

## MEMORANDUM

TO: W. KRATS  
FROM: P.M. PETTIGREW  
SUBJECT: Reliability of Tonnage  
and Grade Predictions  
DATE: September 13, 1972

INTRODUCTION:

The following study attempts to further discuss the problems examined in F.P. Forrest's report of August 18, 1971 and the writer's more recent report of February 10, 1972. In the former report the reliability of combined (Pb and Zn) predictions was discussed and it was fairly convincingly established that for the core of the ore body such predictions are quite accurate and that the greatest accuracy of grade predictions is experienced for ore predicted at close to the average for the ore body.

In the second report quoted above these statements were confirmed by further data. It was also pointed out that, close though (Pb + Zn)% predictions may be to that experienced, there was a limiting factor to their usefulness if the Pb % and Zn % were not individually reliably predicted.

The present report adds further data with the bias being mainly on the Pb/Zn ratio, however an attempt is made to demonstrate the "individual variations" within any given tonnage block which give rise to tonnage and ore-grade prediction discrepancies and, by implication, discrepancies in the Pb/Zn ratio.

SUMMARY:

Comparing the Pb/Zn ratio in the ore mined in the first half of 1972 with the ratio that would have been expected, it was found that a value of 0.70 was experienced as against a predicted value of 0.54. This is in agreement with observations previously made in the writers memorandum of February 10, 1972.

A number of "pulp" samples from old D.D.H. core were re-assayed for Pb and Zn. It was found that the greatest discrepancy in assay percentage occurred in zinc and that barium only slightly interfered with the lead values. It seems that assay discrepancies by no means entirely account for the Pb/Zn ratio fluctuations.

It was also found that stockpiling accounts for some of the discrepancy in Pb/Zn ratio between ore extracted and ore milled. Gains of ore outside the predicted 1/2-bench and losses within same also cause deviations from the predictions.

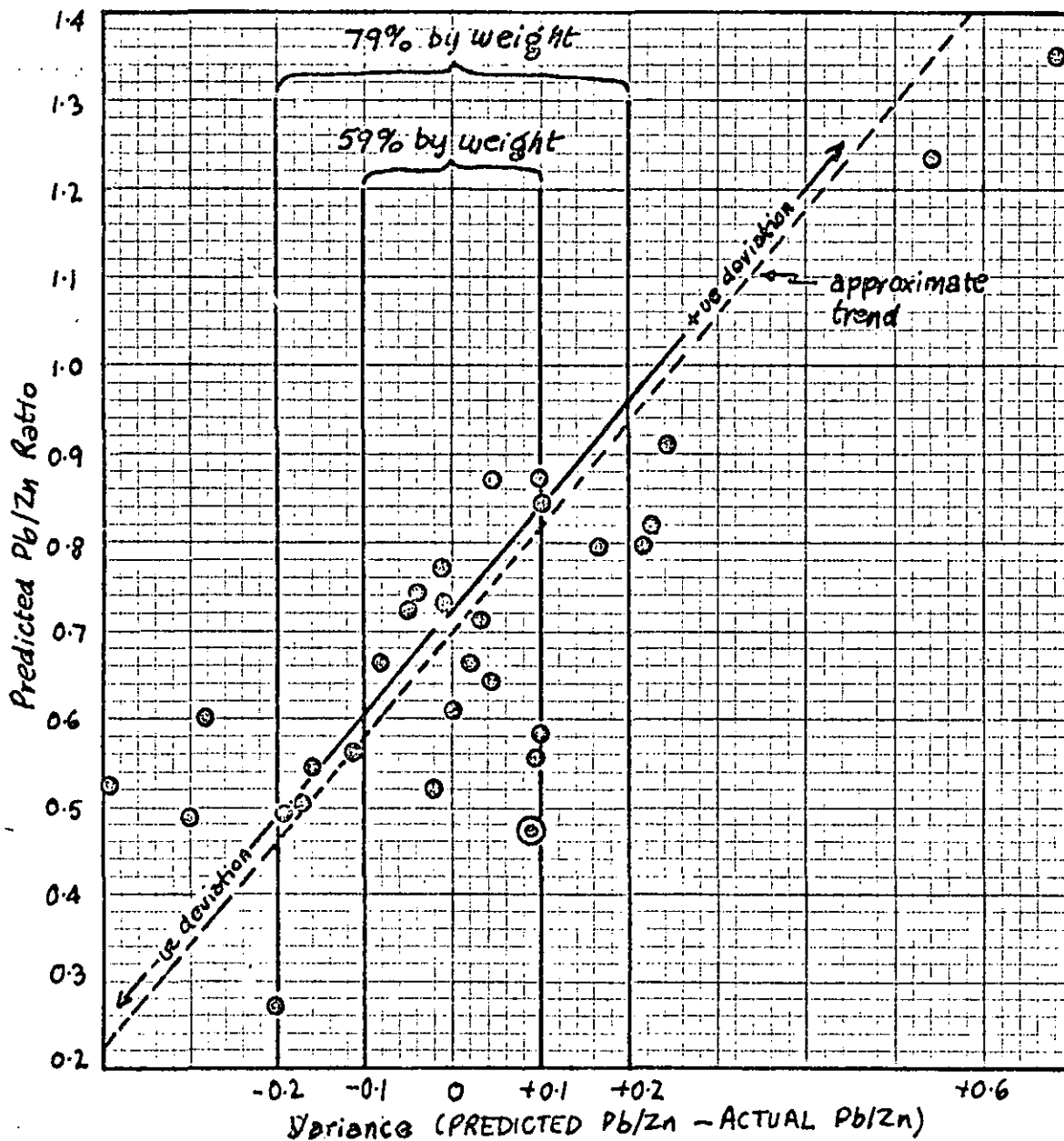
DISCUSSION:

1.

The graph below plots the variance of the actual Pb/Zn ratio from the predicted value against the latter in an attempt to measure the reliability of such predictions. The data was compiled for a memorandum dated February 10, 1972 and was based on ore from tonnage blocks 100 % mined out to the end of December, 1971. There seems to be a general trend line whereby a deviation of zero is expected for predictions close to 0.7;

higher and lower predicted values seem to be increasingly unreliable.

VARIANCE GRAPH



As a further confirmation of this, the period January 1 to June 30, 1972 was considered in terms of tonnage predicted and extracted. These values were arrived at by planimentering. The weighted average grade (predicted) was calculated from D.D.H. values and the grade of the ore extracted was derived from 1170 blast-hole assays done in the laboratory during the same period. This is summarized in the table below:

	<u>Tons</u>	<u>Pb</u>	<u>Zn</u>	<u>Pb/Zn</u>
Predicted	1,779,100	3.5%	6.5%	0.54
Actual	1,809,400	4.00	5.7	0.70

These figures are derived from ore mined from 3870 to 4100 benches inclusive and show a gain of 1.7% in tonnage as against a loss of 9.2% on these same benches in the study carried out previous to December 31, 1971. Accompanying this there is a gain of 14% in the lead values and a loss of 12% in the zinc values. The Pb/Zn ratio discrepancy (-0.16) is in line with the trend of the graph above.

2.

A total of 67 D.D.H. ("pulp") ore samples previously assayed in 1965-70 were re-assayed in the staff lab for Pb and Zn. These had previously been assayed by outside laboratories in 81% of cases; the balance were previously assayed in the staff lab (1970).

Overall the results seem to show no significant errors in the previous Pb assays although in 5% of the samples enough barium interference was present to generate assays for Pb which were incorrect by a factor of 2. The zinc assays, on the other hand, seem to show a significant trend towards having been previously overestimated.

The table below shows the percentage of cases in which lead and zinc re-assays exceeded (or otherwise) the earlier assay values. A difference in assay value of  $\pm$  0.2% in both lead and zinc is considered as not significant:

	<u>Lead</u>	<u>Zinc</u>
> Predicted	27%	16%
No difference	40%	21%
< Predicted	33%	63%

The zinc values were averaged and were as follows:

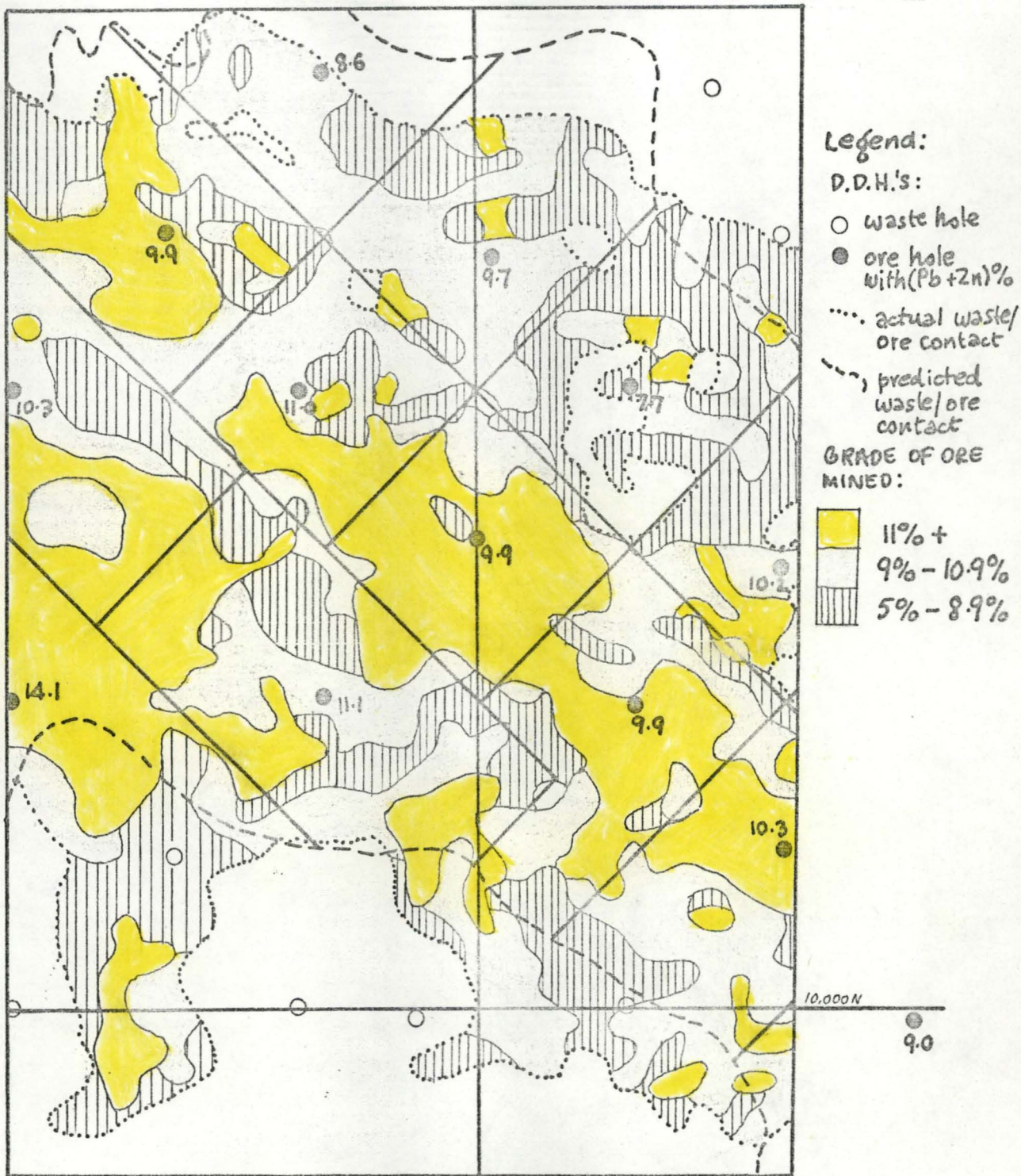
Previous Assay:	6.3 %
Re-assay	5.9 %

Further work remains to be done to confirm these results and in particular to determine the source of the significantly lower zinc assays.

3.

The effects of selective mining are quite interesting. As discussed in the first section above, the first half of 1972 was examined in terms of actual vs. predicted grades. In this study it was found that, by stockpiling somewhat over 19% of the ore extracted, the mill head-feed was upgraded by 8% in the lead and by only 6% in the zinc. Thus, this is yet another factor in producing a fluctuation in the Pb/Zn ratio.

Tonnage blocks are based on supposed radiating areas of influence from adjoining D.D.H.'s. In actuality the (combined) grades seem to be more or less linearly distributed in a NW-SE direction sub-parallel to the NW-SE boundaries of the tonnage blocks. To demonstrate this, the sketch below shows (combined) grade contours of ore in the three categories: 5-8.9% (low grade); 9-10.9% (medium grade stockpile material to mill feed); and 11%+ (high grade stockpile material or mill feed). The contours are based on combined (Pb + Zn) assays from blast holes drilled between January 1971 and June 1972.



Legend:

D.D.H.'s:

- waste hole
- ore hole with (Pb+Zn)%
- ..... actual waste/ore contact
- - - - - predicted waste/ore contact

GRADE OF ORE MINED:

- 11% +
- 9% - 10.9%
- ▨ 5% - 8.9%

(COMBINED) GRADE CONTOUR MAP OF  
ORE MINED ON 3950 BENCH JANUARY 1971 - JUNE 1972  
SCALE : 1" = 100'

Generally, it would seem the grade per block may not always be exactly as predicted but that overall there is an averaging trend. The problem seems to be, though, that the 11.0% ore does not all come from 11.0% blocks, in fact a great deal of it comes from somewhat lower grade (predicted) blocks.

It can therefore be said that the ore removed is not specifically the ore predicted. In fact, it is very much open to doubt that the ore removed and crushed is exactly the same as that predicted. The writer would suggest that the combined grades could well come close to those predicted by simple rescheduling of destinations -- as in fact happens -- but that the Pb/Zn ratio was not necessarily coincident even if it was correctly predicted within a specific tonnage block.

Gains outside and losses within the 1/2-bench outline (waste/ore contact) further complicate matters. These are partly due to undulations of approximately 150' wave length in the contact and that we rarely, if ever, mine out the precise 40' thickness of ore implied on the bench plan.

A more generalized statement will be made later about grade distribution in Zones 1 and 3 and will be incorporated in the report on the pyrite zone at present being prepared.

CONCLUSIONS:

Tonnage and combined grade estimates for the ore available over a six month period seem now to be quite accurate as the upper benches are gradually removed from the ore-planning picture.

Pb/Zn ratios in the range of 0.6 to 0.8 and especially around 0.7 are at present fairly reliable.

Deviations in the predicted vs. actual ratios do not seem to be entirely due to assay errors. Rather they reflect the problems of determining an accurate area of influence for a specific D.D.H. Consideration should be given to the possibility of modifying the "weighting" put on areas of influence.

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