

Ref: DG/gjc/112  
MINING AND DEVELOPMENT

819001

MD 78

**MICROFILMED**  
FICHE No.013531-

A REASSESSMENT OF THE PIONEER RESERVE ESTIMATES

AS AT JULY, 1980

**95-3702.**

Distribution: Direction Mines  
L. Bubenicek/File  
F. Young  
S. Everett - Pioneer

*D. C. Greenway*  
Prepared By: D. Greenway  
17th. July, 1980

A REASSESSMENT OF THE PIONEER RESERVE ESTIMATES

819002

AS AT 10TH. JUNE, 1980

INTRODUCTION

The ore reserve was estimated using the present pit face positions but utilising the general pit outline used by previous authors. A data base has now been established using all the Pioneer drill holes and is stored on punch cards in the Mining and Development library.

1. CONCLUSIONS

- (a) The remaining pit reserves at Pioneer contain 544.04 tonnes Sn below 65 m RL.
- (b) The Pioneer mining operation has a life of approximately two years based on the above reserve at agreed production rates as per MD 77.
- (c) That any divergence from the production schedule and/or overburden removal (whether rate of production or non-achievement of the 65 m RL level) will require a new assessment of the project's economics.
- (d) The heterogeneity of the distribution of tin precludes selective mining and overall pit grade has to be used for production assessments.

2. RECOMMENDATIONS

- (a) That a 60° overall batter angle is maintained.
- (b) That a continuous comparison of actual production against estimates from reserves is maintained to monitor progress.

3. SUMMARY OF RESULTS

<u>BATTER ANGLE</u>	<u>VOLUME m<sup>3</sup></u>	<u>GRADE Kg Sn/m<sup>3</sup></u>	<u>TONNES Sn</u>
Surface - Basement:			
90°	3,965,645	0.163	
70°	4,356,466	0.148	
60°	4,575,457	0.141	
45°	5,030,206	0.128	
			646.4
65 m RL - Basement:			
90°	1,801,460	0.302	
70°	1,889,103	0.288	
60°	1,936,071	0.281	
45°	2,022,469	0.269	
			544.04

<u>BATTER ANGLE</u>	<u>VOLUME m<sup>3</sup></u>	<u>GRADE Kg Sn/m<sup>3</sup></u>	<u>TONNES Sn</u>
60 m RL - Basement:			
90°	1,294,863	0.400	
70°	1,336,183	0.388	
60°	1,360,149	0.381	
45°	1,409,872	0.367	
			517.95

55 m RL - Basement:			
90°	788,265	0.595	
70°	805,840	0.582	
60°	812,996	0.577	
45°	831,453	0.564	
			469.02

For production schedules, the 60° batter angle has been used from both a practical mining consideration and optimisation of reserves. Until October, 1980 the figures from the surface to basement at a 60° batter have been used. From October, the figures from the 65 m RL to basement at a 60° batter angle are utilised.

#### 4. PREVIOUS STUDIES

- (a) Report MD 50 by N. Overton - May, 1979 - "Ore Reserves, Pioneer Tin Lead, North East Tasmania."

Summary of Results.

Area of enveloping pit polygon: 78,731.8 m<sup>2</sup>  
 Volume of proposed pit : 3,975,471 m<sup>3</sup>  
 Average grade of Sn O<sub>2</sub> below  
 60 mRL distributed throughout  
 pit : 0.165 Kg Sn O<sub>2</sub>/m<sup>3</sup>

In the report, two methods of grade calculation are tabulated.

<u>INTERVAL</u> <u>(RL in m)</u>	<u>Kg Sn O<sub>2</sub> IN SLICE</u>	<u>ACC. GRADE POLYGON</u> <u>Kg Sn O<sub>2</sub>/m<sup>3</sup></u>	<u>ACC. GRADE (AVERAGE)</u> <u>Kg Sn O<sub>2</sub>/m<sup>3</sup></u>
55	622,123.4	0.900	0.746
56	12,752	0.824	0.684
57	6,944.7	0.756	0.629
58	5,214.2	0.698	0.580
59	4,658.4	0.648	0.540
60	4,441.2	0.605	0.505

- (b) Memorandum Ref. No. AF/32 10th. January, 1980, "Ore Reserves - Pioneer Tin Deposit, N.E. Tasmania".

This report was compiled as a result of further drilling on 50 metre centres, which extended the pit reserves to the south. The new reserve calculation in this report was based on the parameters described in the previous report.

Summary of Results.

PARAMETER (POLYGON METHOD)	JANUARY, 1980 CALCULATION
Volume of ore below 55m	883,909.2 m <sup>3</sup>
Volume of ore below 60m	1,463,349.5 m <sup>3</sup>
Contained Sn O <sub>2</sub> below 55m	798,944.8 Kg Sn O <sub>2</sub>
Contained Sn O <sub>2</sub> below 60m	839,223.7 Kg Sn O <sub>2</sub>
Total Volume of Pit	5,198,715.4 m <sup>3</sup>
Volume of waste above 55m	4,314,806.2 m <sup>3</sup>
Volume of waste above 60m	3,735,365.9 m <sup>3</sup>
Stripping ratio (ore below 55m)	1:4.882
Stripping ratio (ore below 60m)	1:2.553
Overall Grade Distributing Sn O <sub>2</sub> below 60m throughout pit	0.1614 Kg/m <sup>3</sup>
Average Grade below 55m	0.904 Kg Sn O <sub>2</sub> /m <sup>3</sup>
Average Grade below 60m	0.573 Kg Sn O <sub>2</sub> /m <sup>3</sup>

The above reserve estimates were based on an 80% Radford factor (Ref. 2) and using recovered volume. Further, a polygon weighting method was applied for assessing overall grades.

5. METHOD OF CALCULATION

(i) Pit Parameters

The same pit outline was used as in the previous study except that an allowance was made for a revised pit face position (as at December, 1979 - the last full survey). See Figure 1.

The pit volume was calculated with batter angles of 90°, 70°, 60° and 45° from basement to surface, and from basement to 65 mRL when the pit reaches the prestripped overburden section. See Figure 2.

(ii) Grade

All the figures quoted in this report are as Kg Sn/m<sup>3</sup> where cassiterite is assumed to contain 78.8% Sn. The grade in each drill hole was cumulated from the basement up the hole. In the calculation of cumulative grade, the "theoretical volume" of the drill hole for each sample interval was utilised. The decision to use theoretical volume and not "recovered volume", or some other "factor", was taken with due consideration to the drilling method involved (cable tool drilling). Observation of the "recovered volume" figures on the individual drill holes show that many have an accumulation of greater than 100% recovered volume on theoretical volume occurring near the base of the hole. The interpretation was that incomplete bailing of the hole occurs as the drilling progresses until the bottom of the hole is reached. It was therefore decided that theoretical volume gave the best estimate for this reserve calculation.

It was further noted that most drill holes penetrated the granite basement for some distance and the samples recovered from this lithology contained quantities of tin. As from previous observations and studies the granite does not contain in-situ tin, the amount contained in those samples was reapportioned over the "ore horizon" producing a "revised grade" column in the computer print out. See Section 5 (iii) for method of calculation.

The calculation of grade for the various pit parameters, i.e. below 55 m RL, 60 m RL, 65 m RL and surface was produced using the cumulative grades and cumulative hole volume and interpreted for the various reduced levels (see Figures 3 to 6). The cumulative grade from basement to surface was produced from the computer output direct using all the drill holes. The method of calculation involved interpolating the cumulative hole volume and cumulative grade for each particular reduced level, and for each drill hole producing a cumulative volume and a cumulative amount of tin. These figures were summed for all the drill holes used in the reserve estimate and a total cumulative volume and a total cumulative tin was produced hence a mean grade for each designated reduced level.

$$\text{MEAN GRADE} = \frac{\text{Total Tin from Drill Holes}}{\text{Total Cumulative Drill Hole Volumes}}$$

This method utilised no relationship between individual drill holes and assumes that each drill hole value has the same chance as any other drill hole value of occurring within the deposit.

(iii) Computer Output (Utilising Control Data's facilities)

Only the drill holes which occur within the inner pit outline were used thus any material incorporated in the reserve figures from the batters was assumed to not contain tin.

Initially, all the information from the Pioneer drill holes was compiled into a data base (see computer output file in Mining and Development library; Job. No. Pioneer 1 - 80, amendment Ø).

From this base data, an output format was established (see computer output file) producing the "cumulative revised grade", "cumulative drill hole volume" and "revised grade" for each interval, the former two using basement/alluvial contact as a datum.

- (a) Steps in producing computer output from base data (see Figure 7 example of print out).

Any imperial units in the base data were converted to a metric equivalent.

Column 3 - Theoretical Volume (on output sheet, see computer output file).

Input - From the base data either expressed as a percentage of the theoretical volume (metricated logs) or as lbs/ft<sup>3</sup> (imperial logs).

Output - As Theoretical Volume

Theoretical volume was calculated from the hole diameter for each sample interval, i.e.

$$\frac{(\text{Hole diameter})^2}{4} \times \pi \times \text{sample length} = \text{theoretical volume}$$

Column 4 : Weight of concentrate  
Input : in grams  
Output : in kilograms

Column 6 : Grade  
$$\frac{C5 \times C4}{C3 \times 100} = \text{Kg Sn/m}^3$$

Column 7 : Reduced Level  
Input : As depth down the hole for each sample interval and for basement/alluvial contact.  
Output : As reduced level using collar reduced level to calculate appropriate value.

Column 8 : Lithology: From drill holes using on-site interpretation of three basic units.  
Output : As either 1, 2 or 3.  
1 = Alluvial overburden  
2 = "Ore Horizon"  
3 = Basement

Column 9 : Revised grade.  
Any grade values which occur with the material recovered from the basement rocks (lithology 3) are to be apportioned over lithology 2 on the basis of:

Steps in calculation:

- i) Cumulate Kg Sn for lithologies 2 and 3 respectively.
- ii) 
$$\frac{\text{Kg Sn (for lithology 3)}}{\text{Kg Sn (for lithology 2)}} = (\text{factor}) F$$
- iii) Multiply each original sample interval Kg Sn in lithology 2 by  $(1 + F)$ .
- iv) Column 9 is "Revised Grade" for each sample interval.

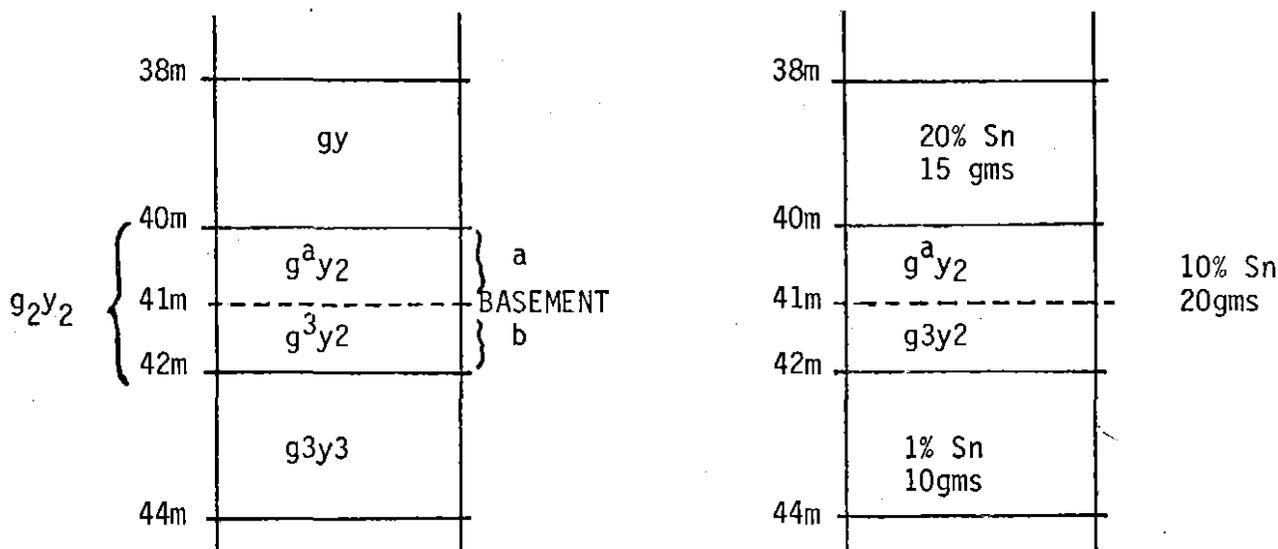
Column 10 : Cumulative Hole Volume  
Cumulate Column 3 from base of lithology 2.

Column 11 : Cumulative "Revised Grade".

$$\frac{C9 \times C3}{C10} = \text{Column 11.}$$

Note: All cumulations commence at the base of lithology 2 and proceed up the drill hole to collar.

- (b) (i) Where no lithology 2 indicated, apportionate lithology 3 over lithology 1 on the same basis as previously described.
- (ii) In most drill holes the recorded basement ore interface does not correspond to the sample depths down the hole. Where this occurs, a reapportioning has to be calculated on the basis indicated below.



Where "g" = grade and "y" = weight of Sn

$$\frac{\text{BASEMENT TO UPPER SAMPLE INTERVAL}}{\text{SAMPLE INTERVAL (CONTAINING BASEMENT)}} = \frac{41 - 40}{42 - 40} = 0.5 = F$$

$$g_2 y_2 = g_3 y_2 (I - F) + g_a y_2 F$$

$$g_a = \frac{g_2 y_2 - g_3 y_2 (I - F)}{y_2 F}$$

$$= \frac{g_2 - g_3 (I - F)}{F}$$

$$= \frac{10 - 1 (1 - 0.5)}{0.5} = \frac{9.5}{0.5} = 19.00$$

The lower portion of the sample interval is assigned the same grade as the next sample in the basement = 1% Sn.

The total weight of concentrate for the sample interval straddling the basement contact is divided on the ratio of:

$F \times y_2$  for section "a"

$(I - F) y_2$  for section "b"

(iii) Some of the holes are presented in imperial units. If a hole is in imperial units, a figure 1 has been placed in column 60 on the input card.

With the imperial logs, a number of points should be noted:

\* Recovered volume for each sample interval has been recorded as  $\text{ft}^3$ .

Conversion:  $\text{ft}^3 \times 0.0283 = \text{m}^3$  (for output)

\* The sample interval is in feet (usually 5 ft.)  
ft.  $\times$  0.3048 - metres (for output)

\* Drill hole diameter is in decimal inches  
= inches - 2.54 - centimetres (for output)

(iv) NOTE: The recorded weight of concentrate is already in grams.

grams  $\div$  1,000 = kgs. (for output)

(c) Volume Calculations for various pit parameters:

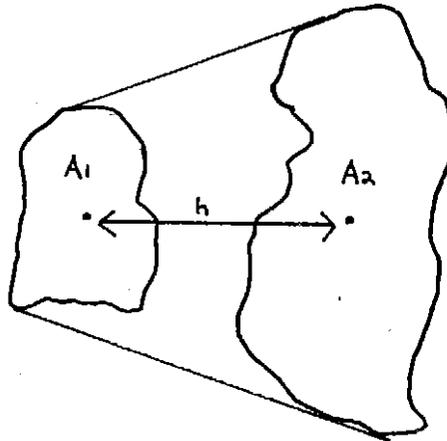
(i) To calculate the area of the pit included in the above reserve calculations for the different batter angles i.e. 90°, 70°, 60°, 45°, the rectangular co-ordinates for each change of direction of the pit outline was measured. Using a Hewlett-Packard programme MATH 1 - 25A areas were computed for each of the pit outlines.

The generalised formula used for this computation was:

$$A = \frac{1}{2} (x_1 + x_2) (y_1 - y_2) + (x_2 + x_3) (y_2 - y_3) + \dots + (x_n + x_1) (y_n - y_1)$$

where x, y, etc. are the co-ordinates at each point around the pit outline.

(ii) To calculate the volume for each batter angle and for the different reduced levels, the "truncated cone formula" was used.



General Formula:  $Volume = \frac{h}{3} (A_1 + A_2 + \sqrt{A_1 \times A_2})$

where A1 and A2 are parallel and "h" is the perpendicular distance between the sections.

The calculated areas for each of the pit outlines were (in m<sup>2</sup>):

BASEMENT - Surface:	
90°	101,319.50
70°	121,598.00
60°	133,206.00
45°	157,793.50
65 mRL - BASEMENT	
90°	101,319.50
70°	111,255.50
60°	116,641.00
45°	126,650.50

60mRL - BASEMENT

90°	101,319.50
70°	107,819.50
60°	111,619.50
45°	119,569.50

55mRL - BASEMENT

90°	101,319.50
70°	105,854.00
60°	107,709.50
45°	112,519.50

6. REVISED PRODUCTION AND REVENUE CALCULATION FOR 1980 (See Table 1)

The operating costs and the capital expenditures are the same as those used in MD 77 - "Production and Financial Analysis" dated 1st. June, 1980 by D. Greenway.

The price of tin used was \$15,000 per tonne, on a net payable basis from the monthly tin production. A recovery of 70% was used for the mining operation.

7. FUTURE ASSESSMENTS

To facilitate any changes in the production parameters defined above, e.g. overburden removal less successful and reaching some higher RL, a set of graphs have been constructed to utilise the information available and used in conjunction will give new parameters for any future assessment. (Figures 8, 9 and 10).

For example: Overburden removal reaches 70 m RL with pit batters of 60°: From Graph 4 Volume = 2,560,000 m<sup>3</sup>  
: From Graph 5 Grade = 0.225 Kg Sn/m<sup>3</sup>.

D. GREENWAY

17th. July, 1980

REFERENCES

- 1 : "Ore Reserves - Pioneer Tin Deposit, N.E. Tasmania". (Ref. AF/32) 10th. January, 1980. By N. Overton.
- 2 : "Ore Reserves of Alluvial Tin Deposits in N.E. Tasmania" by T. Neale, Kibuka Mines Pty. Ltd., March, 1980.

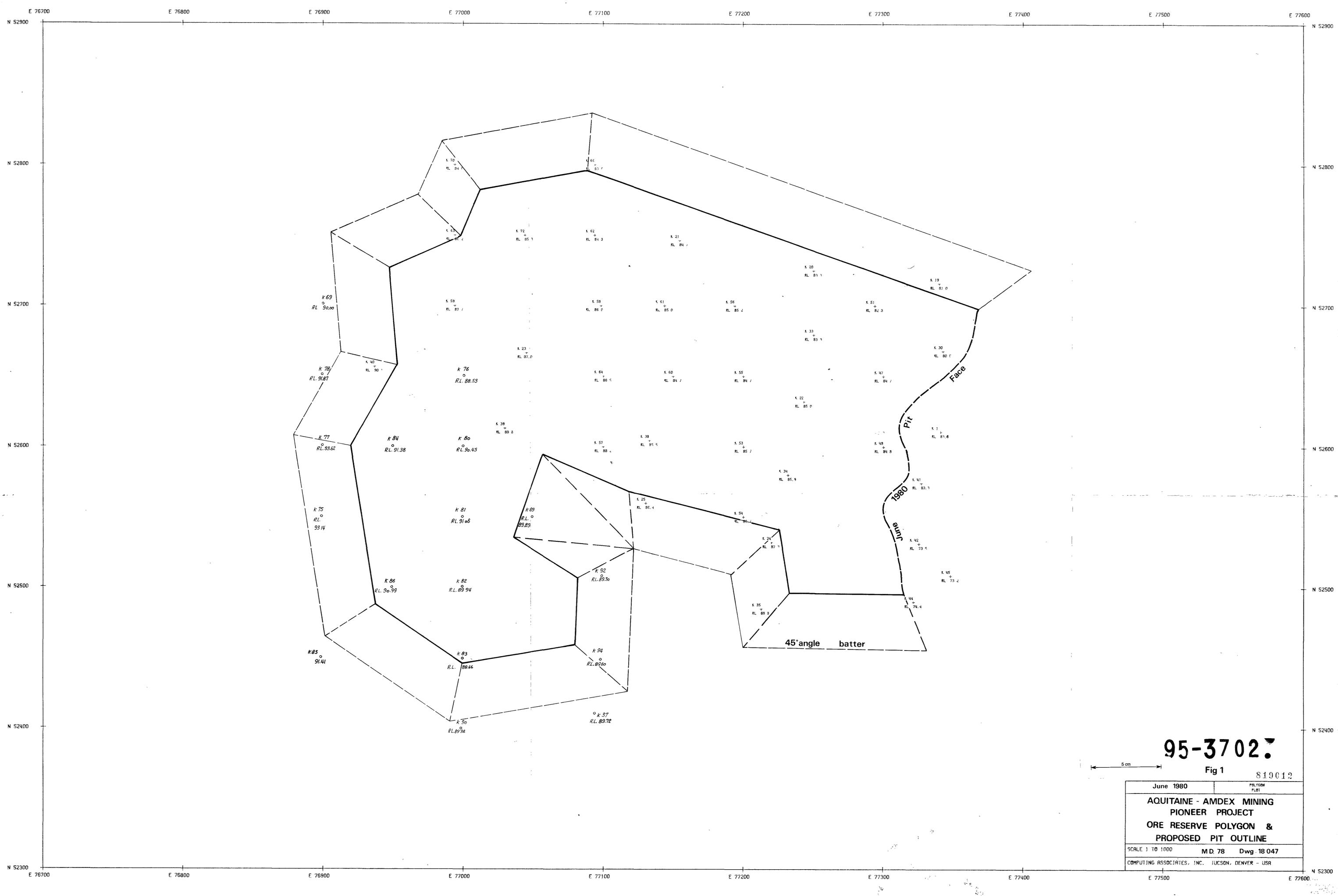
INCLUSIONS

Figures:

- 1 : Map of Pit Outline as at December, 1971
  - 2 : Diagram Showing Method of Calculation of Batters
  - 3 : Example of Computer Output
  - 4 : )
  - 5 : )
  - 6 : ) Set of Graphs
  - 7 : )
  - 8 : Example of Section Plot
- Table 1 : Revised Production Schedule and Revenue for 1980.

STORES IN MINING AND DEVELOPMENT LIBRARY

- 1 : Set of Sections for each Drill Hole: Plotting cumulative grade against reduced level.
- 2 : Complete print out of data.
- 3 : Print out of Volume Calculations.



95-3702

5 cm

Fig 1 819012

June 1980	POLYGON PLAN
<b>AQUITAINE - AMDEX MINING PIONEER PROJECT</b> <b>ORE RESERVE POLYGON &amp; PROPOSED PIT OUTLINE</b>	
SCALE 1 TO 1000	M.D. 78 Dwg. 18 047
COMPUTING ASSOCIATES, INC. IUCSON, DENVER - USA	

95-3702.

## M E M O R A N D U M

TO: S Everett

FROM: K Morrison

DATE: 12th August 1980

SUBJECT: D. Greenways assessment of Pioneer reserves, July 1980

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Further to the note submitted regarding this subject, the following comments are made.

- 1) The proposed pit outline map used by Darrel is similar to our 100g/m<sup>3</sup> cut-off map. His total volume is 7.5% less than ours ( 3.966 million m<sup>3</sup> against 4.285 million ). These figures represent geological reserves ie. 90° batters.
- 2) The main discrepancy is due to the grade calculation method used and the consequent average grade for the deposit. Darrel uses theoretical volume and a 78.8% Sn value for cassiterite. A comparison of this method with ours, using hypothetical but typical numbers, is shown below.

Given : 30 litres drilling sample  
 150 grm pan concentrate  
 2.5% Sn assay

Method 1)	$\frac{150 \times 2.5}{78.8}$	x	$\frac{1000}{40.3}$	=	118g/m <sup>3</sup>
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95-3702.

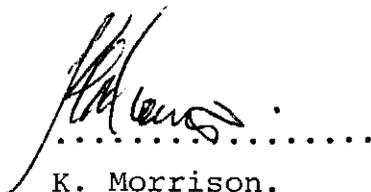
2/.....

$$\text{Method 2) } \frac{150 \times 2.5}{70} \times \frac{1000}{32.2} = 166\text{g/m}^3$$

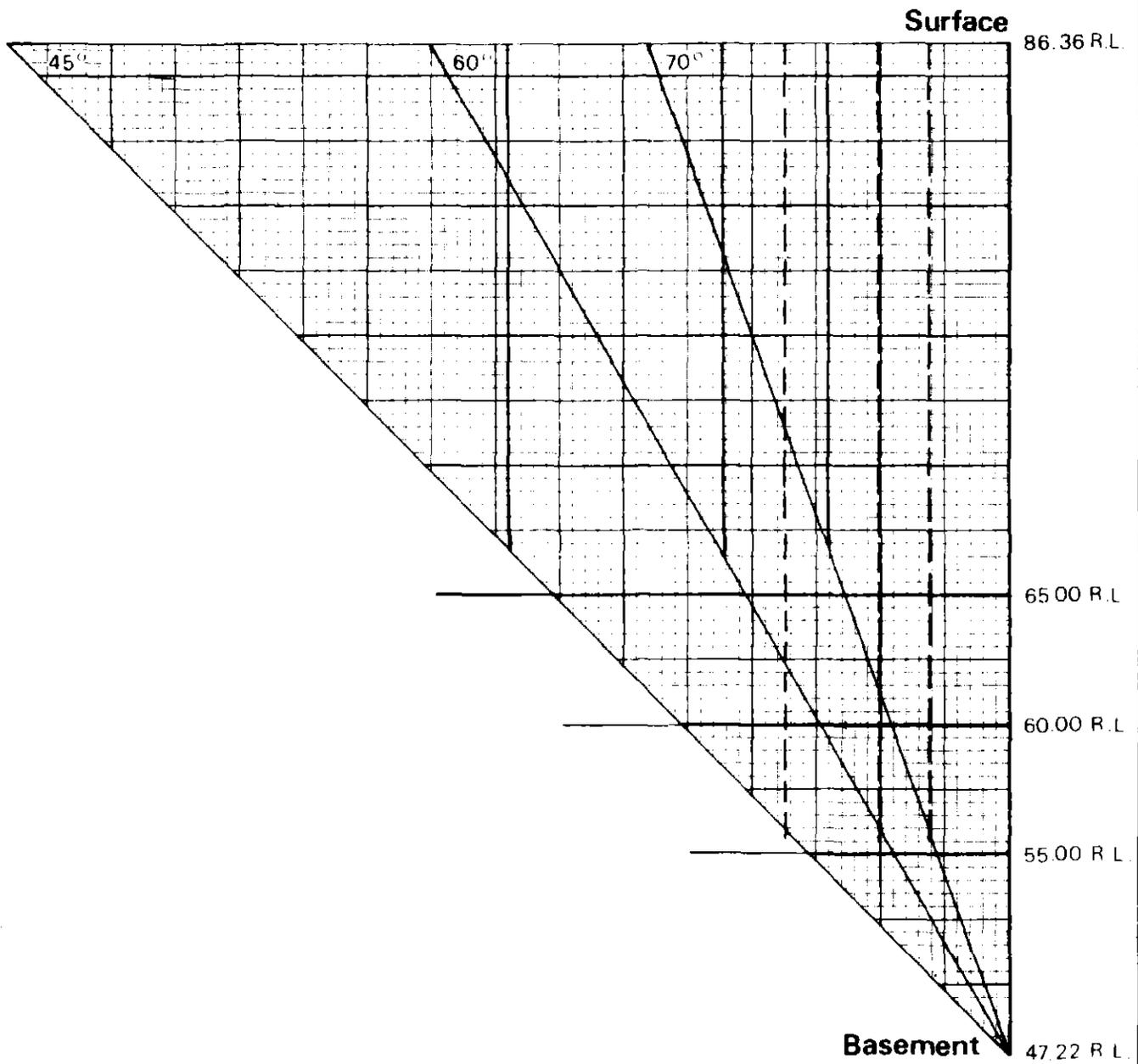
The difference is 29%.

If Darrel's overall grade of 207 grms SnO<sub>2</sub>/m<sup>3</sup> is increased by 29% the result is 267g/m<sup>3</sup>. Our overall grade, based on Trevor's recovered volume, recovered tin method was 268g/m<sup>3</sup>. Cassiterite reserves, using 267 as the grade and Darrels volume of 3.966 million m<sup>3</sup> are 1,059 tonnes.

3) Darrel states that the Pioneer Mine has a life of approximately two years, however no mention is made of the Football Ground reserves and the probability of a continuous deposit. The high grade obtained from K134 and the continuing high grade ground being mined in the southern face seem to improve that probability.

  
 .....  
 K. Morrison.

819015



Method of calculation for volume contained in batters with angles 45°, 60°, 70° for surface & 65m R.L.

Author: D.C.G	Date: June 1980	Dwg No.: 18042	fig 2
Drafted by: G.D.	Report No.: M.D 78	Base Plan:	

PROJECT - PIONEER  
SUBJECT - DATABASE

JOB NO. 1-80 AMENDMENT 0 COMPILED BY - DCGI G.D.

DATE - 80/06/18

DRILLHOLE NO- K 53

COLLAR CO-ORDS- 52600.00 N 77200.00 E RL 85.72

SAMPLE TYPE-

HOLE SIZE- 16.03 TOTAL DEPTH- 37.00  
BASEMENT DEPTH- 36.25

STATISTICS

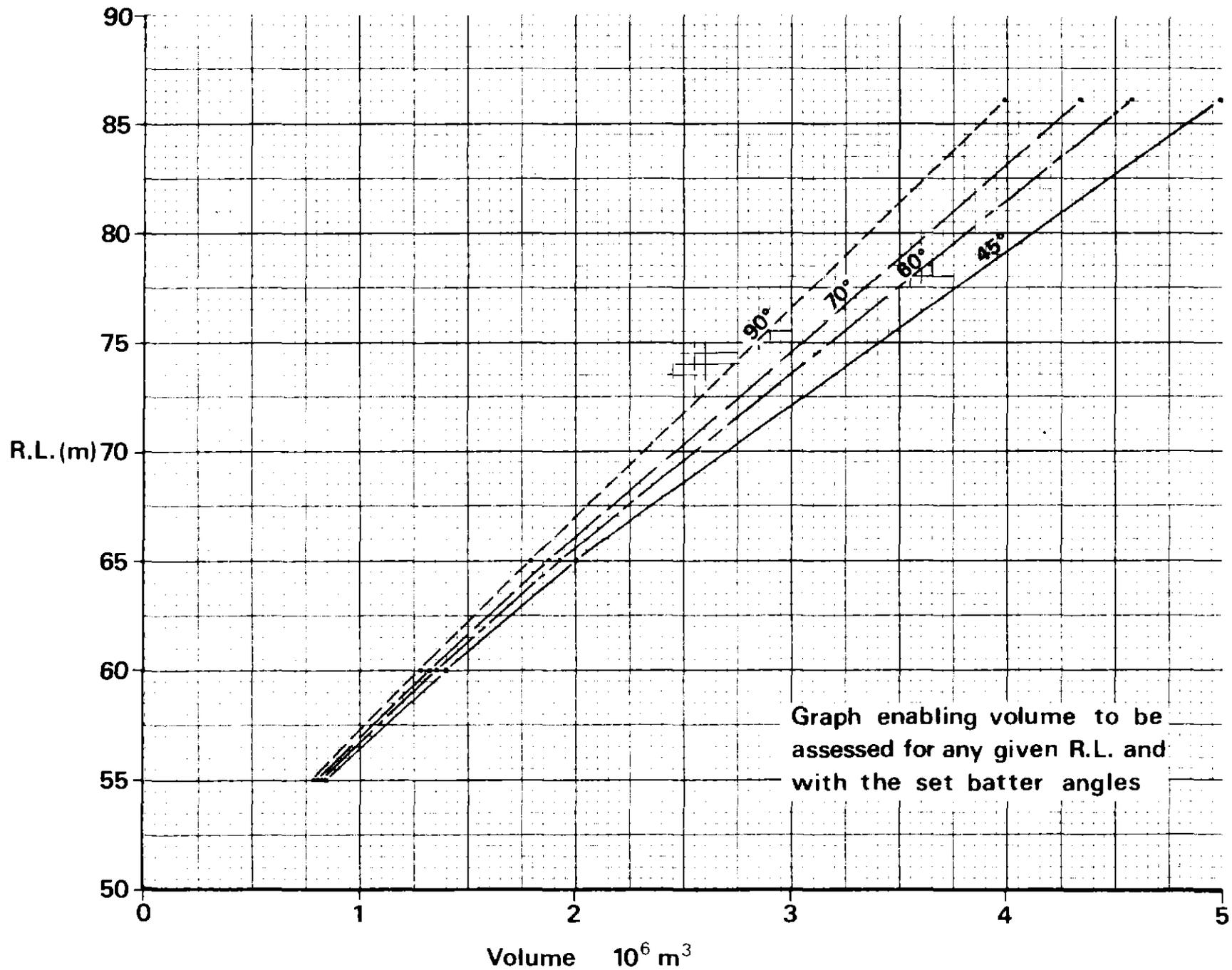
BASE DATA

INTERPRETED DATA

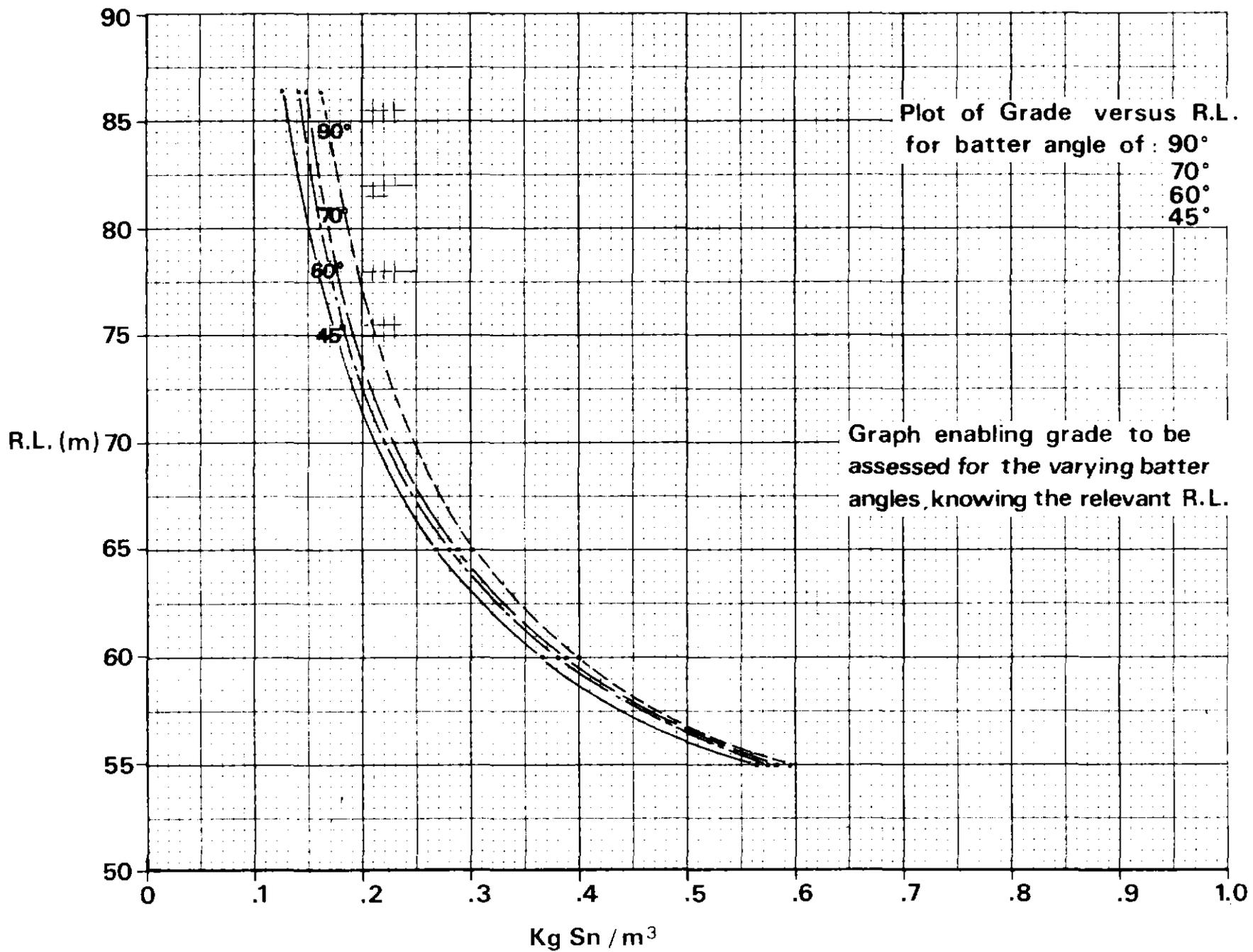
1	2	3	4	5	6	7	8	9	10	11
FROM(M)	TO(M)	THEOR. VOLUME (CU.M)	WEIGHT CONCENTR. (KG)	CONCENTR. ASSAY (PCT.SN)	KG/M3 SN	R.L.(M)	LITHOLOGY	REVISED GRADE	CUM. THEOR. VOL(CU.M)	CUM.REV. GRADE
0.00	2.00	.040	.0359	12.18	.108	83.72	1	.108	.727	.481
2.00	4.00	.040	.0304	3.91	.029	81.72	1	.029	.686	.503
4.00	6.00	.040	.0228	7.21	.041	79.72	1	.041	.646	.533
6.00	8.00	.040	.0305	6.94	.052	77.72	1	.052	.605	.565
8.00	10.00	.040	.0267	5.84	.039	75.72	1	.039	.565	.602
10.00	12.00	.040	.0251	4.64	.029	73.72	1	.029	.525	.645
12.00	14.00	.040	.0277	3.91	.027	71.72	1	.027	.484	.697
14.00	16.00	.040	.0319	3.55	.029	69.72	1	.029	.444	.758
16.00	18.00	.040	.0445	1.85	.020	67.72	1	.020	.404	.831
18.00	20.00	.040	.0317	1.55	.012	65.72	1	.012	.363	.921
20.00	22.00	.040	.0121	4.62	.014	63.72	1	.014	.323	1.034
22.00	24.00	.040	.0186	5.21	.024	61.72	1	.024	.283	1.180
24.00	26.00	.040	.0338	6.96	.058	59.72	1	.058	.242	1.372
26.00	28.00	.040	.0284	4.95	.035	57.72	1	.035	.202	1.635
28.00	30.00	.040	.0145	3.99	.014	55.72	1	.014	.161	2.035
30.00	32.00	.040	.0856	48.60	1.031	53.72	2	1.045	.121	2.709
32.00	34.00	.040	.2609	51.72	3.343	51.72	2	3.387	.081	3.541
34.00	36.00	.040	.2853	51.62	3.648	49.72	2	3.696	.040	3.696
36.00	37.00	.020	.0256	16.57	.210	48.72	3	.210	0.000	0.000

810016

Author: D.C.G.  
Drafted by: G.D.  
Date: June 1980  
Report No.: M.D.78  
Dwg No.: 18044  
fig 4



819017

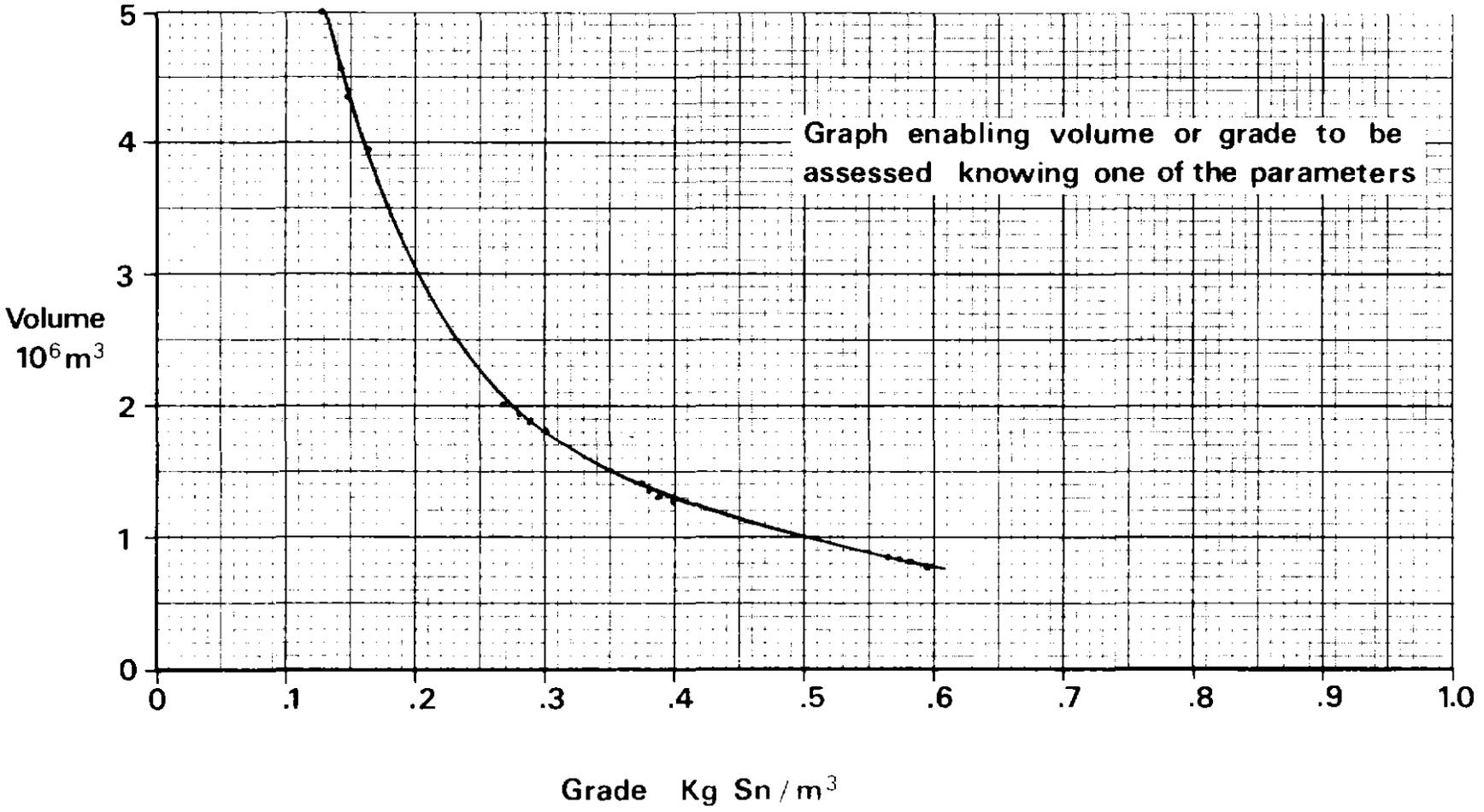


819018

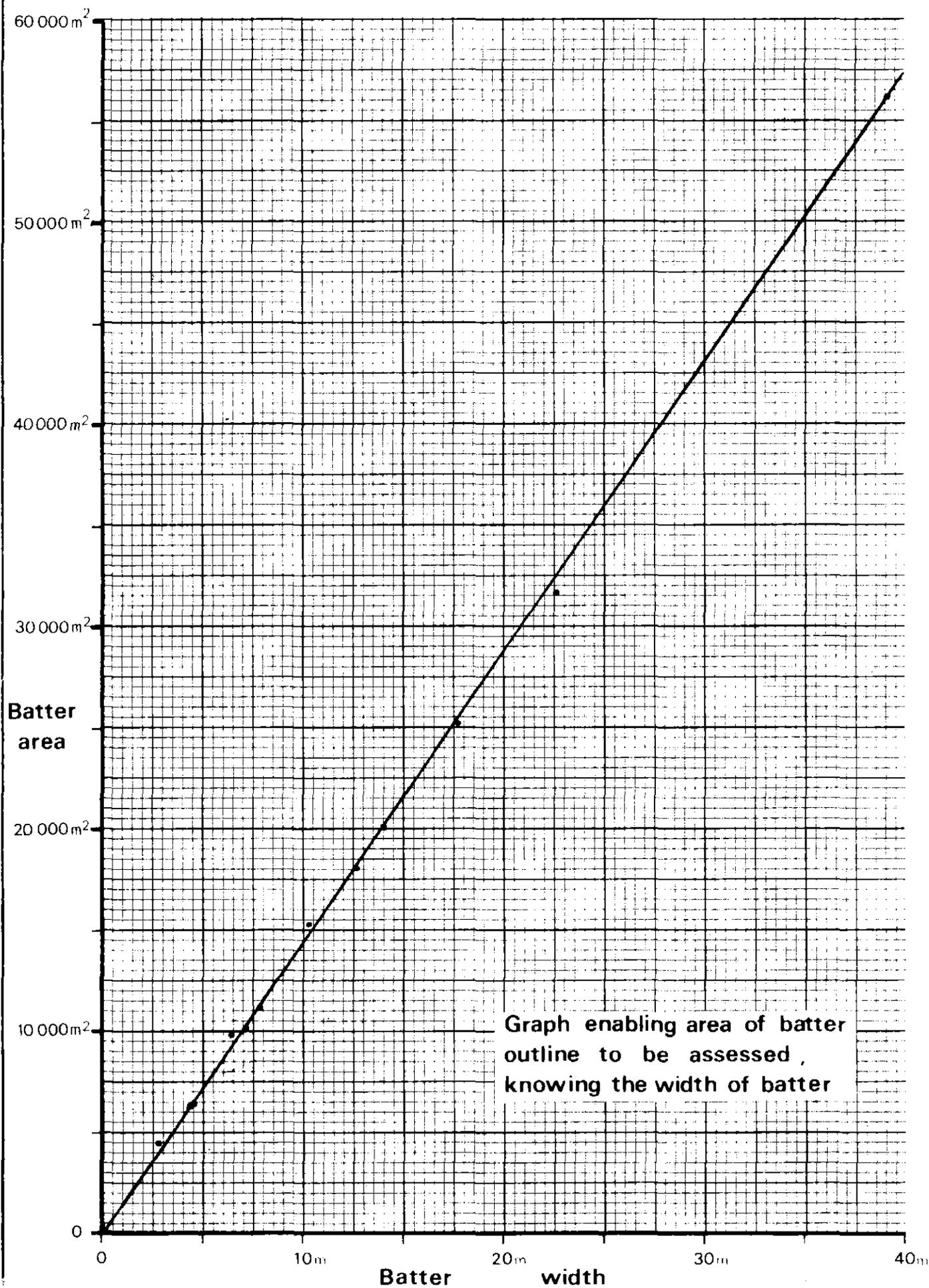
Author: D.C.G.  
Date: June 1980  
Drafted by: G.D.  
Report No.: M.D.78  
Eng No.: 18 045  
Base Plan

fig 5

Author: D.C.G.  
Date: June 1980  
Drafted by: G.D.  
Report No.: MD 78  
Dwg No.: 18046  
Base Plan:  
fig 6

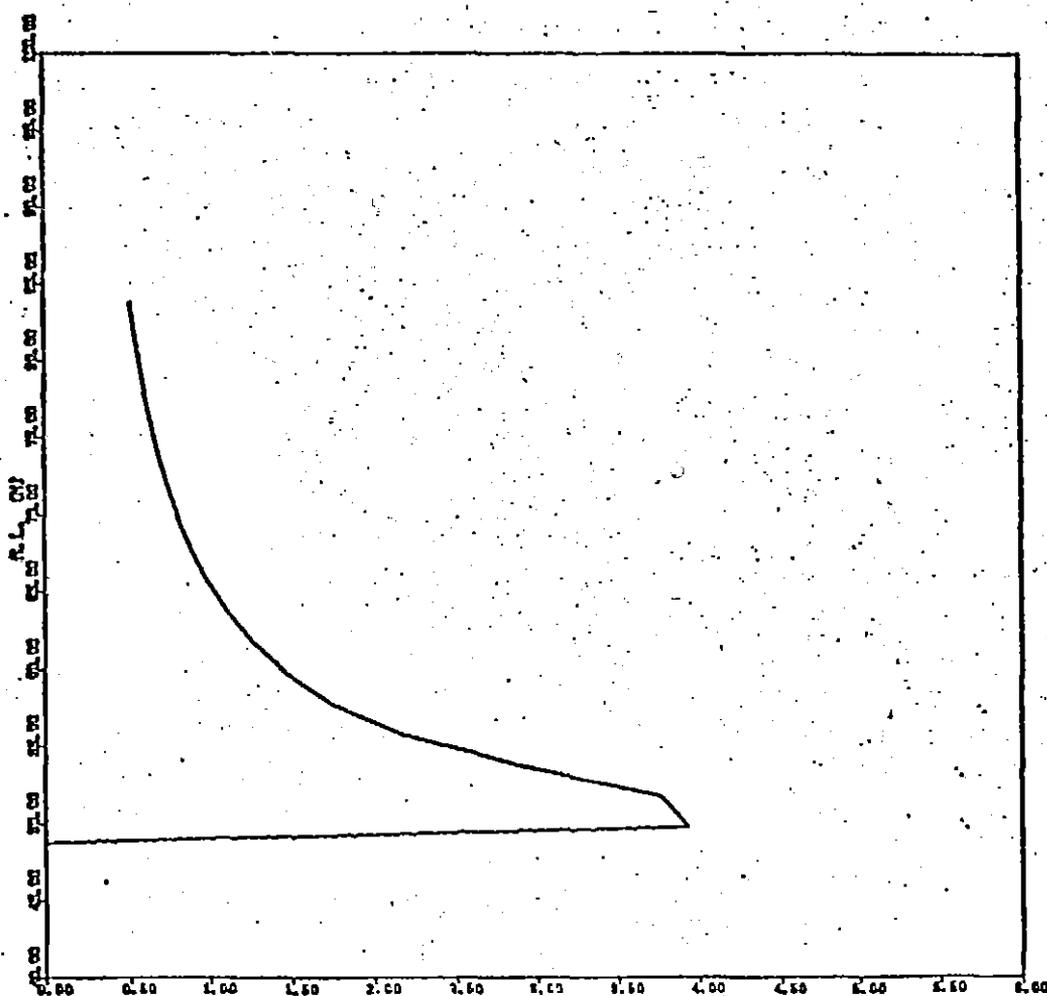


819019



Graph enabling area of batter outline to be assessed, knowing the width of batter

DRILL HOLE: K 53 52600.00 N 77200.00 E RL: 85.72

Cumulative revised grade ( $\text{Kg/m}^3$ ) Fig. 8.

REVISED PRODUCTION AND REVENUE ESTIMATES  
 OVERALL 60% BATTER: 70% RECOVERY

JULY, 1980

TABLE 1

	January	February	March	April	May	June	July	August	September	October	November	December	
Ore production m <sup>3</sup>							35,000	70,000	70,000	70,000	70,000	70,000	
Grade Kg Sn O <sub>2</sub> /m <sup>3</sup>							0.179	0.179	0.179	0.357	0.357	0.357	
Tonnes of Concentrate assuming conc. contains 93% Sn O <sub>2</sub> (Actual)	( 9.25)	(10.20)	( 8.50)	( 3.30)	( 7.45)	( 5.65)	6.73	13.47	13.47	26.86	26.86	26.86	
at payable Sn (70.7% of concentrate including 2.4% Sn equivalent smelting charge)	6.54	7.21	6.01	2.33	5.27	3.99	4.76	9.52	9.52	18.99	18.99	18.99	
Revenue (\$15,000 per tonne Sn) Actual	(51044)	(19615)	(144871)	(87899)	(26338)	79050	59850	71400	142800	142800	284850	284850	1,395,387
<u>ON SITE COSTS</u>													
Mine operating	35,875	46,542	39,404	39,161	55,000	60,000	62,000	65,000	60,000	60,000	60,000	70,000	651,982
Overburden removal	825	103	653	6,535	2,500	11,500	23,000	35,000	35,000	35,000	35,000	35,000	220,115
<u>OFF SITE COSTS + ON SITE STAFF</u>													
Marketing & Administration	13,602	31,882	18,776	15,298	19,000	19,000	19,000	19,000	20,000	20,000	21,000	21,000	237,858
Option payment WOODS and rates			50,121										50,121
Interests						8,232						26,249	34,481
GOVERNMENT LOAN - CAPITAL O/B STRIPPING OF NEW PLANT													\$1,194,557
Already spent	150,000												
Labour, dozer	53,000	At end of April											
2nd. stage O/B removal	65,000												
New plant	30,000												
Screen & Spiral	50,000												
	\$348,000												
Miscellaneous	\$ 7,000												
Loan Repayment - Principal												83,334	
Loan Balance					311,000								

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