THE BROKEN HILL PROPRIETARY COMPANY LIMITED

REPORT

ON

MT. WELLS TIN MINE

NORTHERN TERRITORY

MELBOURNE:

27th March, 1958.

W. C. SMITH

REPORT

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I N D E X.

PLANS ACCOMPANYING REPORT.

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SUMMARY.

Mt. Wells Tin Mine is held by this Company under option to purchase for £35,000, and the option is due for renewal for a further period of twelve months on 30th May, 1958, at a price of £1,000. The mine has produced a total of 1,000 tons of metallic tin from 99,000 tons of ore treated in the period 1879 to 1928 inclusive, giving a recovered grade of 1.01 per cent metallic tin. Assuming continuity with depth, the maximum ore reserves which can be expected in the three principal lodes down to battery level would be of the order of 100,000 tons of recoverable grade 1 per cent. Deep mining may produce an additional 360 tons of ore per vertical foot, but exploration and development at depth may be costly if it involves a search for new ore shoots.

During 1957, this Company drilled three diamond drill holes, mapped and sampled the accessible workings, and mapped the surface. Total expenditure on the area was £15,283. The drill cores and samples were assayed, but the results appear to be inconsistent and do not give any reliable indication of reserves or grade. The results of the drilling are not inconsistent with the conclusion obtained from mapping, that the lodes pitch to the north, but the evidence is inconclusive. Surface prospecting beyond the leases at Mt. Wells has found no evidence of other significant tin lodes.

Should the mine be considered worth an additional expenditure of between £5,000 and £30,000 on exploration, it is recommended that two short holes of 200 feet and 250 feet be drilled at the northern end to test whether Main Lode and West Lode pitch to the north. If these give positive indications, it is recommended that further testing be carried out by sinking and driving on the lode, to give adequate bulk sampling.

If further investigations are to be made, it should be possible at this stage to negotiate a new option agreement at a substantially lower purchase price, on the basis of the unsatisfactory results obtained to date.

INTRODUCTION.

On 31st May, 1957, this Company obtained a free-working option over the Mt. Wells tin leases, north of Burrundie, N.T., and from June to November inclusive, a party of from five to eight Company employees and two contract drillers, under the charge of Mr. L. G. Hollingworth, carried out an investigation of the mine by mapping, sampling and diamond drilling.

This report gives a summary of the history and production record of the mine, quoted from or deduced from previous reports, and discusses the results of the Company's investigations. Recommendations are made concerning additional work required for a reasonable assessment of the mine.

PREVIOUS REPORTS.

A total of 25 reports by Government surveyors, geologists and mine inspectors have been examined. Of these, the most important are:-

Tennyson-Woods, J.E.; Reports of the Northern Territory of South Australia, 1885 and 1886.

Sabine, Gustav (Government Surveyor) Reports of N.T. of S.A., 1893.

Jensen, H. I., Gray, G. J., and Winters, R. J., Northern Territory Bull. No. 16, 1916 (including full quotations of reports by Brown, H.Y.L., 1895 and 1906, and Oliver, T.G. 1913).

Rayner, J.M. and Nye, P.B., A.G.G.S.N.A. Report N.T. No. 15(a).

Mr. Macandie of this Company briefly reported on Mt. Wells in a memorandum for Mr. Hockey dated 23rd December, 1940. In his report he referred to three privately held reports by Ellis, H.A., 1926, Bell, N.C., 1929 and Hughes, W.A., 1940. These have not been located.

HISTORY.

Tin was first discovered at Mt. Wells in 1879. In 1885, the Port Darwin Mining Co. was formed, with a capital of £120,000, a sum equal to three-quarters of the total value of metallic tin which was to be produced by the mine in fifty years of production. From 1885 to 1889, the Company carried out extensive development and spent large sums on water supplies and plant, but actual production probably did not exceed 60 tons of metallic tin. Three adits, shafts and drives were put in to Main Lode, two dams were built and a battery erected in 1886. However, water supplies were still inadequate for the treatment plant, so a 1¾ mile pipeline was run from the McKinley River in 1888, and a large amount of new plant was ordered. Treatment problems appear to have caused over-expenditure on plant and development without corresponding production, and, in 1889, the Company was in financial trouble following the complete failure of a new roller mill and the purchase of a thirty-head stamp battery.

In 1890, the Company was re-formed as the New Port Darwin Mining Co. They proceeded with the erection of the thirty-head stamp battery and began another major programme of development. In 1894, an additional twenty head of stamps were being erected, and about 2,000 tons of ore were treated. The Company was still operating the mine in 1895, but must have ceased operations shortly thereafter, probably because of a sharp fall in the price of tin. Again, production was probably not greater than 20 tons of metallic tin per annum, despite

heavy expenditure on development and plant. By this stage, Main Lode was developed to the present No. 3 Level, and the mine was fully equipped with a large plant.

The Daniels Bros. probably commenced work in the area about 1899, following a sharp rise in the price of tin. Until 1902, they appear to have worked mainly the alluvial tin north of the mine, but in 1901, they purchased the Mt. Wells leases, and mining commenced, using Chinese tributers, in 1902. The treatment plant appears to have become the property of the Crown, but was sold, presumably to Daniels Bros., in 1905. Mining operations were continued, using Chinese tributers, until 1914, and this period appears to have been the most productive and profitable in the history of the mine. The West Lode was opened up in 1906, yielding the highest ore grade recorded from the mine, and the peak production was 89 tons of metallic tin in 1910.

Mining ceased in 1914, as a result of a fall in the price of tin. In 1915, a few Chinese tributers produced a small parcel from surface workings, and in 1916, low-grade ore from the West Lode dumps was put through the battery. Mining was resumed in 1917, with the letting of a new tribute.

In 1919, the mine came under new ownership, possibly the miners' co-operative named the Mt. Wells Company, which Rayner and Nye record as having taken over in 1922. The new owners commenced work on East Lode, which yielded slightly higher grade ore than average for Main Lode. By 1921, they were again working Main Lode, but operations were unprofitable because of the low price of tin.

No record can be found of the years 1922 and 1923, but by 1924, Chinese tributers were again working the mine. Production under tribute continued until early 1929, when the mine was finally closed because the remaining Chinese tributers were too few and too old to maintain satisfactory production. By this time the mine had become the property of a Mr. McKeddie.

On the death of Mr. McKeddie, the mine became the property of his beneficiaries, until it was forfeited to Messrs. Harris and Jones in 1956. Harris and Jones produced one small parcel of hand-picked ore from dumps in 1956, but it appears that their main aim was to find a buyer for the mine.

LOCATION AND ACCESS.

Mt. Wells Mine, as shown in Figure I, is 3½ miles by road north of Burrundie Siding, which is 124 miles by rail south of Darwin. The road from Burrundie to the mine is formed and partly gravelled, and may be regarded as an all-weather road, except for two small creek crossings and a soil flat which may need a little work. Mt. Wells is also 136 miles by road from Darwin. From Darwin to Fountain Head is a good bitumen highway, but the 19 miles from Fountain Head is a very dusty graded-earth track, which would be impassable for at least short periods in the wet season.

TIMBER AND WATER.

The vegetation of the Mt. Wells area is open forest of eucalypts, including Bloodwood and Moreton Bay Ash, with some Ironwood. These should be adequate for mine timber.

The only surface water near the mine is in two small dams, which could not be relied on for continuous supply for operations in the dry season. There is one bore at the old Army camp near the mine, but neither the quality nor quantity of water available from this source are known. Additional water can be pumped from the McKinley River, about 1¾ miles east of the mine, and a large dam could be constructed, if necessary, on the river, about three miles southeast of the mine. The Department of Works installed a hydrological recording station at this site in September, 1957.

TITLES AND OPTION.

Messrs. R. C. Harris and A. R. Jones hold Mineral Leases Nos. 140B, 141B, 142B and 143B, covering the principal lodes and workings at Mt. Wells. In addition, they hold Machinery Area No. 2B, where the old stamp battery was erected, and Water Rights Nos. 7B and 8B, covering the two dams.

On 31st May, 1957, they signed an agreement giving this Company a free working option over the four leases, the machinery area and the two water rights. The agreed purchase price was £35,000, and the agreement was for a period of six months, with right to extend for periods of six months, twelve months and six months consecutively on payment of £1,000 for each extension. The right to the first extension was exercised by the Company on 30th October, 1957, so that the option was extended until 30th May, 1958.

PHYSIOGRAPHY.

Mt. Wells is the highest peak in a range of hills trending west of north from Burrundie, parallel to and west of the McKinley River. The hills are steep, with slopes commonly over 30 degrees, and Mt. Wells Trig. stands 866 ft. above mean sea level. It is probably about 700 ft. above the nearby alluvial plain of the McKinley River, and 500 ft. above the small creek on its eastern side.

To the south of Mt. Wells is a region of dissected hills, forming the divide between the Mary River and Daly River systems, and to the north is the more mature topography of the Mary, McKinley and Margaret Rivers, with isolated ranges of steep hills standing out from wide flood plains.

GEOLOGY.

STRATIGRAPHY:

The range of hills which includes Mt. Wells consists of a sedimentary formation which the Bureau of Mineral Resources has named the Burrel Creek Formation. They place it as the lowest member of the Brocks Creek Group, at the base of the Lower Proterozoic sedimentation of the Katherine Darwin Region. They describe the Burrel Creek Formation as consisting principally of greywacke siltstone with minor amounts of quartz greywacke and quartz siltstone. On the eastern side of the McKinley River, the Burrel Creek Formation is overlain by the Golden Dyke Formation, consisting of quartz siltstone, chert, silicified dolomite and marl. This in turn is overlain to the east by the Masson Formation, in which coarse quartz greywacke is predominant. All three formations are intruded by granite plutons and diorite dykes and/or sills. The nearest outcrop of granite to Mt. Wells is the Prices Springs Granite, less than ¾ mile west of the mine.

Mt. Wells itself consists entirely of one rock type. In the unoxidised zone in No. 3 Adit, and in the three drill holes, the rock is a grey carbonaceous pyritic micaceous siltstone, with a few thin bands containing quartz sand. The low grade of dynamic metamorphism in the area indicates that the mica is a primary clastic constituent of the sediment, probably sericite. Near Main Lode, the grains of mica are commonly unoriented, but on the eastern side of the mountain the micas have been re-oriented in a place of lineation not normally parallel to the bedding, giving the rock the appearance of a schist. The apparent grainsize of the mica varies considerably particularly in the unoriented material, but this may be due to grouping of the mica rather than the original size of the clastic grains.

STRUCTURE:

The effects of weathering and schistocity have completely obscured the bedding in outcrops at Mt. Wells, but definite bedding was observed in Nos. 2 and 3 Adits, in the tramtrack cutting east of No. 3 Adit portal, and at three places in cuttings at the northern end of Main Lode. These observations, although not sufficient for detailed mapping, give a general indication of the structure in the vicinity of the mine.

As shown in Figure II, the lodes occupy an en-echelon zone on the western limb of an asymmetric anticline. The trace of the axis of the anticline on the horizontal plane at No. 3 Level strikes nearly due north from a point just west of East Lode intersection in No. 3 Adit, but the trend of folds ½ mile north of the mine suggests that the anticlinal axis swings west of north beyond the northern end of Main Lode. An observation of possible bedding at the portal of No. 2 Adit suggests that the axis of the anticline passes near the portal. This would give the axial plane of the anticline a dip of 55 degrees east at Nos. 2 and 3 Adits, but there is limited evidence that its dip steepens to the north. At the northern end of Main Lode, the axial plane probably dips at least 60 degrees east, and ½ mile north of the mine the axial planes of folding are nearly vertical. The adjacent syncline to the west of the anticline is not shown in Figure II, but inconclusive evidence suggests that its axial plane is roughly parallel to that of the anticline and passes to the west of the trig station at the surface and just west of the southern end of Main Lode workings on No. 3 Level.

In No. 3 Adit, the anticline has a northerly pitch of between 5 and 10 degrees, but, at the northern end of Main Lode, the pitch is about 20 degrees north. All folds mapped by the Bureau of Mineral Resources for several miles north of the mine pitch to the north.

The western limit of the anticline is nearly vertical, with little or no minor folding. Bedding in Nos. 2 and 3 Adits and at the northern end of Main Lode strikes nearly due north and dips west at an average of 85 degrees. Schistocity is present but not strongly developed, and the rocks are generally massive and strongly jointed. In No. 3 Adit, the schistocity on the western limb strikes at about 320 degrees and dips 35 degrees northeast, and the many joints include planes parallel to the lodes, parallel to the crest of the anticline, and transversely across the anticline.

The eastern limit of the anticline is flatter with strong minor folding east of No. 3 Adit portal. Bedding in No. 3 Adit strikes between 315 and 356 degrees with dips of between 20 and 25 degrees to the northeast. Schistocity is well developed with a strike of 325 degrees and dip of 45 degrees northeast in No. 3 Adit and average strike of 335 degrees and dip 35 degrees northeast in outcrops. Jointing is similar to the western limb of the anticline, but slightly less prominent.

LODES AND MINERALIZATION:

Tin mineralization is widespread in the district, mainly with iron oxides in narrow quartz veins, around the margins of granite outcrops. At Mt. Wells, the tin lodes occupy a number of en-echelon fracture zones on the western limb of the anticline. They strike at about 10 to 25 degrees and range in dip from steeply west to 55 degrees east. West Lode dips steeply west at its northern end and steeply east at its centre, Main Lode averages about 83 degrees west and East Lode ranges from 55 to 60 degrees east. The eastern or hanging walls of the lodes are occupied by strong quartz veins up to 2 feet thick containing cassiterite and sulphides including pyrite, arsenophyte, chalcocite, and minor amounts of chalcopyrite and molybdenite. The remainder of the width of each lode is a

stockwork of crushed quartz and siltstone mineralized with quartz, fine cassiterite and iron oxides, in the oxidised zone. The stockworks are oxidised down to No. 3 Level.

In West Lode, the highest-grade shoots were found near the northern end in closely fractured zones roughly parallel to the bedding and running off the main fracture at an acute angle. In Main Lode, the highest-grade ore of substantial width occurred in the centre and southern end. Towards the northern end, the lode widened, but with corresponding fall in grade, and at both ends the lode deteriorated into several narrow veins. East Lode also widened and fell off in grade at its northern end, near the axis of the anticline.

A large number of thin quartz veins occupy joint planes and minor faults throughout the mountain. Many have sulphide mineralization and pyrite, arsenopyrite, chalcopyrite, chalcocite and/or minor molybdenite, and some carry cassiterite or wolfram, particularly near the margins of the veins. A number of these small veins have been worked in shallow pits and costeans. All quartz veins have muscovite on their margins, probably from recrystallization of the sericite in the country rock, and some contain minor amounts of pink felspar.

INTERPRETATION:

In the vicinity of Mt. Wells, the soft, relatively incompetent siltstones of the Burrel Creek Formation have been folded, probably about the beginning of Upper Proterozoic time, and intruded by the Frices Springs Granite. The folding was not sufficiently intense to produce drag folds or a high degree of metamorphism, but did produce fracture patterns for the emplacement of tin lodes. The proximity of the tin lodes to the granite throughout the district suggests that the granite was the source of mineralization.

At Mt. Wells, the emplacement of the major tin lodes was controlled by certain local factors. A cupola or apophysis of the Prices Springs Granite outcrops less than 4,000 feet west of the mine. Locally the folding was asymmetrical although it was nearly symmetrical elsewhere in the district. This suggests that although the regional orogenic forces were compressive, the rocks at Mt. Wells were subjected to the localized operation of a couple, possibly related to local eastward intrusion of the granite. During the folding, the micaceous nature of the original sediments favoured the development of schistocity, which, at Mt. Wells, was more strongly developed on the flatter eastern limb of the asymmetric anticline, and the rocks on the steep western limb remained relatively unoriented and massive. The result was that the stresses developed in folding were partly relieved by creep in the schistose rocks on the eastern limb, thereby preventing the development of fracture zones for lode emplacement, whereas the western limb developed strong jointing and en-echelon fracture zones, which now constitute the major tin lodes.

Mineralization at Mt. Wells was contemporaneous with the major fracturing and presumably with the later stages of folding. As the major en-echelon fractures developed they were filled and re-cemented with quartz veins; then, as movement continued, the stronger development of jointing allowed shattering of the adjacent rocks and smaller veins. The mineralization of these shattered zones formed the stock-works which have provided a large part of the ore mined at Mt. Wells. The sulphides associated with the tin lodes may not have been original constituents of the mineralizing solutions, but may have been concentrated by leaching from the carbonaceous sulphide-bearing country rock.

Assuming that the major tin lodes are confined to the western limb of the anticline at depth, as they are at the surface, the lodes should pitch parallel to their intersection with the axial plane of the

anticline. Thus, Main Lode may pitch northeast at about 40 degrees, West Lode may have a slightly shallower northerly pitch, and the pitch of East Lode may be about 50 degrees to the east, nearly down its dip. The inferred trace of the axial plane of the anticline on the surface, as shown in Figure II, is nearly parallel to the outcrop of the northern end of Main Lode, indicating that the intersection of lode and axial plane would pitch slightly steeper than the slope of the hill, which is 35 degrees. These figures, however, cannot be taken as more than a rough guide, because small changes in strike and dip of the lodes relative to the anticline would cause marked changes in pitch.

The width and grade of ore shoots in the mine vary considerably, mainly due to the nature of the fracturing in the stockworks. The fractures appear to have spread out approaching the fold axis giving the wide low-grade zones towards the northern ends of Main Lode and East Lode and deterioration of both ends of the lodes into a number of small veins. The widening of the fractured zone at the northern end of West Lode has produced a number of smaller high-grade ore shoots, possibly because the fractured zone is more nearly parallel to the bedding.

WORKINGS.

Four lodes have been worked by underground mining on the Mt. Wells leases, and many small leaders have been tested or worked by shallow pits and costeans, as shown in Figure III.

MAIN LODE:

Main lode has been worked at three levels over a maximum length of 560 ft. by means of adits driven westerly from its southeastern side at depths of 120, 240 and 400 ft. below its highest point of outcrop. There are open cuts at both ends of No. 1 Level. Originally, a drive was put in along the

lode from the surface at the northern end on No. 1 Level, but thereafter drives were cut on the lode from the adits and an intermediate drive was put in above No. 3 Level. Little now remains of the workings on the lode above No. 3 Level, because it has been stoped out to the surface. The stoped width averages more than 10 ft. in the upper levels, but is about 5 ft. at No. 3 Level. One separate small stope with shaft, three small open cuts and one underhand stope were worked at the northern end of the lode, and a short adit was driven west into a southwestern branch of the lode at its southern end. This was worked on a small scale by both overhead and underhand stoping.

The adits are not timbered and are in good condition, but the workings on the lode are unsafe. All timbers have decayed and there is much loose material in the higher levels. In 1957, this Company cleaned out and timbered the No. 3 Level drives for sampling, but these are still unsafe because of the condition of the upper workings. In addition, a block of ground at the surface in the centre of the footwall has slipped down an average of 10 inches. This block measures roughly 80 ft. by 150 ft. with unknown depth, and, if it is sliding on easterly dipping joints, it will no doubt eventually fall into the main workings.

EAST LODE:

East Lode is roughly parallel to Main Lode, about 240 ft. to the east and offset to the south. It has been worked south from No. 3 Adit and north from a drive at its southern end over a length of 360 ft. and to a depth of 190 ft. below its highest outcrop. It has been stoped to the surface. A small adit and shaft connect with a separate small stope above No. 3 Level at the northern end of the lode.

Much of the timbering in the East Lode workings is newer and therefore in better conditions than the Main Lode timbering, but the

workings cannot be classed as safe without considerable work.

WEST LODE:

West Lode is roughly parallel to Main Lode, about 240 feet to the west and offset to the north. It has been worked partly by underhand stoping, but two adits were driven in from the eastern side in the centre, at depths of 35 and 65 feet. The lode has been worked discontinuously over a length of 700 feet, of which the southern 280 feet were worked only by shallow pits. In the centre, the lode was stoped to the surface from the adit levels over a probable total length of 300 feet, and at the northern end, there are separate small stopes extending for a further 120 feet. The width of the stopes is mainly 3 to 6 feet, but one small stope at the northern end is 18 feet wide.

Both West Lode adits are blocked by falls, and there has been a slip in an open cut in the centre of the workings. The more southerly stopes are completely inaccessible, and the remainder are unsafe because of rotted timbers and soft crumbling walls.

INTERMEDIATE LODE:

A small parallel lode, less than 2 feet wide, has been worked by underground mining, about 60 feet west of the northern end of Main Lode. It was worked from two small shafts over a length of 135 feet and to a depth of 90 feet below its highest outcrop. It has been stoped out to the surface. No. 3 Adit was driven 123 feet beyond Main Lode to cut the Intermediate Lode, but without success.

PRODUCTION.

Production figures for the mine are incomplete, but an examination of all available reports gives sufficient information for a reasonably accurate estimate of total production and grade.

TIN PRODUCTION — MT. WELLS MINE.

Year	Ore Milled (tons)	Concentrates (tons)	Grade	Metallic Tin (tons)	Grade Recovd.	Remarks
1879 to 1886			NOT RECORDED			Production probably small at development stage.
1887		20				Probably from Main Lode.
1888		40	71	28.4		
1889 to 1893			NOT RECORDED			Production probably small, particularly in 1889 and 1890.
1894				15		Quantity shipped.
1895					1.25	Reported by manager.
1896 to 1900			NOT RECORDED			No evidence that the mine was worked in this period.
1901	Nil					No production from leases.
1902		8				Only Main Lode quoted by Brown as being mined up to 1905.
1903		80				
1904		85				
1905		83				
1906	784	64	Est. 60	Est. 38.4	Est. 4.9	Probably includes ore from West Lode
1907	1,234	75.5	65	45.3	3.671	
1908	4,397	133	60	79.8	1.815	

(contd.)

TIN PRODUCTION — MT. WELLS MINE (CONTD.)

Year	Ore Milled (tons)	Concentrates (tons)	Grade	Metallic Tin (tons)	Grade Recovd.	Remarks
1909	7,820	115.10	60	69.06	0.883	Probably from Main Lode only. Oliver reported in 1913 that work on West Lode had ceased some time previously.
1910	7,339	137	65	89.05	1.213	
1911	7,417	88	67	58.96	0.795	
1912	7,400	84.95	63	53.52	0.723	
1913	6,862	51	63	32.13	0.467	Low grade ore from slip in Main Lode.
1914	6,743	66	65	42.9	0.636	From Main Lode.
1915		7.4				From shallow workings.
1916-1917	2,489	16.75	Est. 60	Est. 10.05	Est. 0.40	From dumps at West Lode.
1918	1,300	26.7	Est. 60	" 16.02	" 1.23	Probably Main Lode.
1919			NOT RECORDED			
1920	1,400	28.6 4.5	Est. 60	Est. 17.16	Est. 1.23	From East Lode. From shallow workings.
1921	800	16	65	10.40	1.30	Probably from Main Lode and East Lode.
1922 to 1923			NOT RECORDED			
1924	2,100	27.45	Est. 60	Est. 16.47	Est. 0.78	Probably from Main Lode.
1925	1,985	31.1	" 60	" 18.66	" 0.94	Probably includes ore from West Lode
1926	1,850	28	" 60	" 16.8	" 0.91	
1927	1,600	27.75	" 60	" 16.65	" 1.04	From East Lode.
1928	1,250	18.9	" 60	" 11.34	" 0.91	From both Main and East
Estimated Totals:	99,000	1,590	63	1,000	1.01	Basis of calculation given in text.

The foregoing table has been compiled from published production figures, of which the figures for the period from 1906 to 1914 are probably the most reliable. Grade for the years 1917 to 1928 excluding 1921 has been calculated on the basis of 60 per cent metallic tin in concentrates, which is the lowest grade recorded (1908 and 1909). The estimated totals have been calculated assuming an unrecorded production of 90 tons of metallic tin prior to 1895 and 20 tons of concentrates for each of the years 1895, 1919, 1922 and 1923. Wherever grade of concentrates is not given, it has been assumed to be 60 per cent, and recovered grade up to 1905 has been assumed to be 1 per cent. This may be conservative, because the only recorded grades for that period were 71 per cent in concentrates in 1888, 70 per cent in concentrates in 1903, and recovered grade of 1.25 per cent in 1895.

Of the estimated total of 99,000 tons of ore milled, probably at least 80,000 tons were won from Main Lode, 10,000 tons from West Lode, and 4,000 tons from East Lode.

The total value of tin produced from Mt. Wells was approximately £165,000, based on the annual average tin prices in Australia as recorded by the Australian Institute of Mining and Metallurgy.

GRADE.

No assay values have been published for Mt. Wells. Values quoted in reports are only estimates and range from 2 to 5 per cent for Main Lode and 5 to 6 per cent for West Lode. However, recovered grade has been published for the years 1907 to 1914 inclusive and may be inferred for subsequent years.

Main Lode recovered grade probably averaged 0.9 per cent of metallic tin. Some selection of ore was practised in the mine but probably not at the peak years of production from 1909 to 1914, because even low grade material from a fall in No. 2 Level was put through the battery in 1913.

An estimate of the quantity of material removed from Main Lode workings suggests that no more than 10 per cent was rejected. The average mine grade was therefore probably about 1.5 per cent.

West Lode recovered grade probably averaged about 2.4 per cent. This includes 2,489 tons of material from dumps put through the battery in 1917, for a recovered grade of 0.4 per cent, so little extra allowance need be made for selection in mining. The average mine grade was therefore probably about 3 per cent.

East Lode recovered grade probably averaged about 1.2 per cent, which, allowing for selection, gives an average mine grade of about 1.8 per cent.

The average recovered grade for the whole mine was slightly over 1 per cent, probably equivalent to an average mine grade of 1.6 per cent. On the basis of the average tin price in Australia for December, 1957, this grade of ore would be worth £9/10/- per ton. Allowing £1/-/- per ton for exploration costs and purchase price, this leaves £8/10/- per ton to cover development, mining, treatment, shipping, smelting, realisation, profit and contingencies.

DRILLING AND SAMPLING.

Testing carried out by this Company on Mt. Wells leases during 1957 comprised three diamond drill holes totalling 1,540 feet, and sampling of surface and underground workings. The total cost, including cost of renewal of option, was £14,766, of which the cost of drilling was approximately £8,000, or £5/4/- per foot.

D.D.1 was sited near No. 3 Adit portal, and was aimed to intersect Main Lode about 200 feet below and 200 feet north of No. 3 Adit, on azimuth 317 degrees and depression 23 degrees. Assuming continuity of dips of the

lodes, an intersection of East Lode was expected at about 125 feet and of Main Lode at about 585 feet. The hole was finished at a depth of 695 feet 6 inches. The core showed quartz sulphide veins throughout, except for an interval between 340 feet and 470 feet, and a few shorter intervals of 8 feet 6 inches or less. There were no clearly defined lode intersections and practically no cassiterite was visible in the core. From visual inspection of the core, possible East Lode intersections were 38 inches between 117 feet 2 inches and 120 feet 4 inches, or 22 feet 7 inches between 129 feet 5 inches and 152 feet. Possible Main Lode intersections were 64 inches between 473 feet 4 inches and 478 feet 8 inches or 34 inches between 535 feet 4 inches and 538 feet 2 inches. A total of 110 core samples and 29 sludge samples from D.D.1 were sent for assay.

D.D.2 used the same collar as D.D.1, and was aimed to intersect Main Lode at about 200 feet vertically below No. 3 Adit on an azimuth of 302 degrees and depression of 21 degrees. Assuming continuity of the dips of the lodes, an intersection of East Lode was expected at about 120 feet and of Main Lode at about 545 feet. The hole was finished at a depth of 596 feet. As in D.D.1, quartz sulphide veins were common. A well defined intersection of East Lode over a width of 18 feet between 117 feet 6 inches and 135 feet 6 inches contained coarse cassiterite, but there was no well defined intersection of Main Lode. A possible intersection of Main Lode occurred over 54 inches between 441 feet 6 inches and 446 feet. A total of 103 core samples from D.D.2. were sent for assay.

D.D.3 was sited 44 feet south of No. 3 Adit portal and was aimed to intersect East Lode about 200 feet below No. 3 Level, beneath the centre of its outcrop. It was aimed on an azimuth of 266 degrees at a depression of 66 degrees. Assuming continuity of the dip of the lode, the intersection

of East Lode was expected to occur at about 170 feet, and the hole was finished at a depth of 248 feet. Quartz vein mineralisation was common throughout the core, and a possible East Lode intersection with a little cassiterite was obtained over a width of 11 feet between 160 feet and 171 feet. A total of 32 core samples from D.D.3 were sent for assay.

In addition to the total of 274 samples from the three drill holes, 139 samples from surface and underground workings were taken for assay. These were:-

54 samples from the full length of the wall of No. 3 Adit, from the portal to Main Lode.
21 samples from the northern drive on Main Lode No. 3 Level.
10 samples from the southern drive on Main Lode No. 3 Level.
3 samples from a small stope at the northern end of Main Lode.
10 samples from the tram track near the southern end of Main Lode at No. 1 Level.
30 samples from West Lode workings.
3 samples from East Lode on No. 3 Level.
7 samples from shallow workings west of West Lode.
1 sample from the tram track east of Main Lode on No. 1 Level.

The samples from No. 3 Adit were taken to determine whether any wide zones of low-grade ore occur between the principal lodes, and the other samples were taken primarily as a guide to the grades worked in various parts of the mine.

All samples prepared at Mt. Wells were crushed and divided, and at least one half was retained at the mine. Core samples were obtained by crushing one half of the core after splitting and to obtain a rough guide to the grade of samples, all were tested at the mine by sliming on a Marranboy dish. The assaying of samples were carried out by three laboratories. The first shipment of samples was assayed by the Company's Newcastle laboratory, and the second shipment, including duplicates of a

number of the samples sent to Newcastle, was assayed by the Department of Mines, Tasmania. Thereafter all crushed samples, including all from No. 3 Adit, and the three drill holes, were assayed by Sharp and Howells of Melbourne, and, from the remaining half cores of D.D.1 and D.D.2, a number of check samples were chosen in Melbourne for assay by the Department of Mines, Tasmania.

ASSAY RESULTS.

Assay results obtained by the Newcastle laboratory and the Department of Mines, Tasmania, from the same samples differed widely and irregularly. Assay results above 0.1 per cent obtained by the Department of Mines from check core samples were consistently higher than the corresponding results obtained by Sharp and Howells, and the estimates obtained using a Marranboy dish differed widely and irregularly from the assay results.

The differences between assays of the drill cores can be partly explained by differences in the samples, because they were taken from opposite halves of the core over different lengths, and the crushed samples assayed by Sharp and Howells arrived in Melbourne in an unsatisfactory condition, with some bags leaking. However, these factors seem insufficient to account for the wide differences obtained, and the assays must therefore be regarded as unreliable.

The assay results from the workings are shown in Figure III, and those from D.D.1, D.D.2 and D.D.3 are shown in Figures IV, V and VI respectively. The inconsistency of the results does not allow any reliable estimation of widths and grade, but the following inferences have been drawn.

WEST LODE: Of 28 assays from West Lode over widths ranging from 12 to 84 inches, only six were over 1 per cent tin, and the average was slightly less than 0.8 per cent. This is little more than one quarter of

the mine grade of 3 per cent in West Lode as estimated from the production record.

MAIN LODE: Of 17 assays north of the adit on No. 3 Level, only seven were above 0.1 per cent, but of 10 assays south of the adit, five were above 1 per cent, and three were above 5 per cent. The average of all assays on No. 3 Level in Main Lode was about 1.5 per cent, which is equal to the estimated mine grade from previous production.

In D.D.1 two possible intersections of Main Lode were 0.42 per cent over 4 feet 6 inches and 0.13 per cent over 7 feet. A width of 34 inches of the latter between 535 feet 4 inches and 538 feet 2 inches is probably the Main Lode.

In D.D.2 only selected core samples were assayed at the anticipated position of Main Lode, and the only assay result greater than 0.1 per cent was 0.14 per cent tin over a width of 3 inches at 525 feet.

EAST LODE: Three assays from East Lode workings averaged 0.45 per cent, less than one third of the average mine grade estimated from the production record of East Lode. Assays of No. 3 Adit wall near East Lode gave no values above 0.1 per cent, although T. G. Oliver (1913) described the lode at the adit intersection as 12 feet wide but of low grade.

In D.D.1, East Lode was intersected as a zone 44 feet wide averaging about 0.2 per cent tin.

In D.D.2, East Lode intersection showed cassiterite over a width of 18 feet, but assays showed a width of only 6 feet 6 inches assaying 0.56 per cent.

In D.D.3, a possible intersection of East Lode assayed 0.2 per cent over a width of 9 feet 6 inches.

OTHER MINERALS.

Copper sulphides, wolfram and molybdenite occur in the mine, but not in economic quantities.

Chalcopyrite and chalcocite are common in many veins between East Lode and Main Lode, and one parcel of 7 tons of copper ore (probably chalcocite) assaying 37 per cent copper was hand picked from the hanging wall of Main Lode above No. 3 Level in the year 1918. There is as yet no evidence of a major copper orebody in the mine.

Wolfram was found in two quartz veins, one eleven inches wide in D.D.1 and the other about four inches wide in the gully north of Main Lode.

Molybdenite occurs in very small quantities over a wide zone embracing East Lode, but assays would probably show no more than a trace over any workable width.

SURROUNDING AREA.

On 5th July, 1957, this Company was granted an authority to prospect over an area of about 15 square miles surrounding Mt. Wells, for a period of six months. The area was prospected by panning of samples from creeks, gullys and hillsides, and testing of outcrops in areas from which tin appeared to have been shed, for a total expenditure of £517. Alluvial tin on the McKinley River was also examined. No significant deposits of either alluvial or lode tin were found. The area has previously been covered by many prospectors, including the Chinese miners, and small patches of alluvial and eluvial tin have been worked up to 2/3rds of a mile north of the mine. It is therefore most unlikely that further work in the vicinity of the mine will lead to the discovery of new outcrops of tin ore.

The discovery by Harris, in 1957, of a new tin lode one mile north of Mt. Masson tin mine is evidence that that area has not been fully prospected, and if Mt. Wells were worked, some further detailed prospecting would be warranted. Harris's new find was in a gossanous breccia which the Bureau of Mineral Resources has mapped as silicified dolomite breccia, and

the B.M.R. 1 mile field sheets show many such outcrops. Of five such outcrops examined in 1957, three may have been silicified dolomite, but one was probably a sulphide gossan with little or no tin, and another was the outcrop of a small lead lode. The remainder of these outcrops should be prospected, particularly those around the margins of granite outcrops.

CONCLUSION.

Before considering the results of the drilling and sampling programme, the following is an assessment of the potential reserves of the Mt. Wells Mine based on a study of the workings, the production record and the geological structure.

Where the major tin lodes have been mined over their full workable length, they have given an average of about 360 tons per vertical foot of ore averaging about 1.2 per cent recoverable grade. If the whole en-echelon lode zone is consistent to great depth, as in some similar tin fields elsewhere in the world, reserves down to battery level would be about 120,000 tons and to a depth of 1,000 feet below battery level reserves would be nearly 500,000 tons, containing more than 5,000 tons of recoverable metallic tin. However, as individual lodes may be of limited depth, and persistence may be maintained by en-echelon repetition of lodes at depth as in plan, underground exploration and development costs may be great in deep mining.

Assuming that the individual lodes pitch northerly at 40 degrees and have a maximum depth down pitch equal to twice their true length measured at right angles to the pitch, then total maximum reserves in the three principal lodes would be about 100,000 tons averaging slightly less than 1.1 per cent recoverable metallic tin. Working grade throughout the lodes would, on past record, vary between 0.6 and 4 per cent recoverable metallic tin.

Thus, if all conditions were favourable, the most that could be expected from the mine would be 100,000 tons of ore from existing lodes, and 500,000 tons to a depth of 1,000 feet below battery level, with an overall grade of little more than 1 per cent recoverable metallic tin.

The results of the drilling and sampling to date give no real evidence of reserves or grade, but the drill intersections are not inconsistent with the theory that the lodes pitch northerly. Thus D.D.1 may have intersected a wide low-grade zone at the northern end of East Lode and a narrow vein of Main Lode at its southern end; D.D.2 may have intersected East Lode but passed south of Main Lode; and D.D.3 may have intersected the southern end of East Lode.

The assay results appear to be of little value because of inconsistency in different assays of the same sample and because the irregularity of the mineralization in the lodes would cause wide variations in the values obtained from narrow channel samples and drill cores, even where bulk mineable grade is consistent. Such assay results may serve to indicate the position of lodes, but cannot be used to compute grade, and, therefore, mineable width. The only effective method of determining reserves in such deposits would be by bulk sampling in exploratory shafts and drives.

RECOMMENDATIONS.

If a maximum target of 100,000 tons of ore containing 1 per cent recoverable tin, with the possibility of a further 360 tons per vertical foot in deep mining, is considered to be worth an additional expenditure of between £5,000 and £30,000, the following course of action is recommended:

(a) On the basis of the unfavourable results obtained to date, attempt to negotiate a new option agreement with Harris and Jones at a substantially lower purchase price.

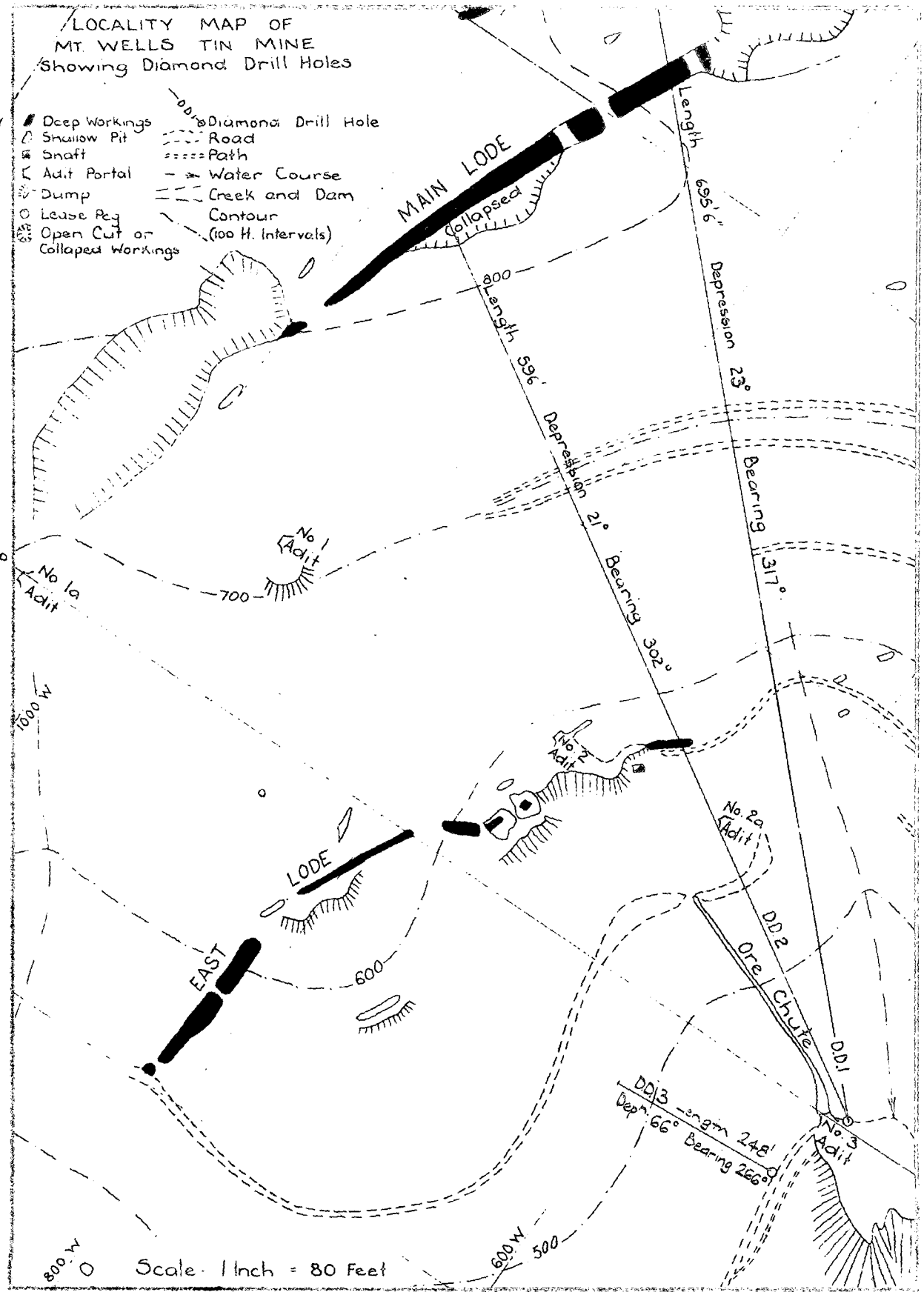
(b) Drill a total of about 450 feet in two diamond drill holes at the northern end of the mine, as shown in Figure III, to test whether West Lode and Main Lode have a northerly pitch. A 200 ft. hole from position 682 N. 882 W. at a depression of 45 degrees on azimuth 149 degrees should intersect the centre of Main Lode at a depth of 180 ft. below the surface, if it pitches northeast at about 40 degrees. A 250 foot hole from position 1099 N. 842 W. at a depression of 45 degrees on azimuth 285 degrees should intersect the centre of West Lode at a depth of 160 feet below the surface, if it pitches northerly at about 40 degrees.

(c) If the drill holes intersect possible lodes of substantial width, continue exploration by underground mining. Main Lode could be tested by a 200 foot shaft sited near the road at its northern end and 400 to 500 feet of driving on the lode. West Lode could be tested by a 320 foot adit from its eastern side or a 150 foot shaft at its northern end and about 400 feet of driving on the lode.

(d) If exploration is continued by mining, investigate sampling and assaying methods to determine the most suitable methods to give reliable determinations of grade of Mt. Wells ore. A method of obtaining reliable approximate analyses at the mine would greatly assist control of exploration and reduce the number of samples required for accurate assay. A new colorimetric method of analysis for tin recently developed in England for geochemical work may be suitable for field use. It has the advantage that with relatively simple apparatus, one operator can easily carry out 40 assays per day.

- - - - - - - - -

MELBOURNE:
27/3/58.
WCS:JMC


LOCALITY MAP OF
MT. WELLS TIN MINE
Showing Diamond Drill Holes
Deep Workings
Shallow Pit
Shaft
Adit Portal
Dump
Lease Peg
Open Cut or Collaped Workings
Diamond Drill Hole
Road
Path
Water Course
Creek and Dam
Contour
(100 ft. Intervals)
200 N
MAIN LODE
Collapsed
Length 695'6"
Depression 23°
Bearing 317°
800
Length 596'
Depression 21°
Bearing 302°
Zero
No 1 Adit
No 1a Adit
700
1000 W
No 2 Adit
No. 2a Adit
LODE
EAST
200 S
600
DD2
Ore Chute
DD1
DD3 Length 248'
Dep. 66° Bearing 266°
No. 3 Adit
800 W
0
Scale 1 Inch = 80 Feet
600 W
500

CR 58/7

FIGURE 3

SURFACE PLAN

MT. WELLS TIN MINE

via Burrundie, N.T.

Scale 1in. = 80ft.

100ft. 0 100ft. 200ft.

TRUE N

LEGEND

- Deep workings
- Shallow pit
- Shaft
- Adit portal
- Dump
- Open cut or collapsed workings
- Lease peg
- Diamond drill hole
- Road
- Path
- Water course
- Creek and dam
- Contour (100ft. intervals)

Note: All sample assays shown as Tr. contain less than 0·1% Sn.

No 3 Level workings shown thus:-

The B.H.P. Coy. Ltd.

W.J.C. 31.8.57

LEASE PEG

COLLAR PROPOSED D.D.5

Bearing 285° Depression 45°

COLLAR PROPOSED DD4

Bearing 149° Depression 45°

No.5 Adit

No.4 Adit

MAIN LODE

Collapsed Cut

DD1 Length 695'6" Depression 23° Bearing 317°

DD2 Length 576' Depression 21° Bearing 302°

DD3 Length 238' Depression 66° Bearing 266°

No.1 Adit

No.2 Adit

No.2a Adit

No.3 Adit

No.1a Adit

Ore Chute

LODE

EAST

866 Mt Wells Trig

DATUM PEG

1600W 1400W 1200W 1000W 800W 600W 400W 200W Zero 200E

1600N 1400N 1200N 800N 600N 400N 200N Zero 200S 400S

CR 58/7 FIGURE 4

RL FEET
800
780
760
740
720
700
680
660
640
620
600
580
560
540
520
500
480
460
440
420
400
380
360
340
320
300
280
260
240
220
200
180
160
140

MAIN LODE

MAIN LODE IN Nº3 ADIT

Nº3 ADIT LEVEL

Nº3 ADIT LEVEL

D.D.1

Nº3 ADIT PORTAL
R.L. 428'

23°

CROSS SECTION ALONG D.D.1.
MT. WELLS TIN MINE N.T.

CR 58/7

SCALE
20 0 20 40 60
FEET

LEGEND
- SILTSTONE
- CASSITERITE
- SULPHIDES
- QUARTZ VEINS

695'6"

ASSAY Nil 7' Nil

RESULTS 0.13

POSSIBLE MAIN LODE

RESULTS

POSSIBLE MAIN LODE

BY Nil 0.42

MINES 7'

DEPARTMENT Nil 7' 7' 0.20

0.34

TASMANIA 0.8 7' Nil

AND Nil 0.10

SHARP

Selected Samples 18.5% 0.44

0.2 0.5 0.1 0.2 0.3 0.2 0.12

PROBABLE EAST LODE

7' 0.1

HOWELLS

7' 8'5"

CR58/7

FIGURE 5

CROSS SECTION ALONG D.D.2.
MT. WELLS TIN MINE N.T.

SCALE
20 0 20 40 60
FEET

LEGEND
- SILTSTONE
- CASSITERITE
- SULPHIDES
- QUARTZ VEINS

MAIN LODE

EAST LODE

MAIN LODE IN Nº3 ADIT

EAST LODE IN Nº3 ADIT

Nº3 ADIT LEVEL

D.D.2.

Nº 3 ADIT PORTAL
R.L 428'

R.L. FEET
820
800
780
760
740
720
700
680
660
640
620
600
580
560
540
520
500
480
460
440
420
400
380
360
340
320
300
280
260
240
220
200

21° N

TASMANIA

HOWELLS

DEPARTMENT

AND

MINES

BY

SHARP

RESULTS

ASSAY

BY

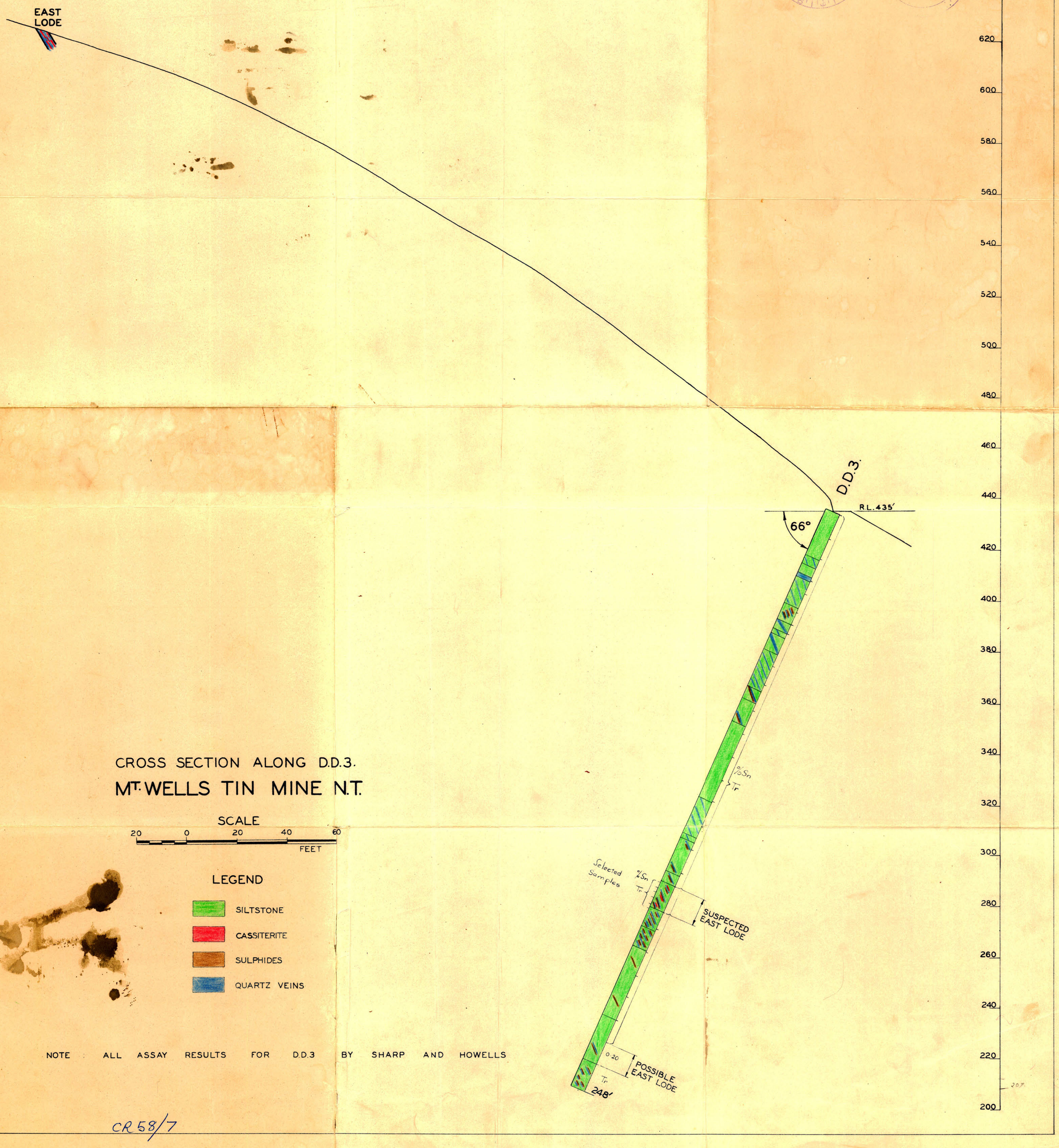
RESULTS

PROBABLE EAST LODE

CR 58/7

CR58/7

FIGURE 6



CROSS SECTION ALONG D.D.3.

Mt. WELLS TIN MINE N.T.

SCALE

20 0 20 40 60

FEET

LEGEND

- SILTSTONE
- CASSITERITE
- SULPHIDES
- QUARTZ VEINS

NOTE ALL ASSAY RESULTS FOR D.D.3 BY SHARP AND HOWELLS

CR58/7