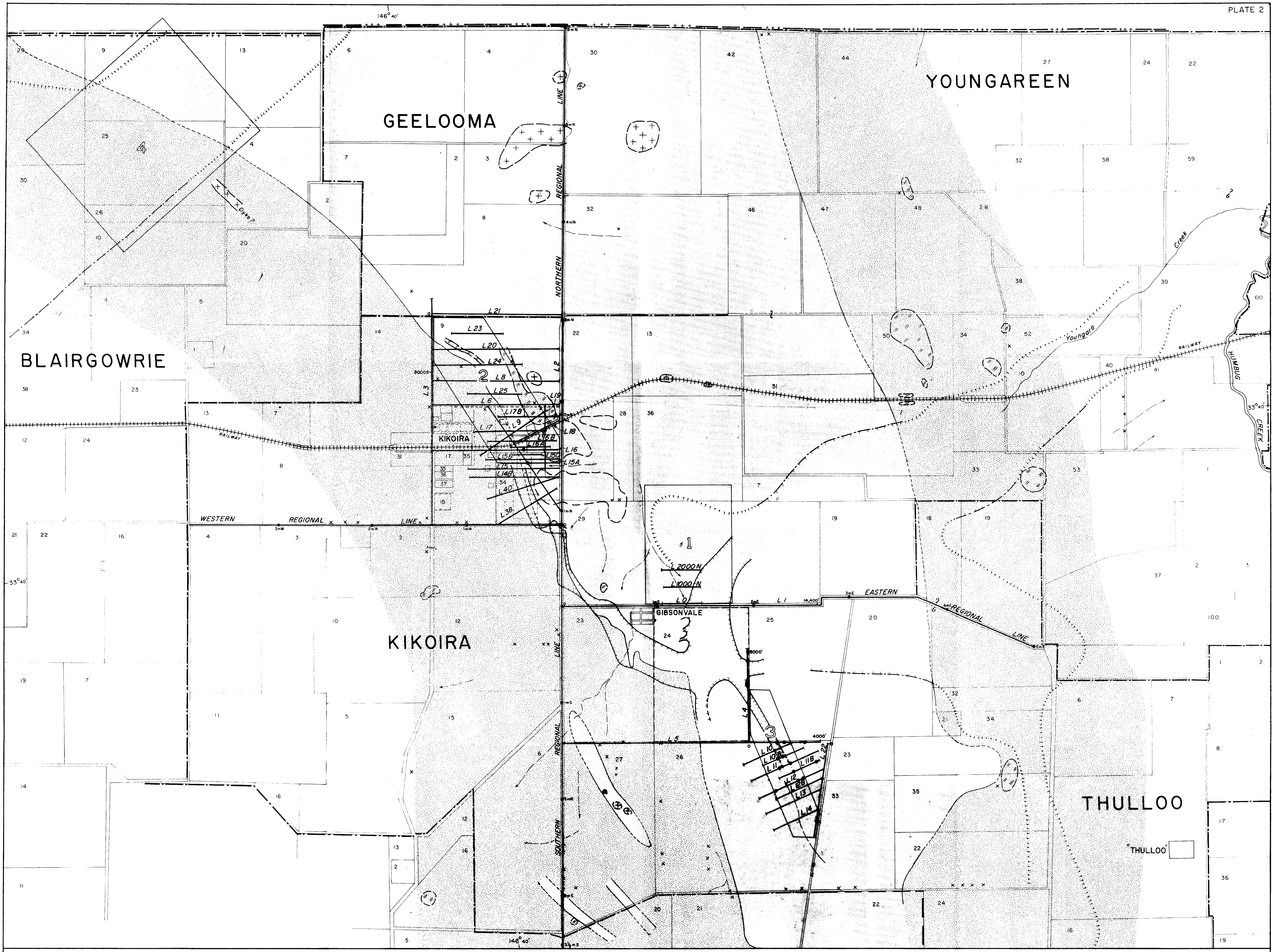


TO ACCOMPANY RECORD No.1964/147

PLATE 2



LEGEND

- Approximate boundary of alluvial soil
- Assumed boundary of alluvial soil
- Defined boundary of Kikoira and Gibsonvale leads
- Approximate boundary of above leads
- x Single small outcrops
- Alluvial line
- Geologic contact (approximate)
- Geologic contact (assumed)
- 3 Areas proposed for geophysical investigation (Number indicates order of priority)
- Area of gravity survey by Geological Survey of NSW 1962
- + + Granite - outcrops
- Granite - soil covered
- Sediment - outcrops
- Sediment - soil covered
- Resistivity depth probe
- County boundary
- Parish "
- Shire "

SCALE

40 0 40 80 120 160 CHAINS

1/2 0 1/2 1 1 1/2 2 MILES

Geology by G J Westner, March 1962

COMPOSITE PARISH PLAN SHOWING
GEOLOGY AND LOCATION OF GEOPHYSICAL TRAVERSES

Based on ATDP Gibsonvale Tinfield Geological Map, 1962

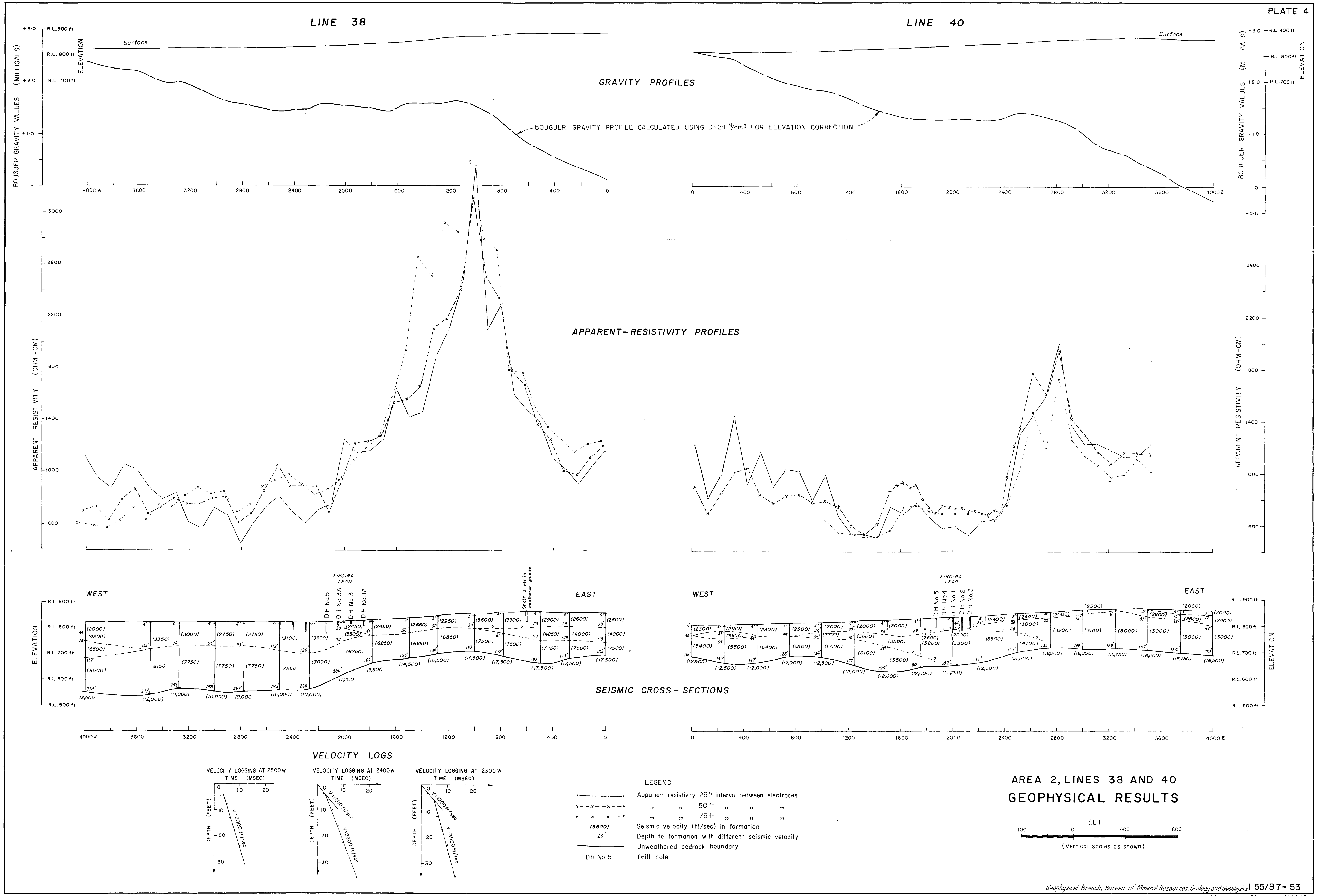
Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics I55/B7-50

TO ACCOMPANY RECORD No. 1964/147

PLATE 3

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics I55/B7-51

TO ACCOMPANY RECORD No 1964/147



KIKOIRA - GIBSONVALE SURVEY, NSW 1963

TO ACCOMPANY RECORD No. 1964/147

KIKOIRA - GIBSONVALE SURVEY, NSW 1963

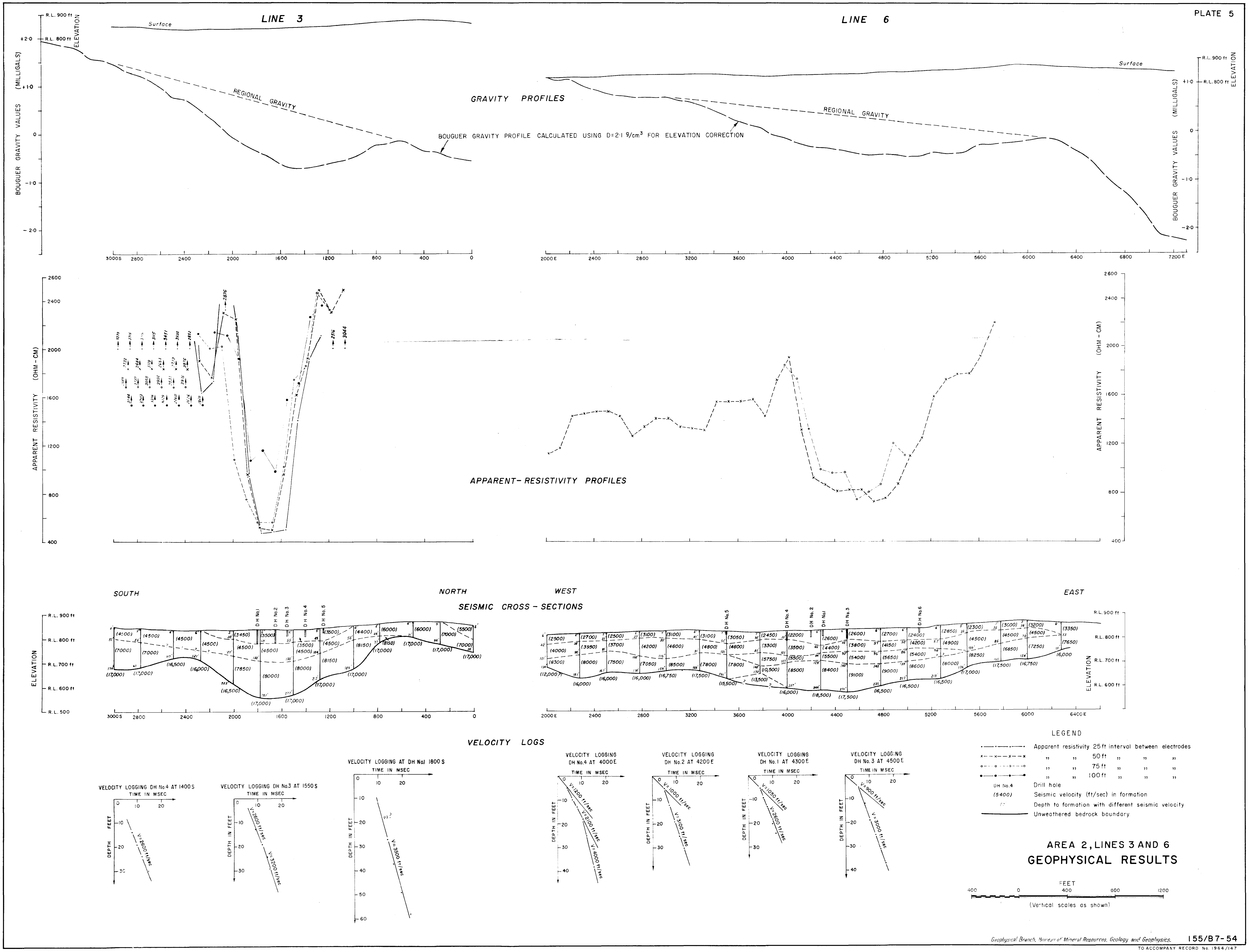


PLATE 6

AREA 3, LINES 4 AND 5
GEOPHYSICAL RESULTS

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics I 55/B7-55

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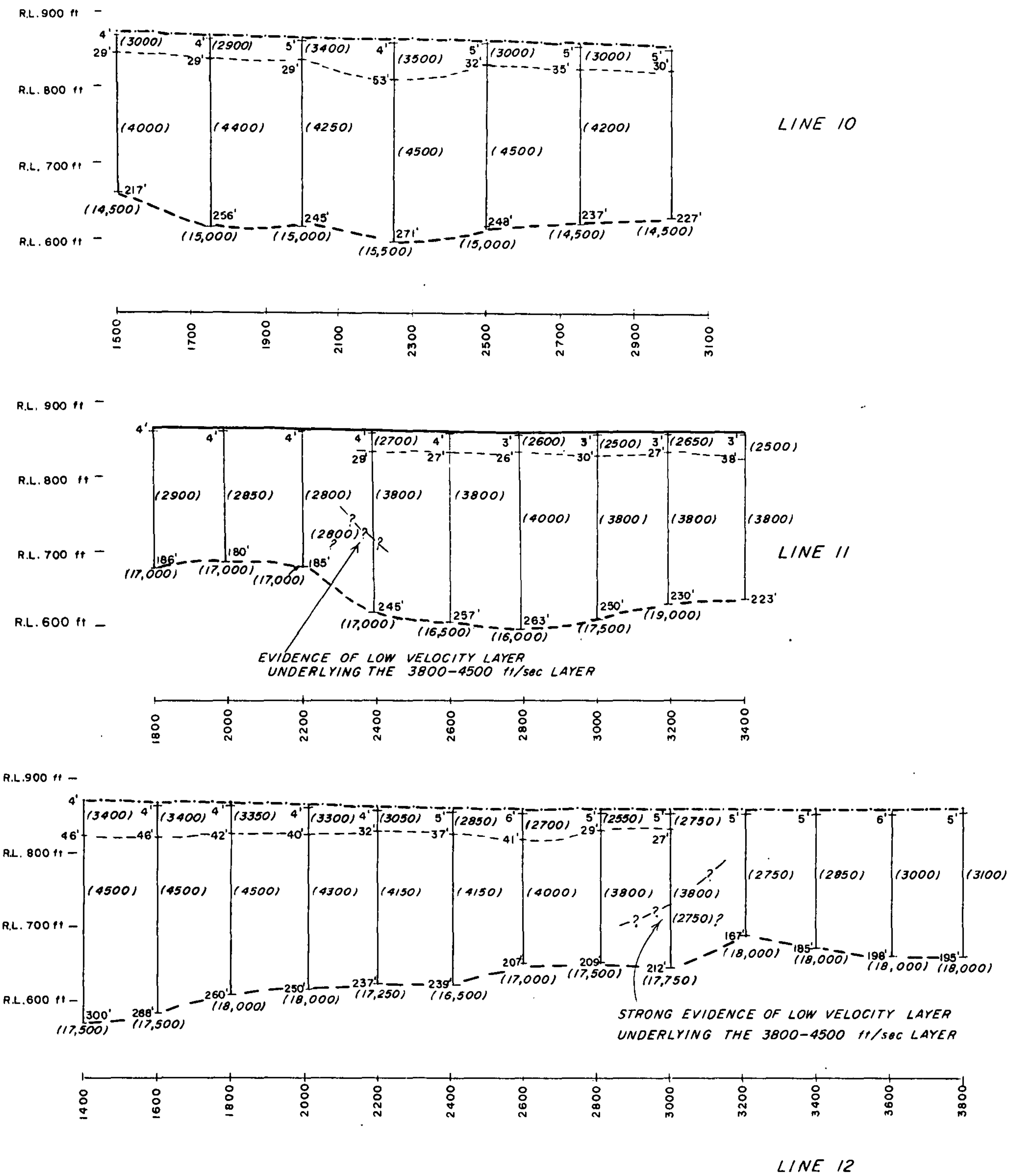
KIKOIRA - GIBSONVALE SURVEY, NSW 1963



SCALES

HORIZONTAL	400	0	200	400	600	800	FEET
VERTICAL	200	0		200		400	FEET

LEGEND

(3400) Seismic velocity (ft/sec) in formation

6'— Depth to formation with different seismic velocity

AREA 3
SEISMIC CROSS-SECTIONS

PLATE 8

KIKOIRA/GIBSONVALE
RESISTIVITY DEPTH PROBES

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics

I 55/B7-60

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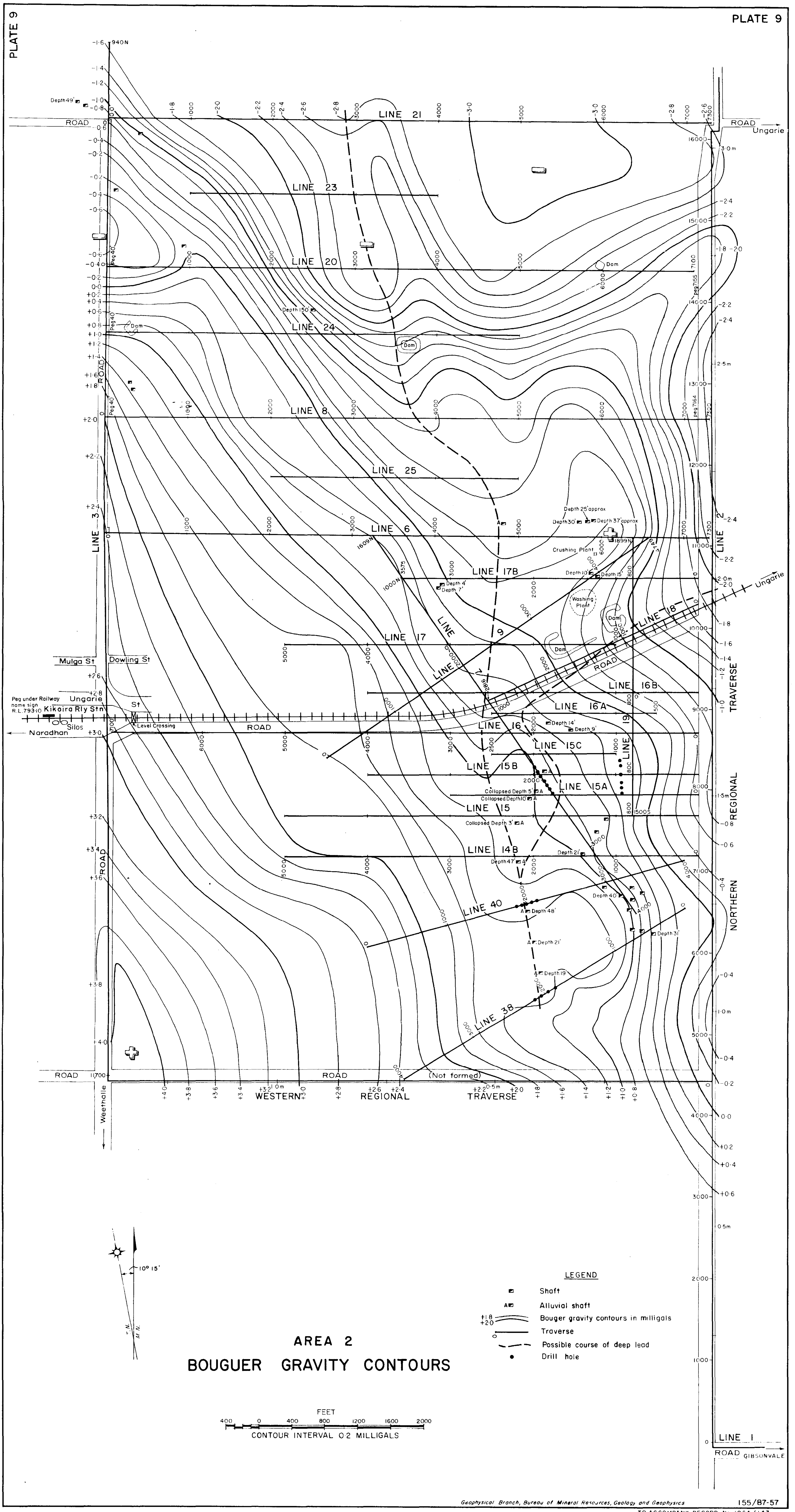

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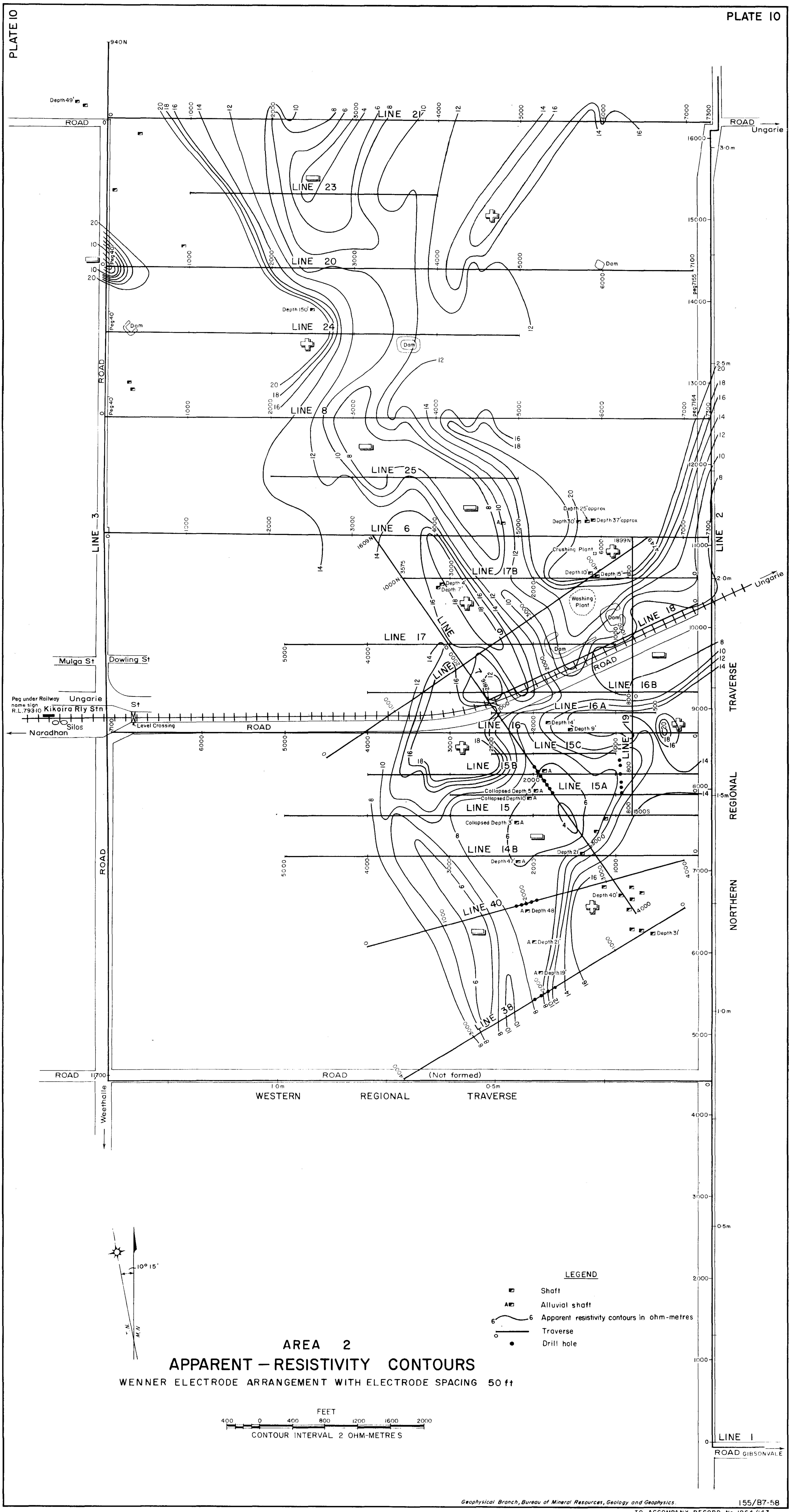
PLATE 10



AREA 2
APPARENT — RESISTIVITY CONTOURS
WENNER ELECTRODE ARRANGEMENT WITH ELECTRODE SPACING 50 ft

FEET 400 0 400 800 1200 1600 2000

CONTOUR INTERVAL 2 OHM-METRES

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. 155/B7-58

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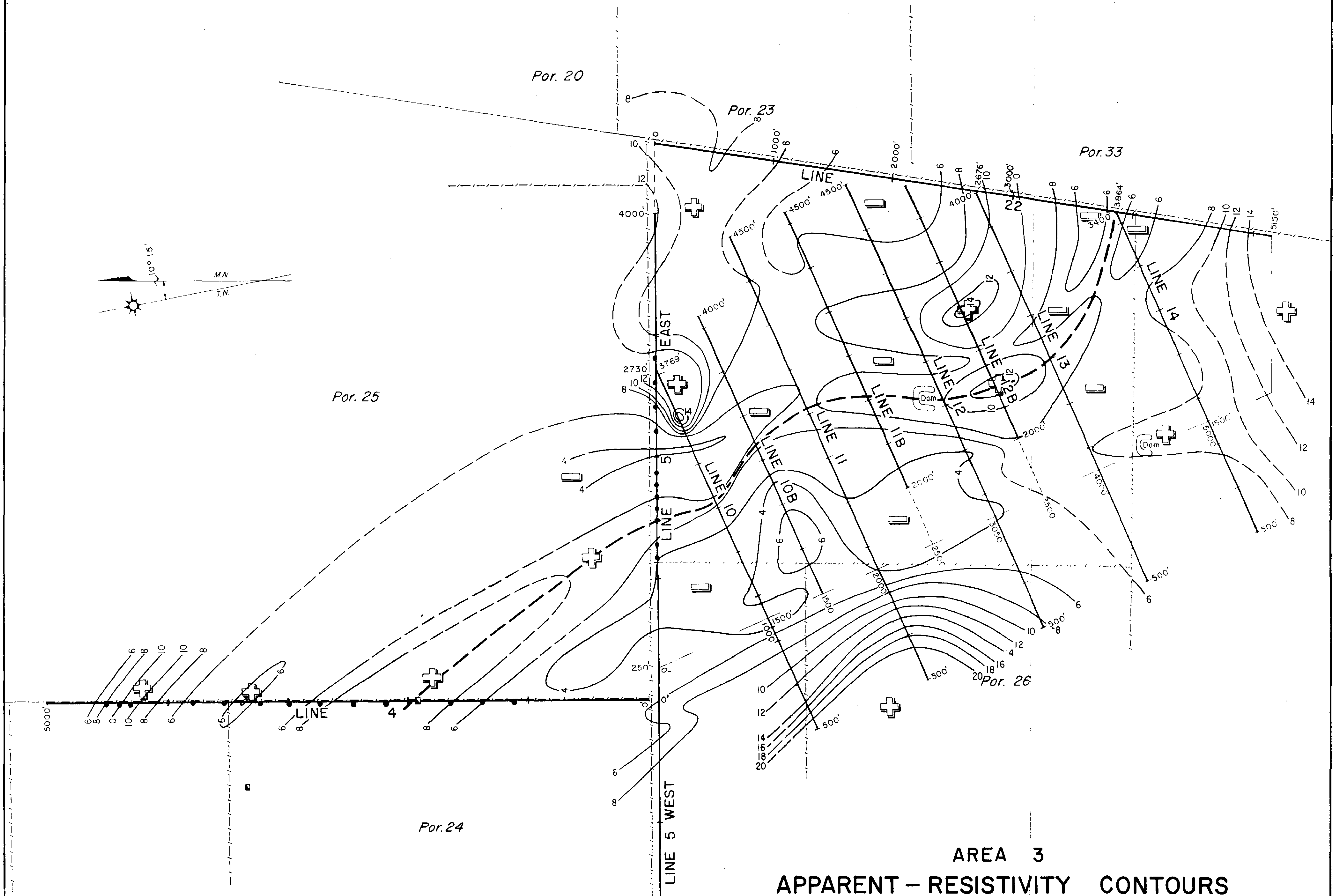
PLATE 11



AREA 3

APPARENT – RESISTIVITY CONTOURS

WENNER ELECTRODE ARRANGEMENT WITH ELECTRODE SPACINC 100 ft

LEGEND

- Shaft
- Apparent resistivity contours in ohm-metres
- Traverse
- Possible course of deep lead
- Drill hole

FEET

400 0 400 800 1200 1600 2000

CONTOUR INTERVAL 2 OHM-METRES

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics.

155/B7 59

TO ACCOMPANY RECORD No 1964/147