CONTACT INFORMATION
Mining Records Curator
Arizona Geological Survey
3550 N. Central Ave, 2nd floor
Phoenix, AZ, 85012
602-771-1601
http://www.azgs.az.gov
inquiries@azgs.az.gov

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RETURN TO STRICKLAND

LAKESHORE MINE
ORE RESERVES

APRIL 20, 1978
HECLA MINING COMPANY

June 8, 1978

MEMORANDUM TO: E. W. Cokayne

FROM: J. D. Pelletier

SUBJECT: Revision of Lakeshore Mine Reserves, April 20, 1978

The accompanying report, "Hecla Mining Company, Lakeshore Mine Reserves," dated April 20, 1978, presents the best estimate of reserves available and replaces all previously reported reserves. Revisions to ore reserves, as compared with those reported September 30, 1977 and contained in the December 6, 1977, "Lakeshore Mine and Plant Development Plan," are as follows:

1. 500 level central porphyry undercut was moved from 500 level to 365 level and the porphyry and overlying oxide reserves were adjusted to conform.

2. Diluted ore from 500 South Porphyry was reduced to reflect expected lower tonnage extraction with the wide draw raise spacing currently planned.

3. It was determined that some ore which had previously been dropped from Tactite II sub-level cave ore reserve estimate could be mined by block cave methods from 336 level.

4. Ore which had been omitted from 365 tactite III ore reserve was added back.

5. Porphyry and chalcocite ore below 200 level was re-calculated on a basis consistent with other reserves.

J. D. Pelletier

HECLA MINING COMPANY

LAKESHORE MINE RESERVES

April 20, 1978

CLASSIFICATION OF RESERVES

The Lakeshore deposit contains several distinct mineral types which are defined as follows:

1. "Oxide ore"------ore with high acid soluble copper content that is segregated for treatment for extraction of acid soluble copper.

2. "Sulfide ore"------ore with little or no acid soluble copper content that is segregated for treatment for extraction of sulfide copper.

    a. "Tactite ore"------tabular deposit of higher grade sulfide ore which lies south of other zones.

    b. "Porphyry ore"------large, irregular shaped deposit of disseminated sulfide ore, centrally located and forming the bulk of Lakeshore ore.

    c. "Chalcocite ore"------higher grade sulfide ore which has been enriched with chalcocite. Chalcocite ore lies west of "C" fault and has been displaced downward by the Fault to its present location.

In addition to classification by mineral type, the Lakeshore deposit is further described in three ways that show gross mineral in the ground, mineable ore, and the ore that it is estimated will be extracted in mining and delivered to the plant. These classes are defined as follows:

1. "Mineral Inventory"------A tabulation of the entire mineral deposit, broken into various grade categories, with no consideration of mining economics nor of dilution nor mining extraction.

2. "In Situ Ore Reserves"------That portion of the mineral inventory which meets defined economic criteria that distinguishes ore from waste, but without any consideration of dilution or mining recovery.

3. "Diluted Ore Reserves"------Defines the tonnages and grades of material which will actually be removed from the mine, after experiencing dilution and losses of mine recovery.

BASIS OF RESERVES

Surface Drilling

El Paso Natural Gas Company drilled 68 diamond drill holes and 18 percussion drill holes through 1969. From that time until the present, Hecla Mining Company has drilled an additional 161 diamond drill holes from surface, most of which were directed at filling in the drill grid. First drilling was approximately on 350 to 400 foot centers and later fill-in drilling is on approximately 200 foot centers.

With the exception of the first few holes drilled, diamond drilling was NX size and drilled vertically. Some holes eventually required casing and were then continued BX size. Core recovery is good, being generally about 90%. A few holes, however, encountered broken ground adjacent to the Lakeshore fault and showed recoveries in the 60-70% range. Sludges were not generally taken except when core recovery was consistently low. To save drilling expense, a system was developed of drilling nearly to the base of post-mineral cap rock using a rotary drill bit, and then casing and continuing the hole with diamond drill core bit. Drill core is split, with one-half sent for assay and the other half saved for future reference.

Surface drilling is surveyed gyroscopically, generally at intervals of 100 feet. Temperatures were recorded at 500 foot intervals in most holes drilled by Hecla.

Underground Drilling

Additional underground drilling is needed when delineating high grade tactite ore and, to a lesser extent, high grade oxide ore. Underground drilling is used to establish specific ore boundaries for lay-out of extraction drifts and to calculate draw specifications for future production in the mining area. Alternate production drifts of Tactite Panel I were drilled with vertical long-hole percussion drills at 80 foot intervals. Since the drifts are on 40 foot centers, the drill holes are spaced on 80 foot centers in both directions. Similar close drilling has been completed in the developed parts of Tactite II. Tactite Panel III has a few underground diamond drill holes where access permitted as well as the original surface drilling. Underground diamond drill core is primarily BX size although some holes drilled with a light rig are AX.

Underground diamond drill holes on the 1100 level of the Oxide Mine are collared approximately 70 feet apart across the strike of the ore zone, and approximately 90 feet apart along the strike. The holes are usually angled upward in varying directions to intercept ore boundaries. Portions of 900 level oxide ore zone have been drilled, although not yet as extensively as 1100 level. Underground development and closer drilling has disclosed the presence of lower grade leached zones within the oxide ore zone. Overall tonnage and grade of oxide ore has, however, been found to be essentially unchanged from that indicated by surface drilling.

Drilling of porphyry ore zones underground has been limited mainly to the south end of the mine. 500 level north drift and 200 level haulage drifts have permitted some fill-in type diamond drilling, mainly as holes fanned outward from 500 north drift and upward from 200 haulage drifts. Considerable fill-in drilling remains, especially below 200 level. Porphyry ore above 200 level is reasonably covered by present surface drilling. Results from underground drilling of porphyry ore have agreed closely with results from surface drill holes.

MINERAL INVENTORY

A mineral inventory of the Lakeshore deposit was calculated by computer in April 1975 based on 350,684 feet of diamond drilling available at that time. This is the best estimate of mineral inventory covering all of the mineralized zones that is available at this time. The 62,960 feet of diamond drilling completed since April 1975 has been essentially fill-in drilling and has not significantly affected mineral inventory.

The mineral inventory was developed using assay data from all diamond drill holes within the mineralized zone. The mineralized zone was divided into blocks 100 feet x 100 feet horizontally and 50 feet high and the average grade of each block was derived by projection of assay data influencing the block grade. The size of blocks in the inventory represent units that could be segregated using selective open pit mining methods and serves equally well to define a mineral inventory. Blocks were classed as oxide

or sulfide depending on whether the ratio of acid soluble copper assay to total copper assay was above or below 0.5. This ratio has been found to closely approximate the usual distinct change from oxide mineralization to sulfide mineralization. The tonnage and average grade of all blocks whose grade was above specified grade cut offs were compiled and are summarized in Table I.

Table I - Mineral Inventory

April 1975

Grade Cut-Off	Oxide Mineral Inventory		Sulfide Mineral Inventory	
	Tons	% Acid Soluble Copper	Tons	% Copper
0.10	825,375,000	0.45	808,583,000	0.47
0.30	142,583,000	0.72	523,083,000	0.62
0.40	103,000,000	0.86	401,500,000	0.70
0.50	79,583,000	0.99	293,583,000	0.80
1.00	28,250,000	1.52	50,583,000	1.39

IN-SITU ORE RESERVES

In-situ ore reserves have been calculated using all available assay data of September 30, 1977 and depleting the reserve by ore mined to the same date. The in-situ ore reserves include only such ore as could be mined at, or better than, a cash break-even basis, on the expectation of receiving a normal price for copper produced and experiencing costs and recoveries that could reasonably be expected based on sound engineering estimates and cost projections. In this report a copper price of 78 cents per pound is estimated to be normal relative to the 1977 costs used in establishing

cut-off grades. Non-cash costs such as depletion, amortization and depreciation were not considered, although future cash expenditures for mine development or to replace equipment were included as costs.

The in-situ ore reserves are calculated from lay-outs consistent with block cave mining methods used at Lakeshore. All lay-outs include any waste rock within the ore column that might be drawn to extract ore lying above. Waste lying above the ore column (dilution) is not included in in-situ ore reserves. Lay-outs below 200 level are not as accurate as those for 200 level and above due to incomplete fill-in drilling to the usual 200 ft. x 200 ft. pattern.

Table II - In-Situ Ore Reserves

In-Situ Oxide Ore Reserve

Level	Ore Zone	Tons	% Acid Soluble Cu
1100	Oxide	2,294,000	1.42
900	Oxide	3,259,000	1.81
500	N. Porphyry (Oxide over Sulfide)	2,522,000	1.68
500	N. Oxide	648,000	1.25
365	N. Porphyry (South Area)(Oxide over Sulfide)	4,064,000	1.84
365	N. Oxide (South Area)	4,259,000	1.30
365	N. Oxide (North Area)	4,877,000	1.40
200	N. Porphyry (South Area)(Oxide over Sulfide)	1,408,000	1.11
200	N. Oxide (North Area)	2,043,000	0.86
Total In-Situ Oxide Ore Reserve		25,374,000	1.47

Table II (cont'd)

In-Situ Ore Reserves

In-Situ Sulfide Ore Reserves

Level	Ore Zone	Tons	% Total Cu
500/400	Tactite Panel I	2,564,000	1.23
336/266	Tactite Panel II	2,183,000	1.73
500	Tactite Panel III	1,853,000	1.67
365	Tactite Panel III	2,902,000	1.79
200	Tactite Panel III	1,513,000	1.82
Sub-Total	In-Situ Tactite Ore Reserve	11,015,000	1.63

Level	Ore Zone	Tons	% Total Cu
500	South Porphyry	5,332,000	0.79
500	Southwest Porphyry	2,555,000	0.90
500	North Porphyry (under Ox)	1,333,000	1.20
365	South & Central Porphyry	19,681,000	0.77
365	North Porphyry (South Area) (under Ox)	3,291,000	0.92
200	South Porphyry	6,295,000	0.68
200	Central Porphyry	13,557,000	0.84
200	North Porphyry (South Area) (under Ox)	1,674,000	0.82
200	North Porphyry (South Area)	3,877,000	0.99
-50	Porphyry	31,443,000	0.74
-400	Porphyry	14,245,000	0.69
-625	Porphyry	4,819,000	0.82
Sub-Total	In-Situ Porphyry Ore Reserve	108,102,000	0.78
-50/-625	Chalcocite West of "C" Fault	19,062,000	1.41
Total	In-Situ Sulfide Ore Reserve	138,179,000	0.93

It is noted that the oxide or sulfide mineral inventory at a grade cut-off of 0.50% copper shows substantially more tonnage at a much lower grade than does either the oxide or sulfide in-situ ore reserve. This results primarily because the mineral inventory includes all blocks above the grade cut-off whether or not they are included within an ore column that can be

economically mined from a specified level planned for development. Table III is an approximate reconciliation of in-situ ore reserves with mineral inventory showing the substantial tonnage of mineral inventory that cannot be mined by caving methods at present estimated costs and prices.

Table III

Reconciliation of In-Situ Ore Reserves with Mineral Inventory at 0.50% Cu Cut-off

	Tons	%ASCu
In-situ oxide ore reserve	25,374,000	1.47
Depletion through September, 1977	2,646,000	1.03
+0.5% Cu excluded from reserve	51,563,000	0.75
Total = +0.5% Cu Oxide Mineral Inventory	79,583,000	0.99
	Tons	**% Cu**
In-Situ sulfide ore reserve	138,179,000	0.93
Depletion through September, 1977	2,396,000	0.79
+0.5% Cu excluded from reserve	153,008,000	0.68
Total = +0.5% Cu Sulfide Mineral Inventory	293,583,000	0.80

Tactite In-Situ Ore Reserves

Tactite in-situ ore reserves are hand-calculated reserves based on layed out mining areas. (Figure 1)

Tactite Panel I in-situ ore reserves are calculated by assigning the column and grade of each drill hole to the nearest draw point. Column and grade is pro-rated to each draw point between those assigned drill grades until all draw points have been valued with respect to column and grade. Drill hole columns are averaged from undercut to top of ore based on 0.70% copper cut-off. Tonnages are calculated at 10.5 cu. ft. per ton in place. Tonnages associated with unusually wide spacing between draw raises, such as intervening vent drift pillars, are included in reserves and are undercut as mining progresses across them.

Other Tactite in-situ ore reserves are calculated from drill hole polygons plotted on drill sections. Cut-off grade and tonnage factors are the same as Tactite Panel I. Geology and ore zones are shown on the sections. Grades are the drill hole column from undercut to top of ore except where geology indicates that footwall waste is more or less than in the drill hole. In that event, the ore zone grade is combined with an adjusted amount of footwall waste.

900-1100 Oxide In-Situ Ore Reserves

Hand calculated in-situ ore reserves of 900 level and 1100 level oxide ore zones were calculated from sections. Geology and grade zones were shown on sections through each line of draw raises. Grades were pro-rated within grade zones to draw raise locations. Cut-off grade is 0.90%

acid soluble copper with minimum column height of 40 feet. A tonnage factor of 12.5 Cu. ft. per ton in place is used for all oxide ores.

500, 365 and 200 Level Porphyry In-Situ Ore Reserves and Oxide In-Situ Ore Reserves

An adequate porphyry in-situ ore reserve was difficult to calculate using sections because the drill hole grid was not uniform and the drill holes tended to wander from one to an adjacent section as shown by surveys at depth. It was therefore decided to use a computer to make corrections necessitated by the variable sample locations in assembling the assay data. An up-dated computer mineral model was completed in April, 1977 that included only porphyry ore zones and oxide ore zones below 1400 elevation.

For purposes of valuing revenue in the cut-off calculation, a normal 1977 copper price of 78 cents was estimated to conform with 1977 operating and development costs. The ore column versus grade cut-off curves developed for both porphyry and oxide ore are shown in Figures 2 and 3. Details of their derivation are shown in Table IV. It will be noted on the curves that at very high grades the calculated column height is abnormally low and would result in very low tonnage recovery. These minimal columns were arbitrarily increased in height to compensate for the expected low tonnage recovery.

The computer model mineral inventory printed on sections at 100' intervals was used as the basic grade data for a reserve based on a calculated

FIGURE 2 — SULFIDE ORE DEVELOPMENT CUT-OFF

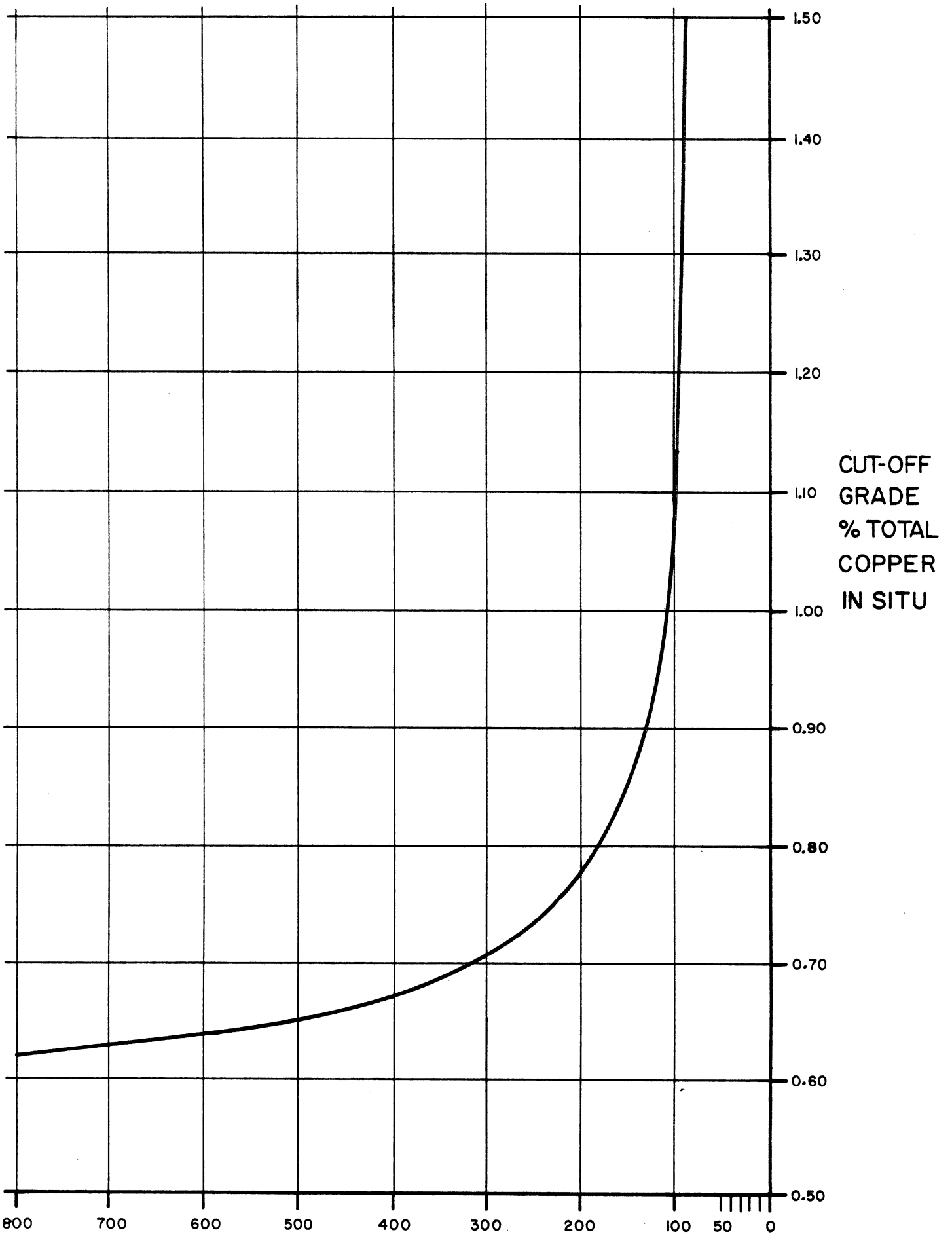

FIGURE 3 — OXIDE ORE DEVELOPMENT CUT-OFF

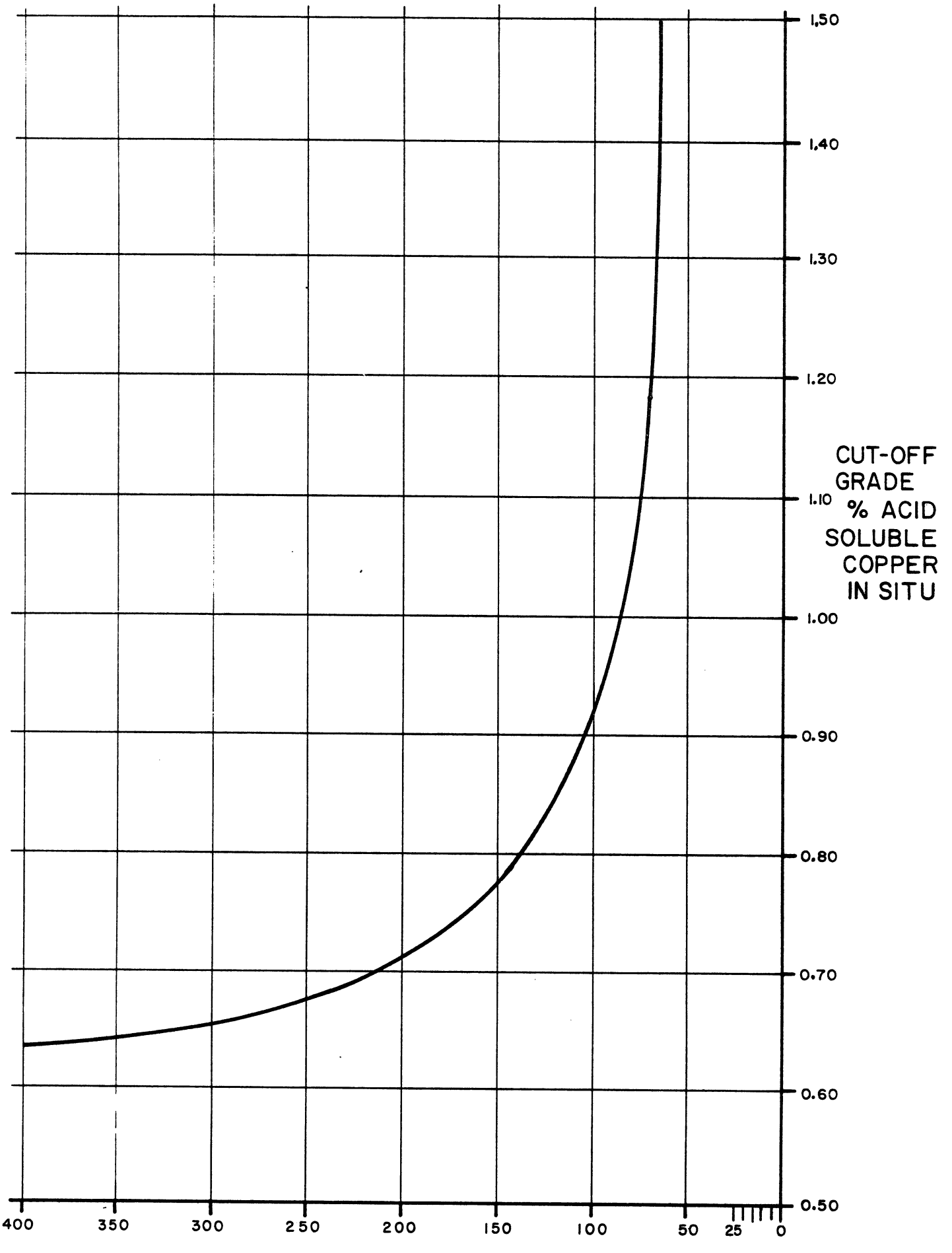

Table IV

CALCULATION OF CUT-OFF GRADE FOR PORPHYRY ORE AND OXIDE ORE

	Per lb Cu
Normal price, 1977	$ 0.78
Less: Quality and sales deductions	0.037
Royalties and severance tax	0.056
Metallurgical treatment, extractive	0.100
Net value to cover other costs	0.587

	Per Ton Sulfide Ore	Per Ton Oxide Ore
Other Operating Costs:		
Crushing and concentrating	$ 1.39	$ 0.16
General and administrative	0.97	0.97
Mine production cost	1.28	1.47
General mining cost	2.24	2.24
Less Estimated reductions*	(0.88)	
Total other operating costs	5.00	4.84

	Sulfide Ore	Oxide Ore
Lbs Cu to cover other operating costs	8.52 lbs.	8.25 lbs.
Lbs Cu required in heads, 84% recovery	10.14 lbs.	9.82 lbs.
Indicated draw cut-off	0.507%	0.491%
Rounded draw cut-off	0.5%	0.5%

*Estimated reductions to be made in G & A and General Mining costs related to porphyry ore through more detailed analysis

Table IV (cont'd)

	Per Square Foot Developed					
	Porphyry Ore				Oxide Ore	
Block preparation and panel development costs	$30.25				$22.71	
Lbs Cu to cover Bl. prep. and Panel Dev.	51.5 lbs.				38.7 lbs.	
Sulfide Development Cut-Off:						
Grade in Place	0.60	0.65	0.70	0.80	0.90	1.00
Draw grade 90% extr.	0.540	0.585	0.630	0.720	0.810	0.900
Lbs. Cu recovered, 84% Rec.	9.07	9.83	10.58	12.10	13.61	15.12
Lbs. to cover other Op. costs.	8.52	8.52	8.52	8.52	8.52	8.52
Lbs. available for dev. costs	0.55	1.31	2.06	3.58	5.09	6.60
Tons per sq. ft. to cover dev.	93.6	39.3	25.0	14.4	10.1	7.8
Column required, feet	1170	491	313	180	126	98
Estimated tonnage extr.	100%	100%	100%	100%	97%	89%
Column required in place	1170	491	313	180	130	110
Oxide Development Cut-Off:						
Grade in place	0.65	0.70	0.80	0.90	1.00	1.20
Draw grade, 90% extr.	0.585	0.63	0.72	0.81	0.90	1.08
Lbs. Cu recovered, 84% Rec.	9.83	10.58	12.10	13.61	15.12	18.14
Lbs. to cover other Op. costs	8.25	8.25	8.25	8.25	8.25	8.25
Lbs. available for Dev. costs	1.58	2.33	3.85	5.36	6.87	9.89
Tons per sq. ft. to cover dev.	24.5	16.6	10.1	7.2	5.6	3.9
Column required, feet	306	208	126	90	70	49
Est. tonnage extraction	100%	100%	93%	88%	83%	72%
Column required in place	306	208	135	102	84	68

economic cut-off. A program of fill-in drilling from surface of 365 level North oxide ore zone was underway at the time the computer model was being calculated and some holes in this area had not been included. These were plotted on the sections and their ore zone grade data accepted at the hole location was pro-rated to, or averaged with, the computer ore zone grade approximately 200 feet to either side of the drill hole.

Proposed undercut elevations were drawn on overlays on the sections and the ore zone was divided into 50' wide columns corresponding with the 50' by 50' wide x 25' high block stacks of the computer section. The top of the ore zone was noted and the height of ore column, and average grade of columns was recorded on the overlays. Lateral mining limits as determined by column versus grade cut-off curve (Figures 2 and 3) were marked by vertical lines on section and plotted in plan. A sample reserve calculation section is shown in Figure 4. Tonnage and grade were compiled from the sections for porphyry and oxide ore zones lying between 200 and 900 levels. Grades between sections were weighted by section area. Tonnages were calculated by multiplying the sum of adjacent section areas by half the distance between to obtain volume and dividing by a tonnage factor of 12.5 cu. ft. per ton.

7,994,000 tons of oxide in-situ ore reserves lie above porphyry in-situ ore reserves. It is planned to draw porphyry ore from the lower part of an ore column followed by oxide ore from the upper part of the column.

There will be some admixture of oxide ore into the top of the porphyry column and further mixture of overlying dilution into the top of the oxide column. The minimum oxide column that should be included in the ore reserve because of this dilution on both top and bottom must be determined from future experience. In the absence of such experience, we have largely used judgment and have excluded some oxide lying high above the undercut with which we would not feel comfortable, but which might be recovered. In general, but not exclusively, we have left out oxide columns which would not make ore on their own. Exceptions to this are higher grade porphyry and oxide columns which, even with very poor grade extraction, would together make ore.

Porphyry and Chalcocite In-Situ Ore Reserves Below 200 Level

Drilling below 200 level is generally more widely spaced than above 200 level. It was felt that future planned fill-in drilling of these areas was required before precise mining lay-outs could be made. Nevertheless, the drilling is sufficiently close and the ore intercepts sufficiently long and continuous between adjacent holes to assure that it comprises an in-situ ore reserve.

With reference to porphyry ore below 200 level, mining limits were established on the computer sections using the same method as for porphyry ore above 200 level and taking undercuts corresponding to -50, -400, and -625 elevations. Thus the calculation of reserves below 200

level is consistent with the calculation of reserves above 200 level although both the mining limits and the undercut horizons are no more definitive than the drill spacing allows.

Chalcocite ore lying west of "C" fault and below 200 level was not included in the up-dated computer model of April, 1977. It was consequently necessary to make a lay-out using an economic column/grade cut-off, and setting undercut levels that would conform with those of the porphyry in-situ ore reserve.

In-situ ore reserves below 200 level are largely based on drilling on approximately 400 foot centers. It has been our experience that fill-in drilling changes details of location and outline of the ore, but has only a minor effect on overall tonnage and grade.

DILUTED ORE RESERVES

Diluted ore reserves are an estimate of ore that will be delivered to the plant. They are made up of the portion of in-situ ore reserves that it is estimated will be extracted during mining and the dilution overlying the ore zone that it is estimated will be drawn with the ore.

Table V

Diluted Ore Reserves

Diluted Oxide Ore Reserve

Level	Ore Zone	Tons	% ASCu	Percent Extraction of In-Situ Reserve Tons	Grade	Copper
1100	Oxide	2,662,000	1.07	116	78	90
900	Oxide	3,871,000	1.19	119	66	78
500	N. Phy. (Ox over Sulf)	2,500,000	1.15	100	68	68
500	N. Oxide	600,000	1.05	100	84	84
365	N. Phy. (S)(Ox over Sulf)	4,100,000	1.20	100	65	65
365	N. Oxide (S)	4,200,000	1.08	100	83	83
365	N. Oxide (N)	4,900,000	1.15	100	82	82
200	N. Phy. (S)(Ox over Sulf)	1,400,000	0.85	100	77	77
200	N. Oxide (N)	2,000,000	0.73	100	85	85
Total Diluted Oxide Ore Reserve		26,233,000	1.09	103	74	76

Diluted Sulfide Ore Reserves

Level	Ore Zone	Tons	% Cu	Percent Extraction of In-Situ Reserve Tons	Grade	Copper
500/400	Tactite Panel I	2,099,000	0.88	97	73	71
336/266	Tactite Panel II	2,458,000	1.15	113	66	75
500	Tactite Panel III	2,064,000	1.20	111	72	80
365	Tactite Panel III	3,221,000	1.25	111	70	78
200	Tactite Panel III	1,500,000	1.20	100	66	66
Sub-Total Diluted Tactite Ore Reserve		11,342,000	1.14	103	70	72

Table V (cont'd)

Diluted Sulfide Ore Reserves (cont'd)

Level	Ore Zone	Tons	% Cu	Percent Extraction of In-Situ Reserves Tons	Grade	Copper
500	South Porphyry	4,800,000	0.70	90	89	80
500	Southwest Porphyry	2,100,000	0.76	82	84	69
500	North Porphyry (under Ox)	1,300,000	0.90	100	75	75
365	South & Central Porphyry	19,700,000	0.68	100	88	88
365	North Porphyry (S)(under Ox)	3,300,000	0.75	100	82	82
200	South Porphyry	6,300,000	0.62	100	91	91
200	Central Porphyry	13,600,000	0.73	100	87	87
200	North Porphyry (S)(under Ox)	1,700,000	0.72	100	88	88
200	North Porphyry (S)	3,900,000	0.81	100	82	82
-50	Porphyry	31,500,000	0.66	100	89	89
-400	Porphyry	14,200,000	0.62	100	90	90
-625	Porphyry	4,800,000	0.71	100	87	87
Sub-Total Diluted Porphyry Ore Reserve		107,200,000	0.68	99	87	86
-50/-625 Chalcocite West of C Fault		19,100,000	1.00	100	71	71
Total Diluted Sulfide Ore Reserve		137,642,000	0.76	100	82	82

Overlying dilution at Lakeshore contains overall about 0.3% acid soluble copper over oxide ores, and about 0.2% sulfide copper over sulfide ores. An approximate reconciliation can be made between diluted ore reserves and in-situ ore reserves by adding estimated dilution to in-situ reserves and subtracting the estimated part of in-situ reserves that is not extracted in mining as shown in Table VI.

Table VI

Reconciliation of Diluted Ore Reserves

With In-Situ Ore Reserves

In-Situ Oxide Ore Reserve	25,374,000 tons @ 1.47% ASCu
Less Ore Not Extracted	7,667,000 tons @ 1.47% ASCu
Plus Dilution (32.5%)	8,526,000 tons @ 0.3% ASCu
Diluted Oxide Ore Reserve	26,233,000 tons @ 1.09% ASCu
In-Situ Tactite Ore Reserve	11,015,000 tons @ 1.63% Cu
Less Ore Not Extracted	3,563,000 tons @ 1.63% Cu
Plus Dilution (34.3%)	3,890,000 tons @ 0.2% Cu
Diluted Tactite Ore Reserve	11,342,000 tons @ 1.14% Cu
In-Situ Porphyry Ore Reserve	108,102,000 tons @ 0.78% Cu
Less Ore Not Extracted	19,385,000 tons @ 0.78% Cu
Plus Dilution (17.2%)	18,483,000 tons @ 0.2% Cu
Diluted Porphyry Ore Reserve	107,200,000 tons @ 0.68% Cu
In-Situ Chalcocite Ore Reserve	19,062,000 tons @ 1.41% Cu
Less Ore Not Extracted	6,437,000 tons @ 1.41% Cu
Plus Dilution (33.9%)	6,475,000 tons @ 0.2% Cu
Diluted Chalcocite Ore Reserve	19,100,000 tons @ 1.00% Cu

The relatively high estimated dilution shown above for oxide, Tactite, and chalcocite ores, as compared with dilution estimated for porphyry ore, reflects the higher ore grade and shorter ore columns of those areas as compared with porphyry.

Mining extraction of both tonnage and grade are based on experience to date in mining tactite ore and in mining oxide ore. Since there has been no mining of porphyry ore as yet, mining extraction is based on other mine experience with similar type ore. The effect of double dilution of oxide ore overlying sulfide ore is considered in the estimates.

Extraction experience in Tactite Panel I and 1100 level oxide ore mining area is tabulated in Table VII. It is noted that initial Blocks 1 and 2 of Tactite Panel I did not cave well and as a result experienced considerable ground weight and closure, finally necessitating the abandoning of some ore. It is also noted that draw raise spacing on 17-1/2' x 20' centers in Tactite Panel I together with unusually low average column ($\pm$ 80') and the need to produce tonnage beyond a comfortable rate for the area resulted in unfavorable extraction. Tonnage and grade of remaining Tactite Panel I blocks are estimated in such a way that the total tonnage drawn from Panel I is at the same percent extraction as the first eight blocks, i.e., 97% tonnage extraction and 73% grade extraction.

Other Tactite panels will be developed with draw points on 17-1/2' x 17-1/2' centers which should be favorable to extraction. On the other hand, reserve grades are higher than for Tactite Panel I, which could result in drawing more dilution to reach the cut-off. Draw from these areas has been estimated at somewhat greater tonnage extractions and somewhat lower grade extraction than the first eight completed blocks of Panel I.

Table VII

EXTRACTION EXPERIENCE

Tactite Panel I Completed Blocks Through August 1977

Block	In-Situ Ore		Diluted Ore Mined		Percent Extraction		
	Tons	% Cu	Tons	% Cu	Tons	Grade	Copper
1	134,000	1.15	68,902	0.92	51.4	80.0	41.1
2	149,000	1.04	87,316	0.50	58.6	48.1	28.2
3	152,000	0.88	168,653	0.66	111.0	75.0	83.2
4	120,000	0.85	124,277	0.67	103.6	78.8	81.6
5	114,000	1.01	156,007	0.80	136.8	79.2	108.4
6	118,000	0.80	119,362	0.60	101.2	75.0	75.9
7	151,000	0.82	156,603	0.59	103.7	72.0	74.7
8	169,000	0.97	186,647	0.77	110.4	79.4	87.7
Total	1,107,000	0.941	1,067,767	0.688	96.5	73.1	70.5

1100 Oxide Mine Completed Blocks Through August 1977

Block	In-Situ Ore		Diluted Ore Mined		Percent Extraction		
	Tons	% ASCu	Tons	% ASCu	Tons	Grade	Copper
1	382,160	1.34	605,416	1.03	158.4	76.9	121.8
2	553,582	1.21	618,350	1.16	111.7	95.9	107.1
3	195,819	1.20	195,738	0.90	100.0	75.0	75.0
4	206,899	1.28	91,425	0.84	44.2	65.6	29.0
Total	1,338,460	1.257	1,510,929	1.055	112.9	83.9	94.7

Oxide reserves on 900 and 1100 levels have been laid out in mining blocks or panels and tonnage extraction is expected to reflect experience to date. Oxide reserves below 900 level, as well as all porphyry reserves, are irregular shaped areas in plan (Figure 1) and have not been "squared up" into rectangular panels. An adjustment of reserves is usual when this is done and detailed reserves calculated. To allow for some loss in calculated reserve in "squaring up", these areas were arbitrarily given 100% tonnage extraction, whereas they would normally be expected to have on the order of 110% tonnage extraction when precise boundaries are known.

Oxide ore grade extraction is estimated based on experience in the first completed blocks of 1100 level. This experience (113% tonnage extraction and 84% grade extraction) is closely equivalent to one-third clean draw and two-thirds varying uniformly from clean ore to a cut-off grade of 0.65% acid soluble copper, or, expressed more simply:

$$\frac{2 + \frac{0.65 \text{ cut-off grade}}{1.26 \text{ reserve grade}}}{3} = 84\% \text{ grade extraction}$$

Use of this formula allows differences in reserve grade to be reflected in grade extraction. As reserve grade increases percent grade extraction decreases (and percent tonnage extraction increases).

Porphyry ores have not yet been "squared up" into panels and have similarly been assigned 100% tonnage extraction. Grade extraction is based on San Manuel experience with blocks having draw raises spaced 17-1/2' x 17-1/2' centers (one third of draw was clean ore, two-thirds varied uniformly from clean ore to cut-off grade of 0.5% copper).

$$\text{Approx. Grade Extraction} = \frac{\frac{0.50 \text{ cut-off}}{\text{x.xx reserve grade}} + 2}{3}$$

Some judgment is necessary in estimating grades as, for instance, in 500 southwest porphyry ore zone where sulfide ore has an abnormal acid soluble content, the grade is lowered to reflect less recovery rather than lower total copper grade. Also, 900 level oxide ore has an unusually high reserve grade as compared with ore lying above or below and its grade was factored downward. All oxide ores lying above sulfide ore are factored downward in grade to reflect the double exposure to dilution at both top and bottom of the oxide column.

POTENTIAL FOR ADDITIONAL RESERVES

Mineralization and ore are truncated against regional size faults on the east and west sides and are clearly offset by these structures. A large thrust fault at the base of Tactite ore may or may not have post-ore movement. Dis-

placement on these faults has not been worked out with certainty. The possibility of locating a downthrown segment of porphyry ore west of "C" fault is good. The present chalcocite ore west of "C" fault is, of course, the faulted equivalent of oxide ore east of "C" fault. The possibility of locating additional ore segments beyond the other regional size faults is more remote, but worthy of further study.

There is a large amount of oxide mineralization and some chalcocite mineralization that will be fragmented by mining the present in-situ ore reserves but will not be mined. Other caving operations have had considerable success with leaching this type mineralization in place. Subject to on-going leaching test work, there is a potential for further recovery of copper by leaching in place on completion of underground mining.

SECTION 4

REVIEW OF MINING TO SEPTEMBER, 1977

4.1 Introduction

Production started in the Tactite I area in November, 1977 and in the oxide mine in March, 1976; both areas were mined by block caving. Production started in Tactite II by sublevel caving in May, 1977. Generally speaking, mining was satisfactory in the oxide mine; it was difficult in Tactite I; and it was unsatisfactory where sublevel caving was used in Tactite II (Figure 11).

A total of 5,237,071 tons has been mined from underground at a grade of 0.94 percent Cu up to August 31, 1977.

The problems of mining in the tactite mine, and the relatively small area that was developed for production, resulted in a deficiency of sulfide ore which was less than half the plant requirements. Many problems were solved and many lessons were learned in this early period of mining. This knowledge is incorporated in the mining plan described below and provides confidence in the projections.

During this early period, much thought was given to other mining methods and it was concluded that block caving was the most suitable

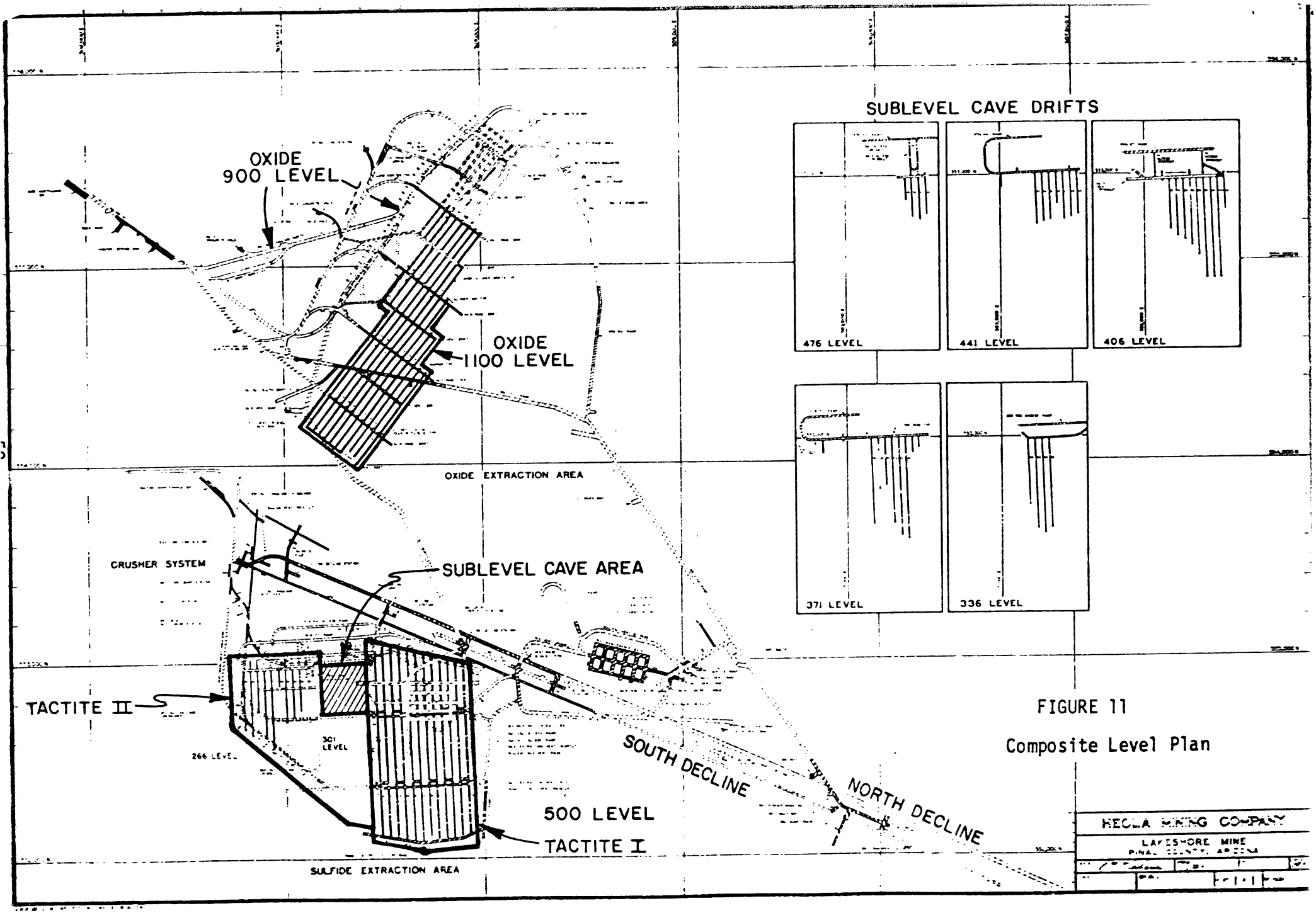

FIGURE 11

Composite Level Plan

method available, even though it is usually applied to ore bodies with great thickness of ore.

4.2 Oxide Mine

Mining commenced on the 1100 Level, which is about 700 feet below the surface. The proposed production rate was 6450 tons per day. Actual production averaged about 5900 tons per day during the last few months of operation.

Caving occurred after approximately 40,000 square feet had been undercut and the operation worked well. The ore broke into small sizes and was readily handled in the extraction drifts. Draw points were established on 17-1/2 feet by 17-1/2 feet spacing in the extraction drifts, and ore was slushed directly into cars utilizing 75 hp slushers and 5-foot scrapers. Draw point size was 4 feet by 4 feet.

Ore extraction as compared to in-situ mining reserves averaged 120 percent of the tons, 82 percent of the grade, and 98 percent of the copper. As of 31 August 1977, 2,723,000 tons had been mined at 1.04 percent acid soluble copper.

Problems encountered were as follows:

1. Problems were created when turning slushers to draw ore from a new adjacent panel when the old panel was not yet finished. Since slusher drifts in adjacent panels are in line, only the drift on one side of the panel can be slushed with the installed slusher hoist. The drift in the adjacent panel must await development until completion of draw in the original drift frees the slusher hoist so that it can be re-installed facing in the opposite direction. A gap in production from the slusher drift results while the slusher is turned and the slusher drift in the adjacent panel is undercut.

2. With the mine operating on a continuous basis, the necessary maintenance to the oxide shaft facilities resulted in a loss of production. This loss resulted because there is very little ore storage available underground and it was not practical to provide more.

3. Spills of rock occur when dumping ore into the skips; these spills are not always completely caught in the spill pocket. The rock that falls to the bottom of the shaft has to be manually

mucked, and this results in a complete shut down of production. The time lost averaged about 4 shifts a month. Rock spills should present fewer problems in the future because of spill pocket repairs that have been accomplished during the shut down and because of a venturi system that has been developed for blowing the rock from the shaft bottom into the skip.

The oxide mine is being scheduled at 6000 tpd while operating through the existing shaft and at 6550 tpd when the proposed No. 2 shaft is operational.

Costs for 1977 were $7.51 per ton of ore, or 38¢ per lb. Cu for all underground costs (including General Mine).

4.3 Tactite Mine

Block Caving in Tactite I

The southernmost portion of the tactite ore body was selected for the first sulfide mining area and was prepared for a variation of block caving. The ore in this area dips to the west at about 20° from the horizonatal, and is at 400 feet in elevation on the west side and 500 feet in elevation on the east side. Depth below surface is about 1300 feet.

This tactite area is about 480 feet by 900 feet, and contains about 4,641,000 tons of ore in place averaging about 112 feet thick and a grade of 1.14 percent Cu in-situ. Twelve concrete-lined extraction drifts were driven on strike from north to south on 40-foot centers. Ore passes were bored 5 feet in diameter from the extraction level to a haulage level established on the 200 level. These ore passes were lined with concrete and steel, resulting in a finished diameter of 4 feet. Draw points were on a spacing of 17-1/2 feet by 20 feet, and were 6 feet wide by 5 feet high. All ore is hauled by ST-2B load-haul-dump diesel-powered scooptrams (2 cubic yard buckets) from the draw points to the dump point over an average distance of 300 feet.

Caving was initiated by undercutting in the southeast corner of the block and extending 250 feet to the west and 120 feet to the north. The ore did not cave as anticipated, but formed an arch which threw damaging weight onto the concreted extraction drifts. This resulted in early drift repairs. The undercut was then extended on additional 250 feet to the east and 100 feet to the north. After about 60,000 square feet had been undercut, a cave was established.

From their very first use, the 4-foot diameter vertical steel-lined ore passes hung up repeatedly and were seriously interfering with the

withdrawal of the muck. Because the cave had already been started, caving pressures continued to build up. To relieve such pressures, it is necessary to quickly remove the swell and keep the ore columns moving at a uniform rate. However, this was frustrated by the hanging up of the ore passes. Consequently, the extraction drift concrete was further damaged and compounded the problem of extraction drift repair. But, then these repairs additionally interfered with the withdrawal of the ore. Therefore, these three factors of blocked ore passes, damaged drifts, and repair work combined to limit production and add to the cost.

To cure the problem of ore-pass hangup, surge bins were cut above the chutes on 200 level and the ore passes were not filled above the surge. This activity, while being most successful, further interfered with production and was not completed until the second half of 1976.

After these problems were under better control, the caving front was progressed north to a point just south of No. 2 Vent crosscut by the end of August, 1977. During this period, production averaged as follows:

3052 tons per day during 1st half of 1976

4275 tons per day during 2nd half of 1976

4927 tons per day during last 5 operating months of 1977

Ore extraction as compared to in-situ ore reserves averaged 99 percent of the tons, 76-1/2 percent of the grade, and 76-1/2 percent of the Cu.

A total of 2,388,900 tons has been mined at 0.81 percent Cu.

Other problems associated with tactite mining are as follows:

1. The ore is about 80 feet thick and consists of relatively hard tactite. The undercut and the extraction drifts must be located beneath the tactite in weak diabase and hornfels rocks. This contact is erratic; consequently, a relatively large amount of very low grade material must be mined with the tactite, causing dilution from below the ore as well as above.

2. The weak rock causes problems in the undercuts and in maintenance of the extraction dirfts.

3. The hard tactite caves at a lower rate than the diabase; at times, therefore, it holds back and low-grade ore is pulled from the sides.

4. The tactite breaks into large boulders, which have to be blasted so that they can be handled through the draw points and into the extraction drifts, slowing production and damaging the draw points.

5. The area is heavily faulted. Caving pressures are transmitted down these zones of weakness, causing point pressure on the extraction drifts. These drifts were strengthened by the addition of 8-foot long epoxied reinforcing rebar bolts, bonding the concrete to the rock.

6. The low ore height requires rapid development of the undercut to keep up with production requirements. It was found that small "stub" pillars were being left in the undercut, which concentrated the loading from the caving action onto the extraction drifts. In addition, a blast hole method of undercutting was tried to speed up the undercutting, but the drifts were damaged and the method was abandoned. A very strict discipline in undercutting was instituted to prevent the formation of stub pillars (or their removal, if they should occur), and to minimize the amount of ground opened up by undercut development.

7. Undercutting is further complicated by a 20° east-west dip to the ore.

8. The extraction drifts had to be repaired, sometimes repeatedly, using arched steel sets. After these sets were installed, it was often not possible to use the ST-2B scooptrams because of restricted space; one-yard scooptrams were then used, with very poor productivity. To improve productivity, the area was being converted to the use of slushers (as in the oxide mine) during the last 6 months of operation. The scrapers used with these units can circumvent the repairs better, and the system requires less ventilation and maintenance.

9. It was not possible to draw off weight when passing over the No. 1 vent crosscut because draw points were not developed. It was very difficult to keep this drift open for necessary ventilation. Draw points are being installed in No. 2 vent crosscut to reduce this problem in the future.

10. Even though enough draw points could be prepared for a higher production rate, tonnage was limited by available extraction drifts. On the average, only 9 of the 12 extraction drifts were available because of repair work.

Even though not all the problems were reduced, significant progress was seen prior to suspension of operation in August, 1977. Productivity was improving due to the methods of improved support, undercutting and drawing the ore.

It is concluded that a tonnage of 4,000 to 5,000 tons per day from an area of this size and nature was not unreasonable; therefore, 4,000 tpd is being scheduled.

Costs for 1977 were $7.64 per ton of ore or 42¢ per lb. of Cu, including all underground costs.

Sublevel Cave Mining In Tactite II

After experiencing the problems described above, other mining methods were examined for their application to Tactite II (the area down dip from Tactite I). Sublevel caving was the only method which appeared to offer a possible alternative. An area immediately to the west of Tactite I was selected as an experiment and as a means of supplementing sulfide tonnage. This flat lying area, dipping 20^{0} to the west, had an area of approximately 300 feet wide by 500 feet long and was about 80 feet high.

Levels were established from ramp systems at 476, 441, 406 and 371 feet above sea level. Production drifts were driven south on 35-foot centers, 10 feet by 10 feet in section, and shotcreted. The 476 level was near the top of the ore, so very little muck was drawn from this level. All the drifts were in tactite and the ground was good - no problems were experienced in holding the drifts or the brows. In addition to the

shotcrete, fans of grouted rebar bolts were installed on 5-foot centers for brow support. The ground on 441 level was not as strong as on 476 level, but the production drifts were held successfully, except for the production drift next to the Tactite I. Problems were encountered with the drill holes closing up after drilling and it became necessary to load holes shortly after drilling. This level was successfully mined (except for poor recovery in #43 production drift).

On the 406 level, conditions deteriorated considerably because the greater part of the development was at, or under, the base fault between the tactite and the weak diabase described in Tactite I above. Shotcrete and rebar bolts would not hold the ground and timbering became necessary. The cost of steel was prohibitive in this development-intensive mining method. The ore extended further to the south on this level than on the upper levels, and maintenance of the support in the headings became so excessive that drifting advance was delayed. In August, 1977 it became clear that this method could not be used at the bottom of the tactite ore, and the ore body was not thick enough for it to be applied to only the upper part.

Sublevel caving is usually applied to steeply-dipping ore bodies, since vertical gravity draw is used to extract the ore. In Tactite II, the ore is not sufficiently thick to obtain satisfactory recoveries and the ground is too weak to be economically supported below the ore.

An average of 700 to 800 tons per day was obtained from May, 1977 (when production started) to August. A small tonnage still remains

developed in the portions of 406 above the base fault. This ore will be mined out later if still intact, but it is not proposed to use this method in the tactite ore body in the future.

A total of 125,124 tons was mined at a grade of 1.05 percent Cu.

Mining The cost was approximately $11.50 per ton of ore, or 55¢ per lb. of Cu for all underground costs.

HECLA MINING COMPANY
P. O. Box 320
WALLACE, IDAHO 83873
(208) 752-1251

March 25, 1976

Mr. E. Grover Heinrichs, Assistant Manager
Essex International, Inc.
Metallurgical and Mining Exploration
1704 West Grant Road
Tucson, Arizona 85705

Dear Mr. Heinrichs:

This morning, Herb Harper was telling me about the excellent Porphyry Copper Symposium in which you played a substantial part.

May I have a copy of the program which includes the abstracts of papers? When will the papers be published? May I be placed on the list for notice of publication? What will be the charge?

Did Jorge Leipen Garay deliver the talk on Mexican copper and mining law? If not, can you give me the name of the individual who did and his address? If you have copies of any of the papers, may I borrow them and make copies and return them to you?

Enclosed is our annual report, visitors' brochures for Star and Lucky Friday mines, 2-19-76 metals speech, 15 pages handed out to security analysts visiting Lakeshore in January, AMC policy and Handy & Harman's annual review. My annual silver review is in March E&MJ.

Yours truly,

Philip Lindstrom

Philip Lindstrom
Investment Manager

PL:sp

Enclosures

cc: HEHarper

DW

Comments ~~on the Current Proposed~~ Lakeshore Metallurgy

Summary of current proposed plan

1. There are two main classes of ore at the Lakeshore property, namely (1) oxide largely in a high lime gangue and (2) sulfide largely chalcopyrite and these will be treated separately.
2. It is proposed to float a sulfide concentrate and to roast the concentrate forming sulfur dioxide gas which will be converted to sulfuric acid.
3. The sulfuric acid will be used to leach copper from the oxide zone in vats to produce a copper solution.
4. The roasted sulfide concentrate will be leached with water and the copper solution will be sent to an electrolytic copper recovery system to produce cathode copper.
5. The residue from the leaching operation containing some unleached copper iron oxides and whatever gold and silver is present will be reduced to metallic iron in a Lurgi reduction unit using natural gas or oil.
6. The leach copper solution (3 above) is treated with the metallic iron to precipitate copper mud. Any gangue minerals and the gold and silver of the flotation concentrate will report with the copper mud. This produce will be sold to a convential smelter.

conventional

7. In my estimation, overall copper recovery from oxide and sulfide ores will be about 75%.

Criticism of Metallurgical Plan & Recommendations

1. ~~8.~~ The copper mud production could be low grade compared to other properties and will command a higher smelting charge.
2. ~~9.~~ The cathode copper may be high in iron and other inclusions, such as silica, since the solutions are not purified after leaching. A similar installation at Ray Mines of Kennecott produces cathodes which require melting and fire

refining before being acceptable for sale.

3. ~~10~~. The reduction of the iron oxide residue to metallic iron is costly and is not done without difficulties (see 5 above).

4. ~~11~~. It is questionable why Hecla did not spend ~~whether or not~~ some 25% more capital ~~expenditures would not have~~ to produce~~d~~ a product of superior ~~acceptable~~ copper grade with a higher overall recovery ~~of copper~~ and no more difficulty with E.P.A. regulations. To accomplish this ~~This~~ would entail several radical changes in the overall flow sheet with a LIX plant to treat the leach solutions from the oxide ore and direct electrolytic recovery for the oxide copper in the present electrolytic tank house.

5. ~~12~~. In place of the roasting and leaching procedure, it probably would have been better to treat the flotation concentrates in a Noranda type furnace with the sulfur providing most of the energy for the smelting operation. The products of this more conventional operation would be copper anodes containing the gold and silver which would provide good feed for the electrolytic plant and a sure method to recover gold and silver which in the present plan is lost. All the cathode copper thus produced would command a top price or would be suitable for wire bars or rod directly.

6. ~~13~~. Overall copper recovery from oxide and sulfide ores would approximate 85% by these suggestions.

Comments on Lakeshore Metallurgy

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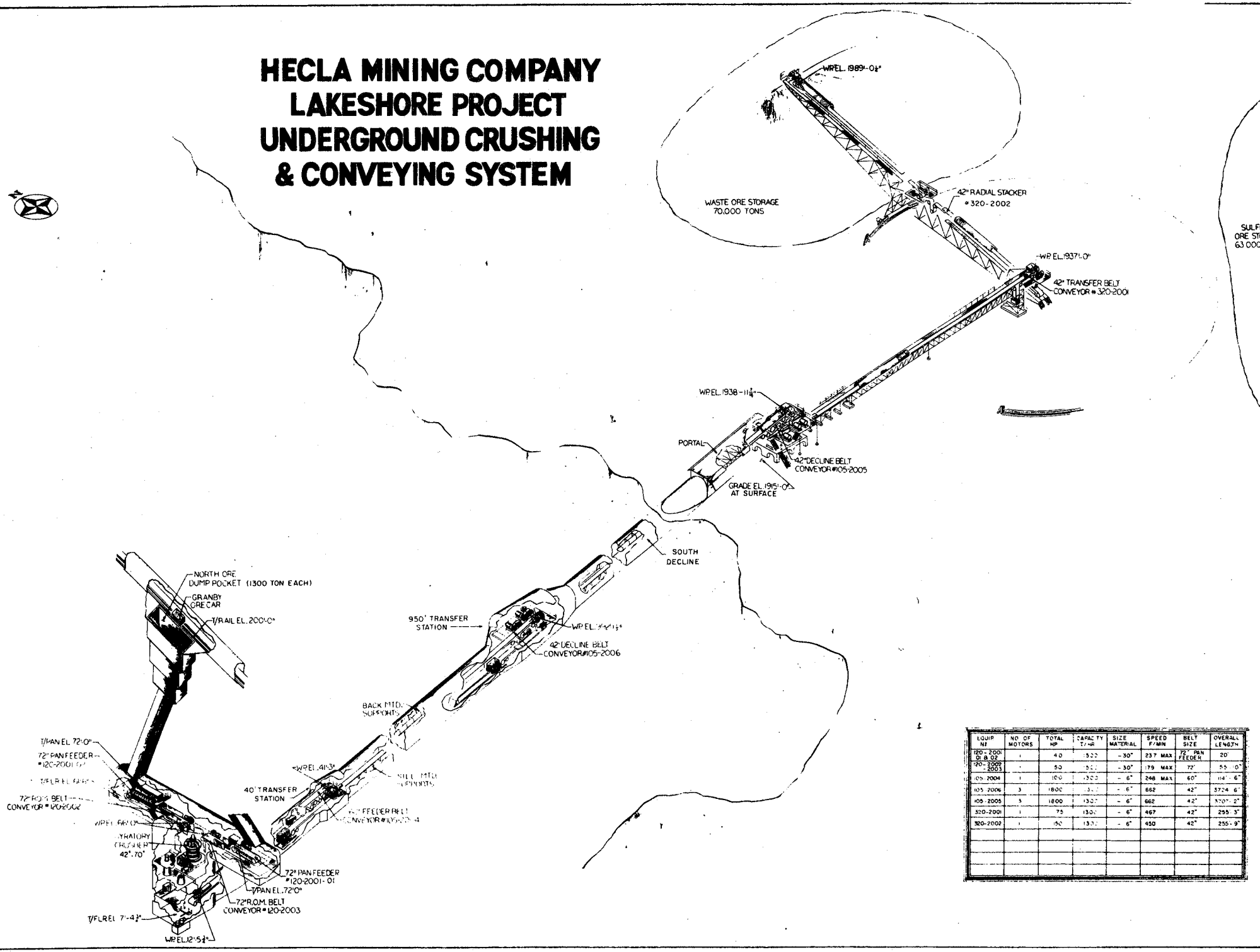
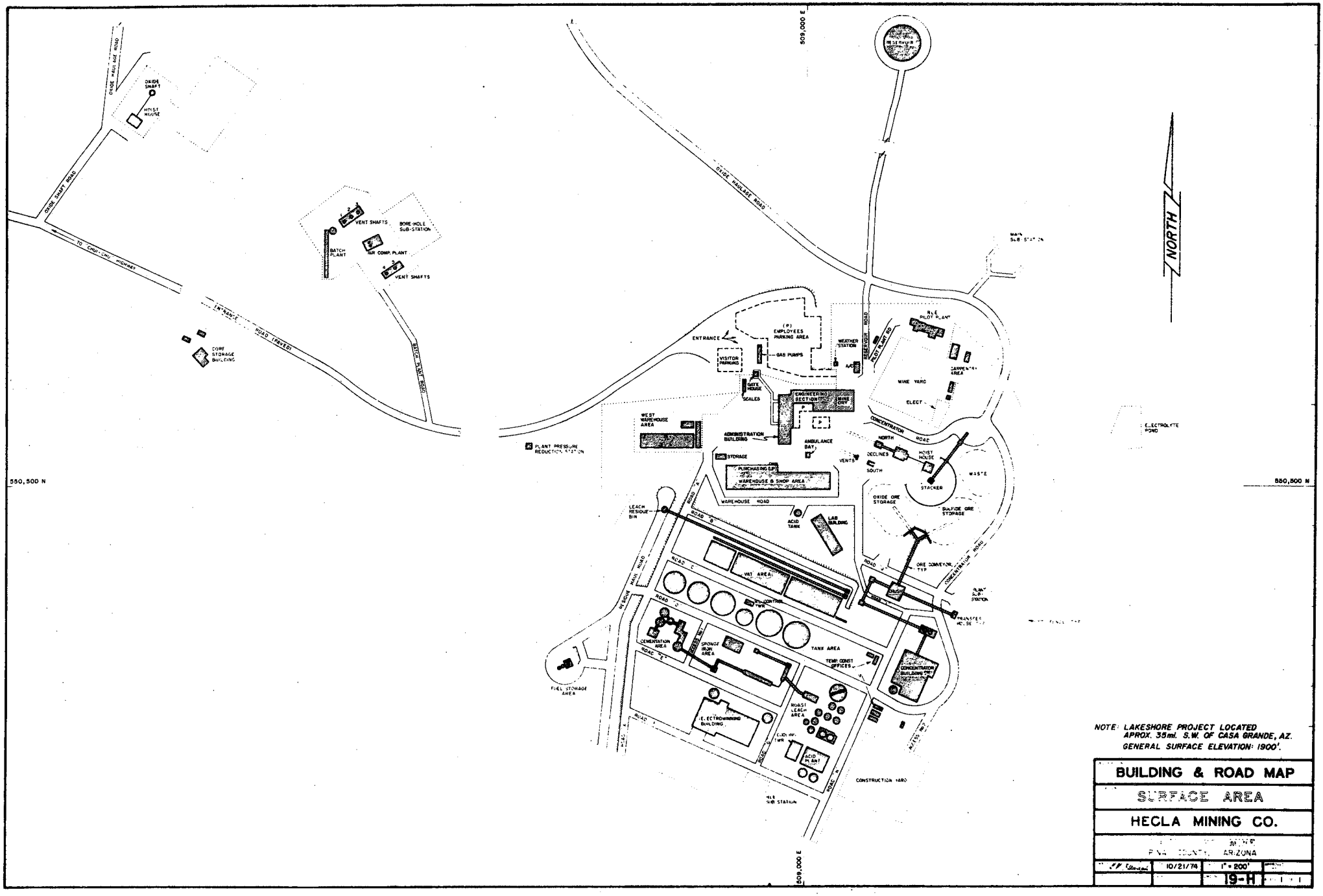
6. Overall copper recovery from oxide and sulfide ores would approximate 85% by these suggestions.

Prepared by: Lyle Lichty, May 1975

HECLA MINING COMPANY
LAKESHORE PROJECT
UNDERGROUND CRUSHING & CONVEYING SYSTEM



EQUIP. NO.	NO. OF MOTORS	TOTAL HP	CAPACITY T/HR	SIZE MATERIAL	SPEED F/MIN	BELT SIZE	OVERALL LENGTH
120-2001-01 & 02	1	40	500	-30"	237 MAX	72" PAN FEEDER	20'
120-2002 - 2003	1	50	500	-30"	179 MAX	72"	55'-10"
105-2004	1	100	1300	-6"	248 MAX	60"	114'-6"
105-2006	3	1800	3300	-6"	662	42"	3724'-6"
105-2005	3	1800	1300	-6"	662	42"	3707'-2"
320-2001	1	75	1300	-6"	467	42"	255'-3"
320-2002	1	150	1300	-6"	450	42"	255'-9"



NOTE: LAKESHORE PROJECT LOCATED APROX. 35mi. S.W. OF CASA GRANDE, AZ.
GENERAL SURFACE ELEVATION: 1900'.

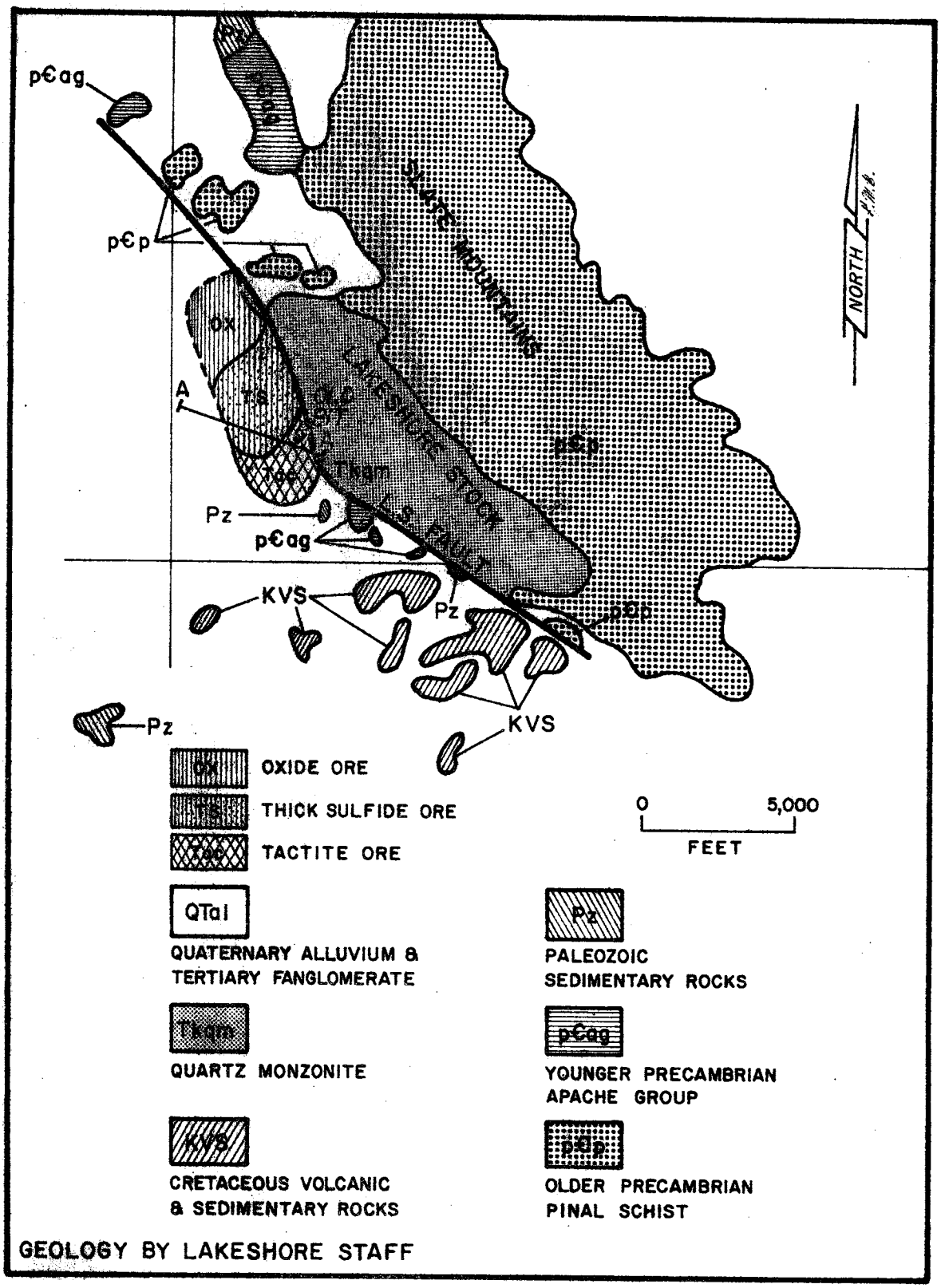
BUILDING & ROAD MAP

SURFACE AREA

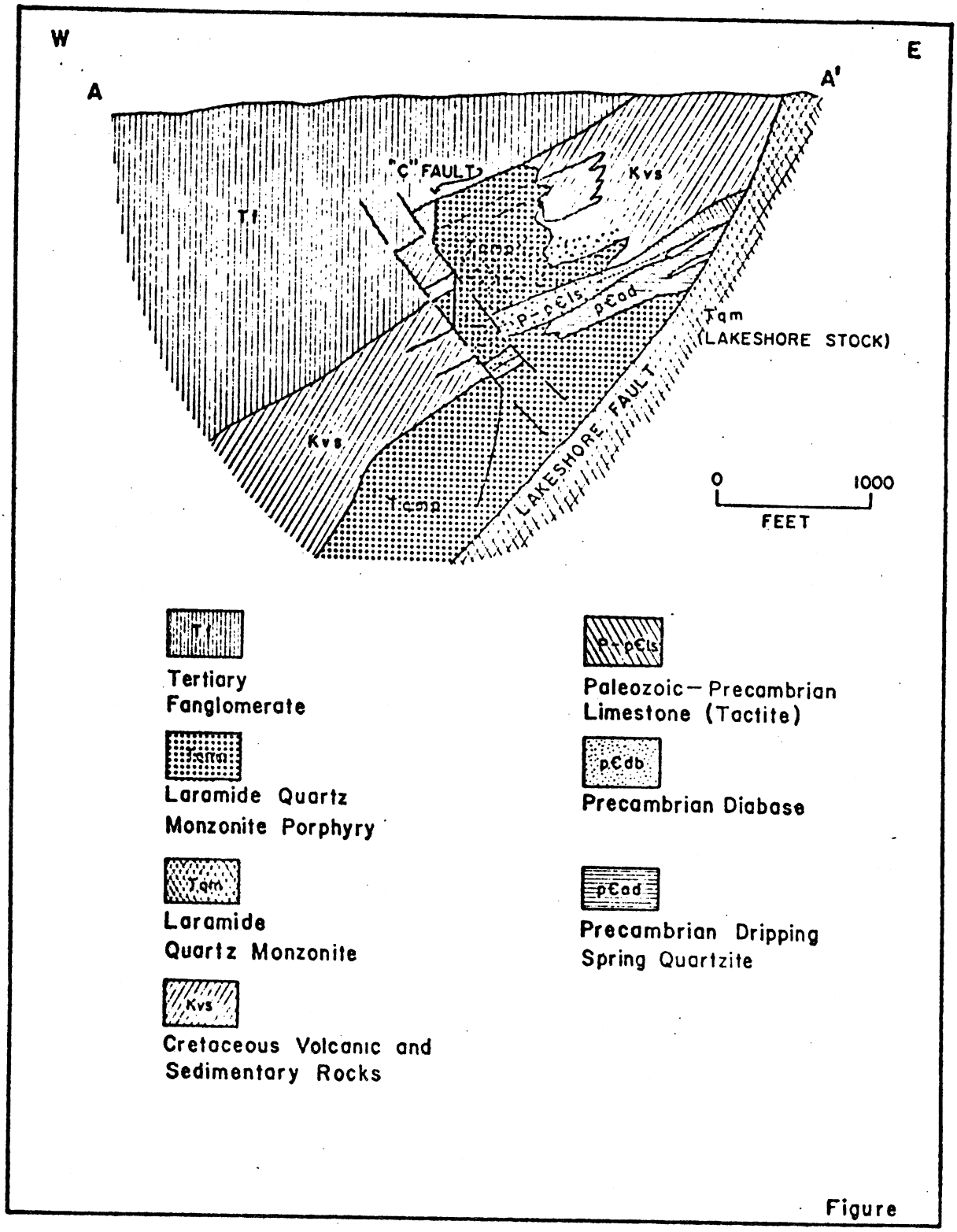
HECLA MINING CO.

PINAL COUNTY, ARIZONA

	10/21/74	1" = 200'	
		19-H	

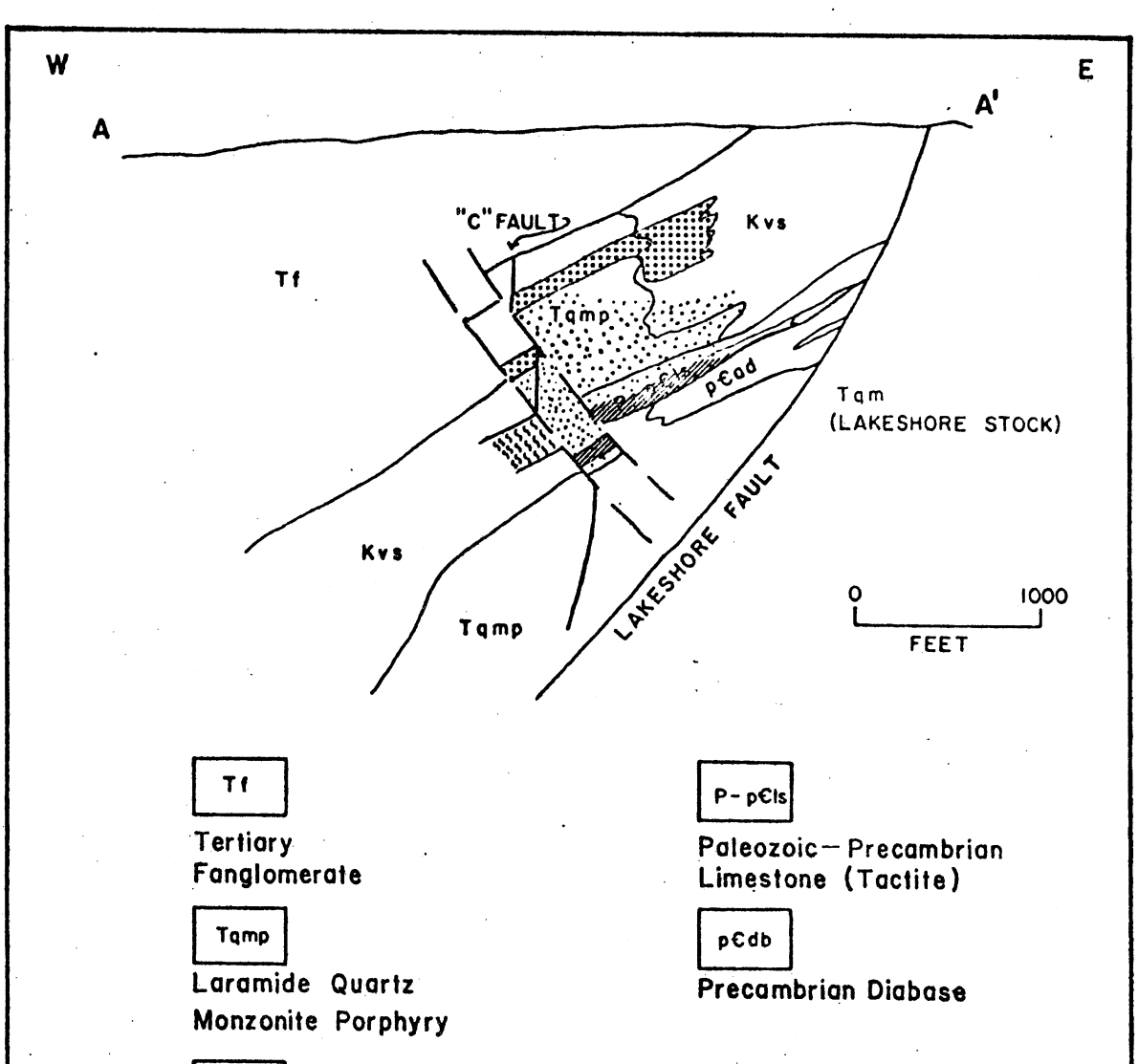


SURFACE GEOLOGY, LAKESHORE MINING AREA



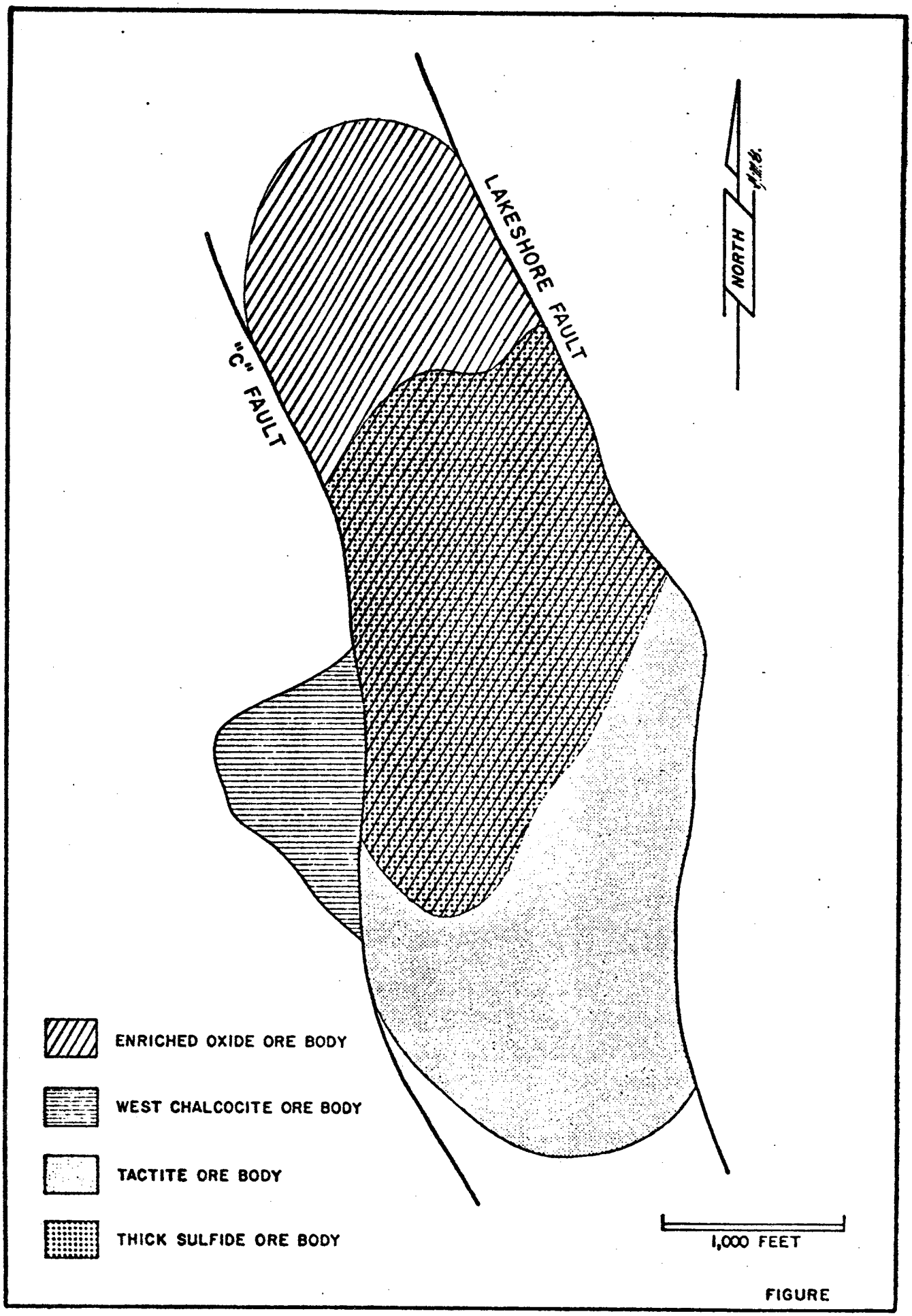
Figure

GENERALIZED GEOLOGIC CROSS SECTION, LAKESHORE MINE, ARIZONA



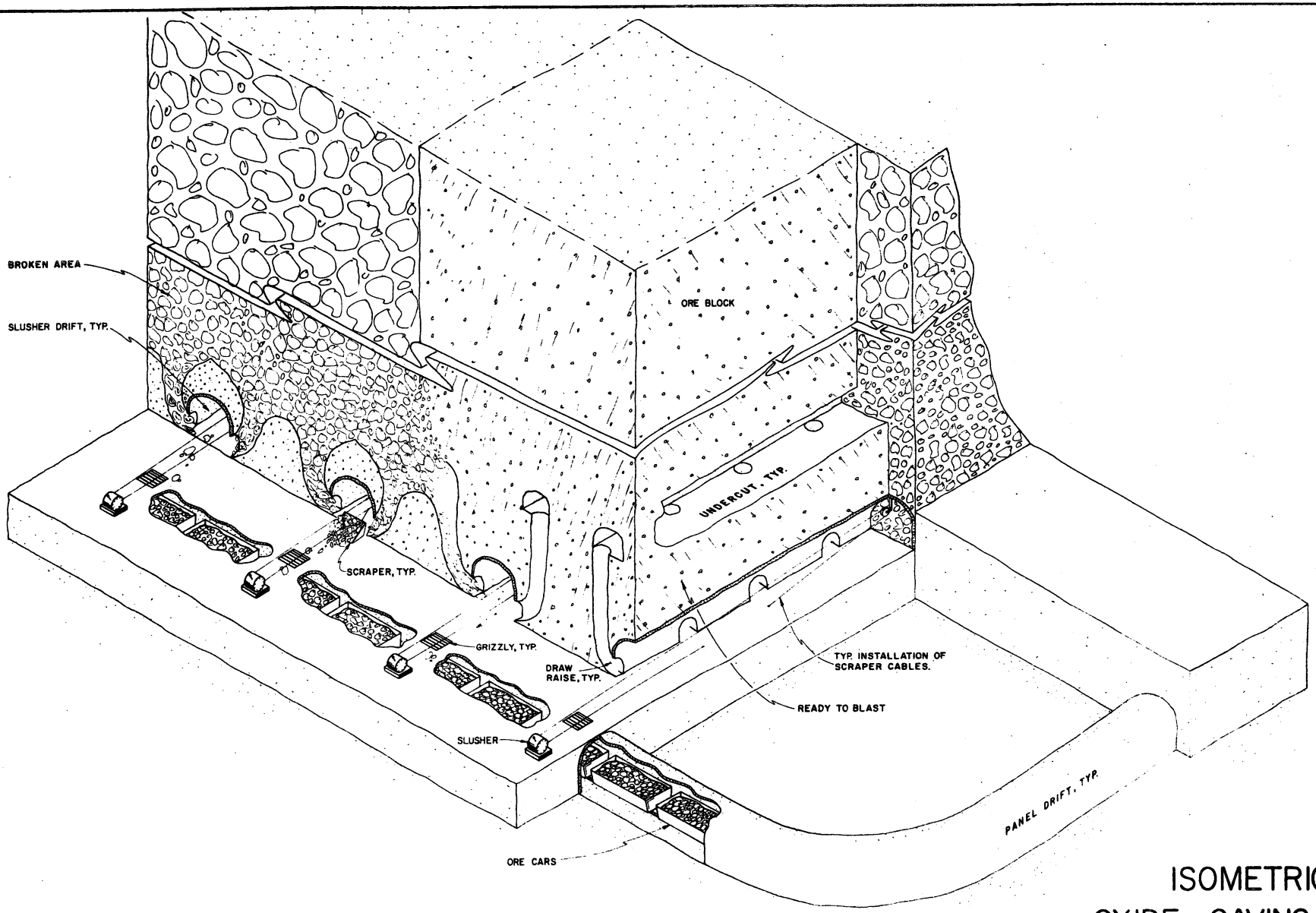
Figure

GENERALIZED ECONOMIC CROSS SECTION, LAKESHORE MINE, ARIZONA



FIGURE

GENERALIZED COMPOSITE ECONOMIC PLAN: LAKESHORE ORE BODY



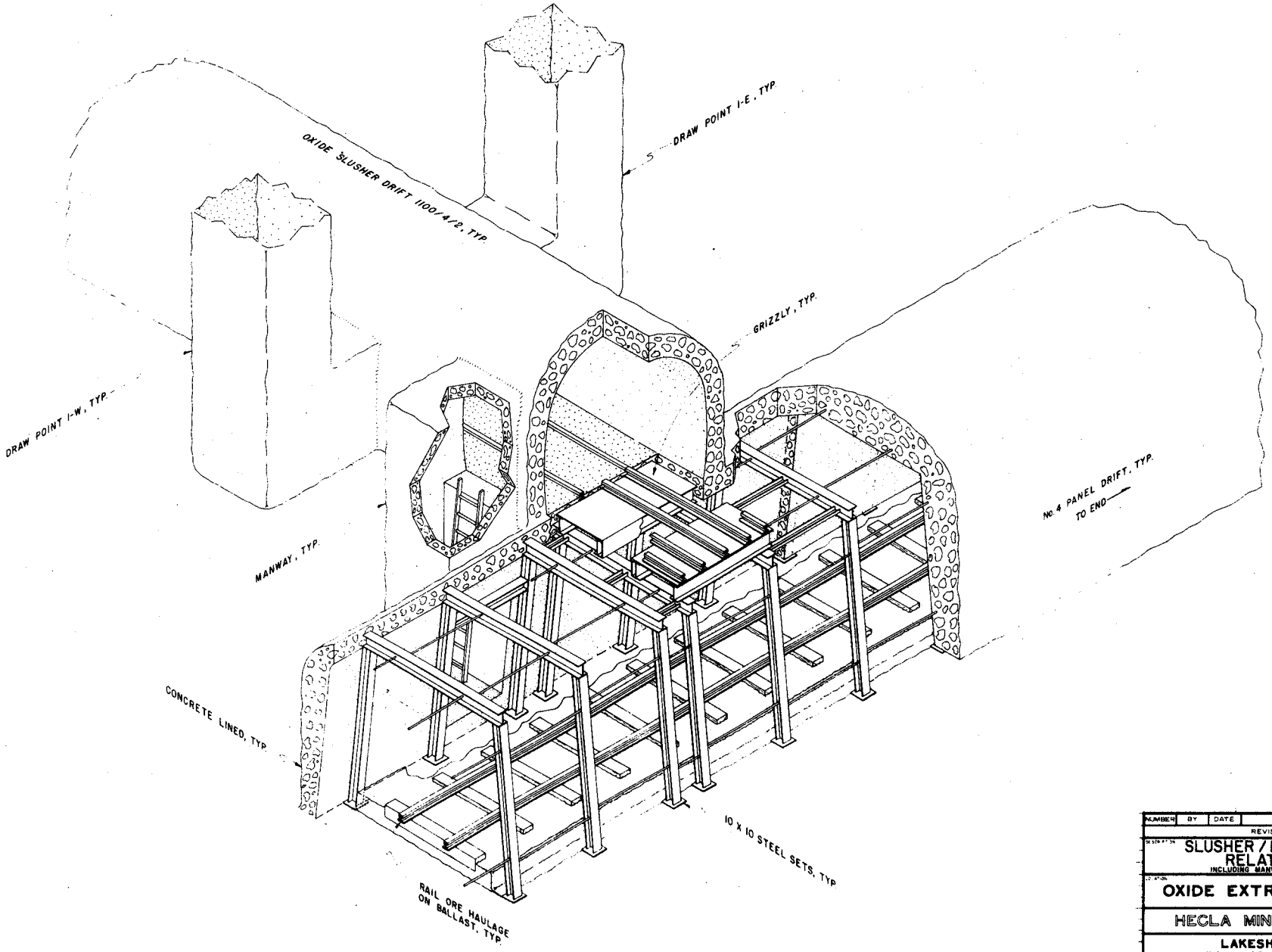
ISOMETRIC OF OXIDE CAVING SYSTEM

HECLA MINING COMPANY

LAKESHORE PROJECT

DWG. BY: J.M. Blaskowski DATE: 12/6/73

DWG. 03-B



NUMBER	BY	DATE	DESCRIPTION

REVISION DATA

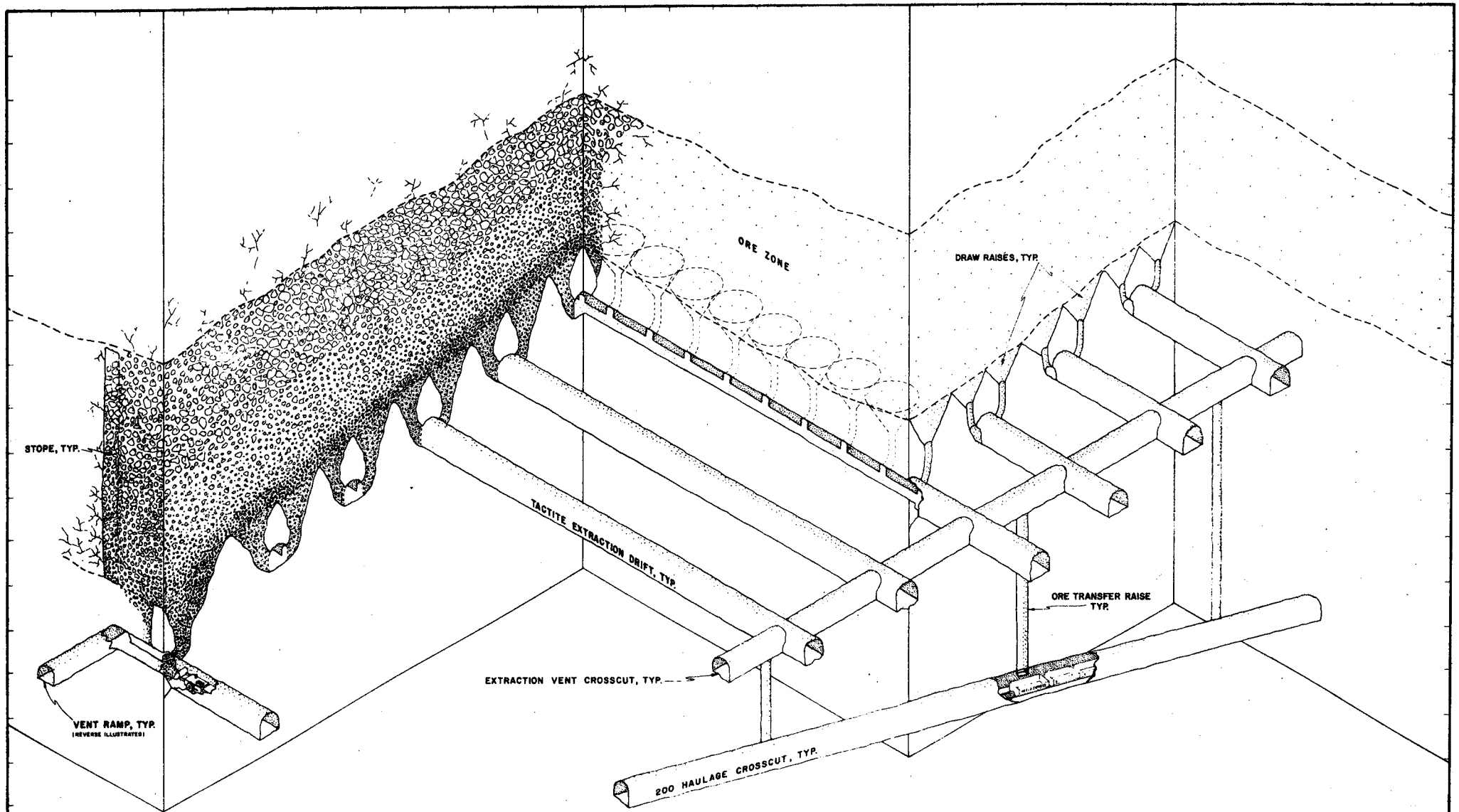
SLUSHER / PANEL DRIFT RELATIONSHIP
INCLUDING MANWAY & DRAW POINTS

OXIDE EXTRACTION AREA

HECLA MINING COMPANY

LAKESHORE MINE
PINAL COUNTY, ARIZONA

DRAWN BY	APPROVED	DATE 3/14/78	CHECKED
SCALE 3/8" = 1'0"	DWG NO 17-B	PLATE 1 OF 1	REVISION



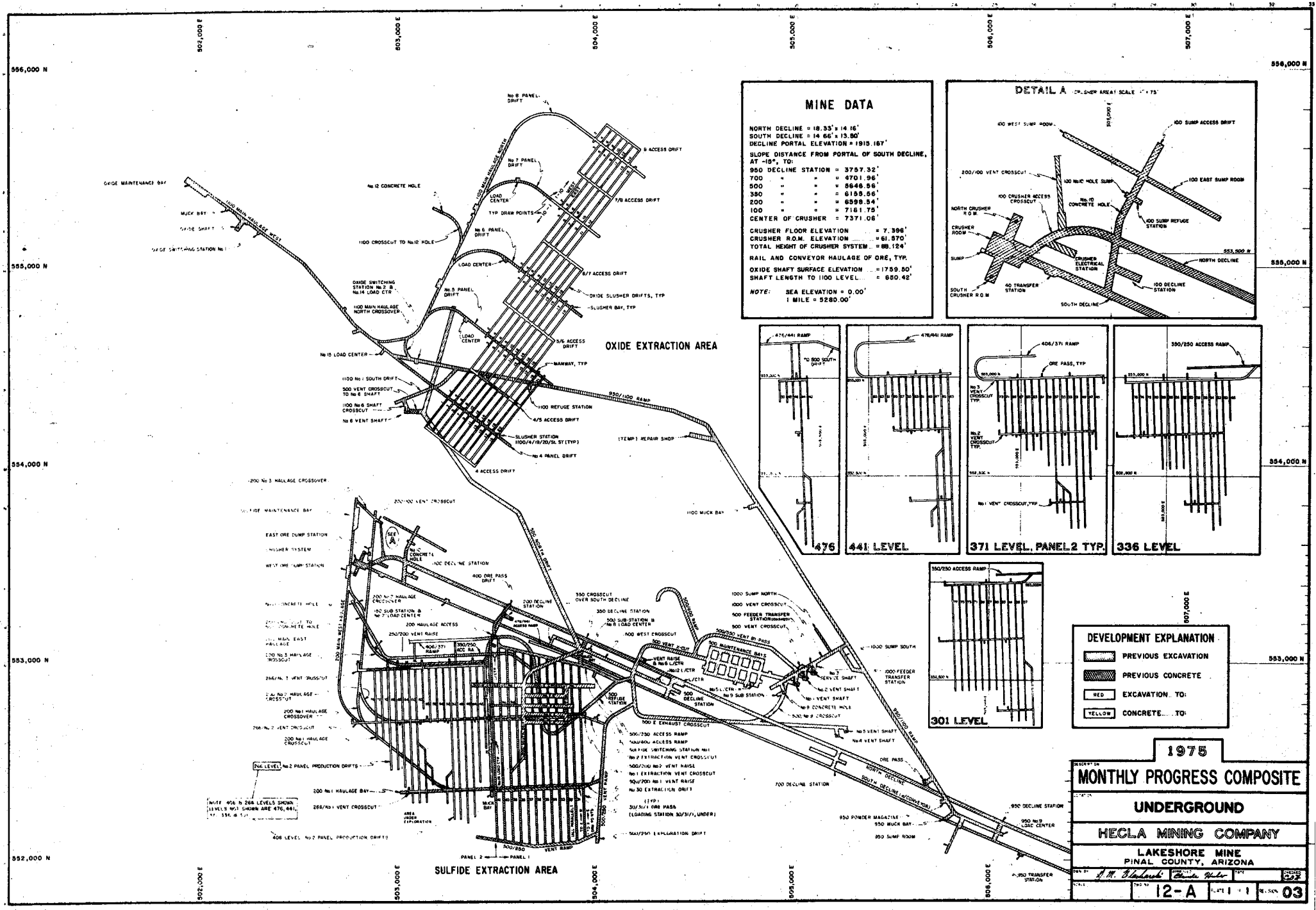
ISOMETRIC OF SULFIDE CAVING SYSTEM

HECLA MINING COMPANY

LAKESHORE PROJECT

DWG. BY [illegible] DATE: 4/23/74

DWG. 04-B


MINE DATA
NORTH DECLINE = 18.33' x 14.16'
SOUTH DECLINE = 14.66' x 13.80'
DECLINE PORTAL ELEVATION = 1915.167'
SLOPE DISTANCE FROM PORTAL OF SOUTH DECLINE, AT -15°, TO:
950 DECLINE STATION = 3757.32'
700 " " = 4701.96'
500 " " = 5648.56'
350 " " = 6188.56'
200 " " = 6598.54'
100 " " = 7161.75'
CENTER OF CRUSHER = 7371.06'
CRUSHER FLOOR ELEVATION = 7.396'
CRUSHER R.O.M. ELEVATION = 61.870'
TOTAL HEIGHT OF CRUSHER SYSTEM = 88.124'
RAIL AND CONVEYOR HAULAGE OF ORE, TYP.
OXIDE SHAFT SURFACE ELEVATION = 1759.80'
SHAFT LENGTH TO 1100 LEVEL = 650.42'
NOTE: SEA ELEVATION = 0.00'
1 MILE = 5280.00'
DETAIL A (CRUSHER AREA) SCALE 1" = 75'
100 WEST SUMP ROOM
100 SUMP ACCESS DRIFT
200/100 VENT CROSSCUT
100 MAIN HOLE SUMP
100 EAST SUMP ROOM
100 CRUSHER ACCESS CROSSCUT
No. 10 CONCRETE HOLE
NORTH CRUSHER R.O.M.
100 SUMP REFUGE STATION
CRUSHER ROOM
SUMP
CRUSHER ELECTRICAL STATION
NORTH DECLINE
40 TRANSFER STATION
100 DECLINE STATION
SOUTH CRUSHER R.O.M.
SOUTH DECLINE
OXIDE EXTRACTION AREA
SULFIDE EXTRACTION AREA
476
441 LEVEL
371 LEVEL, PANEL 2 TYP.
336 LEVEL
301 LEVEL
DEVELOPMENT EXPLANATION
PREVIOUS EXCAVATION
PREVIOUS CONCRETE
RED EXCAVATION... TO:
YELLOW CONCRETE... TO:
1975
MONTHLY PROGRESS COMPOSITE
UNDERGROUND
HECLA MINING COMPANY
LAKESHORE MINE
PINAL COUNTY, ARIZONA
12-A
03

[redacted] [Current]

Comments on the Proposed Lakeshore Metallurgy

1. There are two main classes of ore at the Lakeshore property - namely (1) oxide largely in a high lime gangue and (2) sulfide largely chalcopyrite and these will be treated separately

2. It is proposed to float a sulfide concentrate and to roast the concentrate forming sulfur dioxide gas which will be converted to sulfuric acid

3. The sulphuric acid will be used to leach copper from the oxide zone in vats to produce a copper solution

4. The roasted sulfide concentrate will be leached with water and the copper solution will be sent to an electrolytic copper recovery system to produce cathode copper

5. The residue from the leaching operation containing some unleached copper, iron oxides and whatever gold and silver is present will be reduced to metallic iron in a Lurgi reduction unit using natural gas or oil.

6. The leach copper solution (3 above) is treated with the metallic iron to precipitate copper mud. Any gangue minerals and the gold and silver of the flotation concentrate will report with the copper mud. This product will be sold to a conventional smelter

7. In my estimation overall copper recovery from oxide and sulfide ore will be about 75%

8. The copper mud production could be low grade compared to other properties and will command a higher smelting charge.

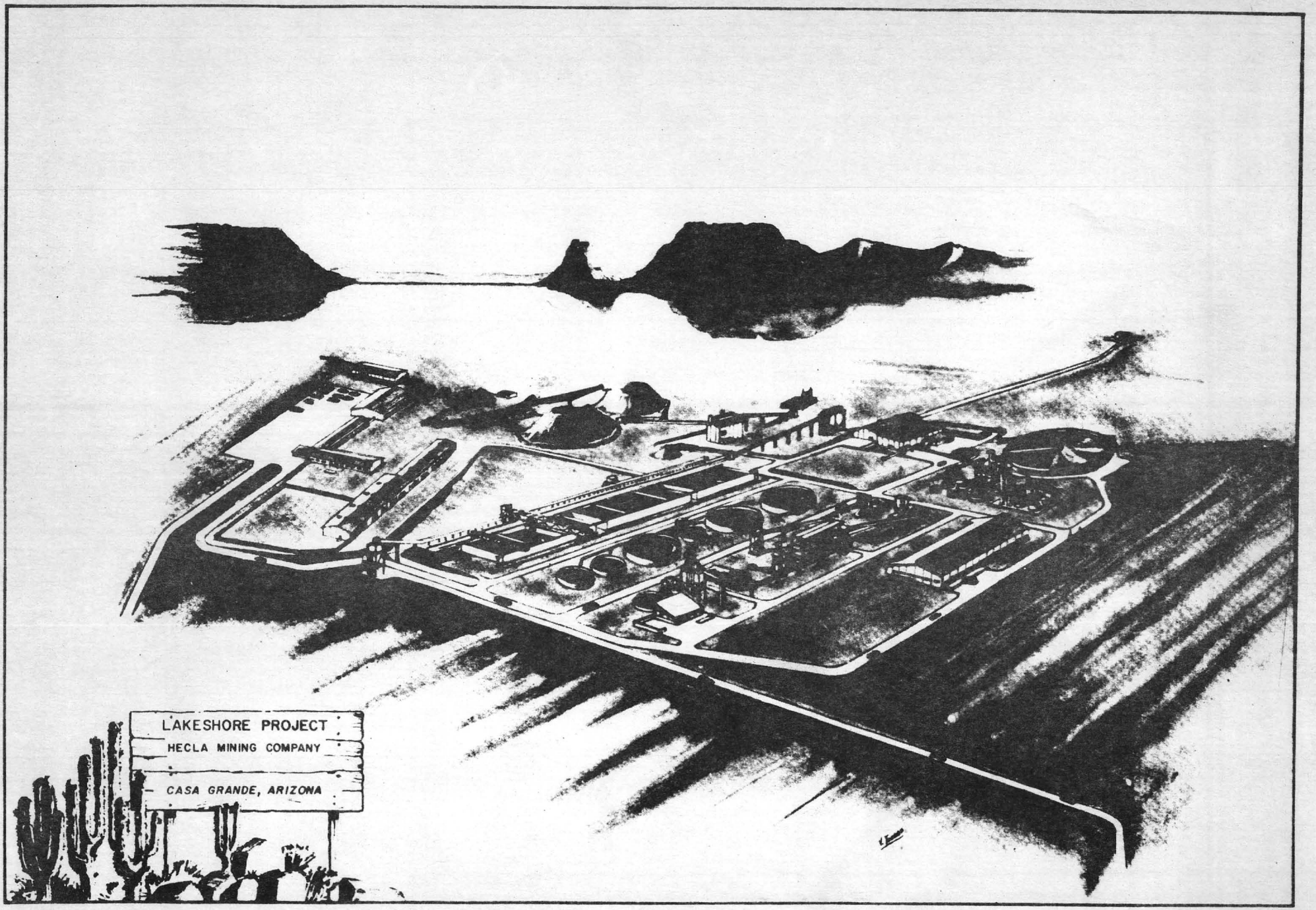
9. The cathode copper may be high in iron and other inclusions such as silicates since the solutions are not purified after leaching. A similar installation at Ray Mines of Kennecott produces cathodes which require melting and fire refining before being acceptable for sale

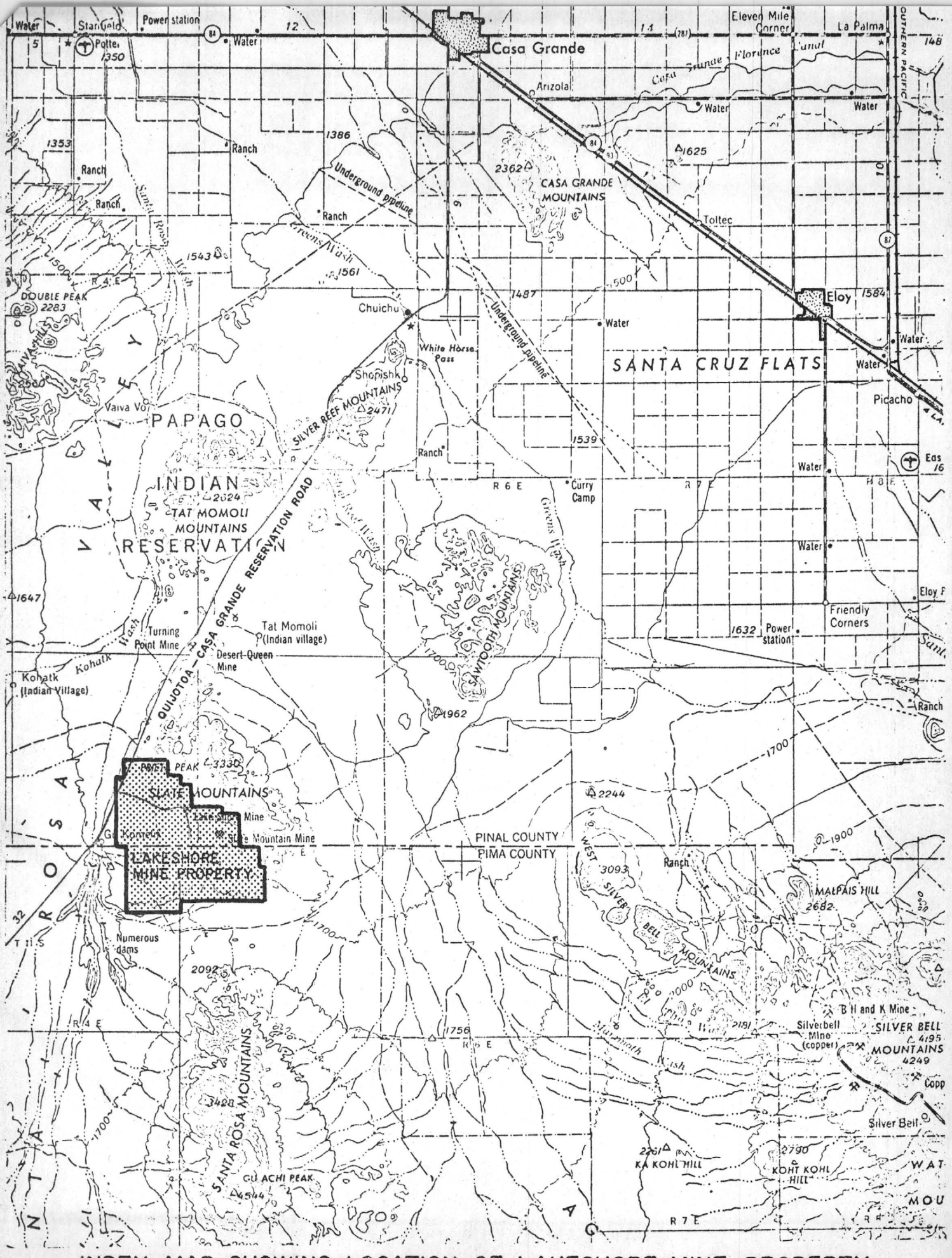
10. The reduction of the iron oxide residue to metallic iron is costly and is not done without difficulties (See 5 above)

11. It is questionable whether or not some 25% more capital expenditures would not have produced a product of acceptable copper with a higher overall recovery of copper and no more difficulty with E.P.A. regulations. This would entail several radical changes in the overall flow sheet with a LIX plant to treat the leach solutions from the oxide ore and direct electrolyte recovery for the oxide copper in the present electrolyte tank house

12. In place of the roasting and leaching procedure, it probably would have been better to treat the flotation concentrates in a Noranda type furnace with the sulfur providing most of the energy for the smelting operation. The products of this more conventional operation would be copper anodes containing the gold and silver which would provide good feed for the electrolytic plant and a sure method to recover gold and silver. All the cathode copper thus produced would command a top price or could be suitable for wire bars or rod directly.

13. Overall copper recovery from oxide and sulfide ores would approximate 85% by these suggestions.

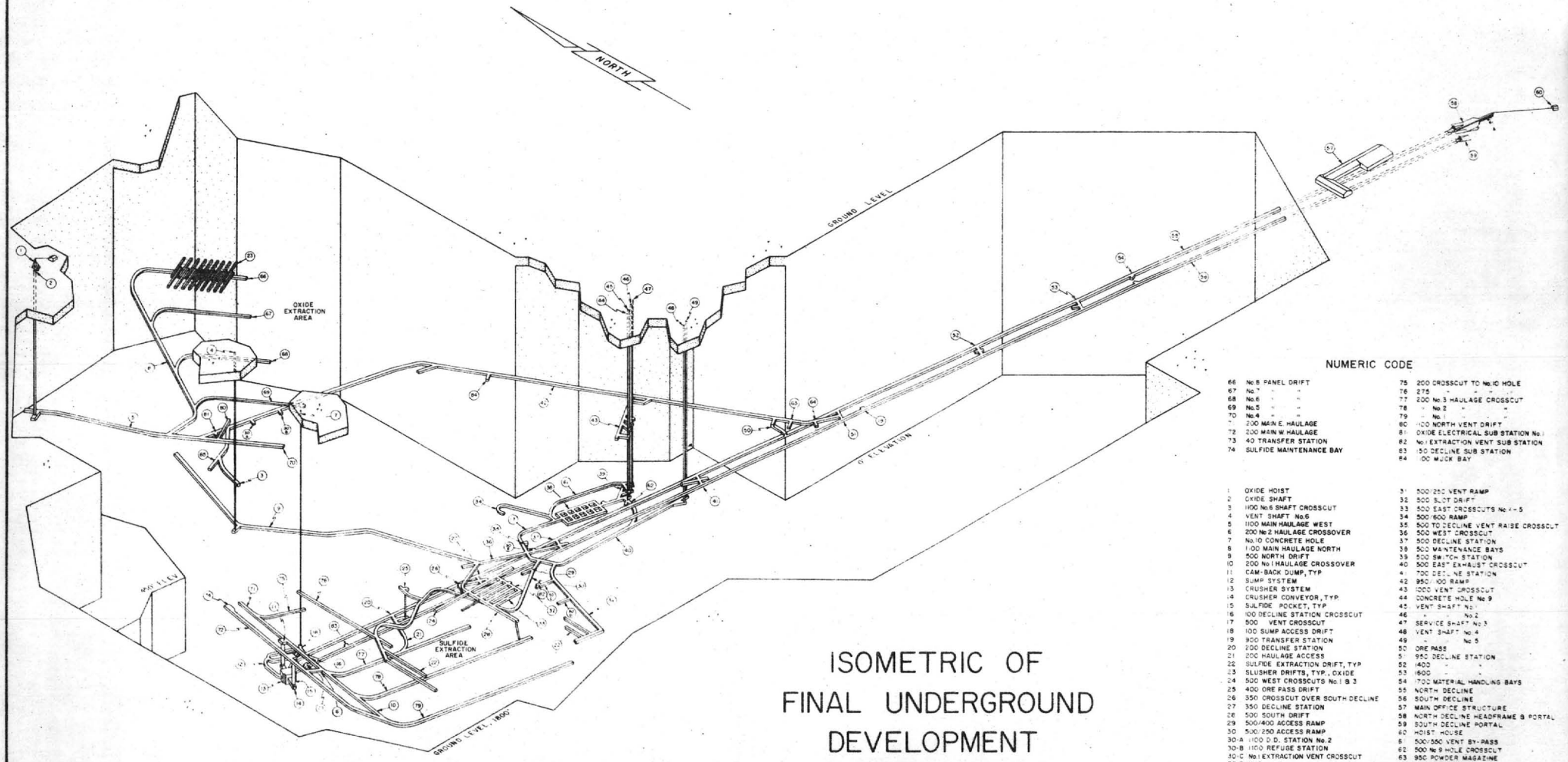

LAKESHORE PROJECT
HECLA MINING COMPANY
CASA GRANDE, ARIZONA



INDEX MAP SHOWING LOCATION OF LAKESHORE MINE PROPERTY

SCALE: 1" = 4 miles

Fig. 1



ISOMETRIC OF FINAL UNDERGROUND DEVELOPMENT

HECLA MINING COMPANY

LAKESHORE MINE

DWG BY: [illegible] DATE: 5/1/73 1973

SCALE 1" = 324'

NUMERIC CODE

66	No.8 PANEL DRIFT
67	No.7 " "
68	No.6 " "
69	No.5 " "
70	No.4 " "
71	200 MAIN E. HAULAGE
72	200 MAIN W. HAULAGE
73	40 TRANSFER STATION
74	SULFIDE MAINTENANCE BAY
75	200 CROSSCUT TO No.10 HOLE
76	275 " " " "
77	200 No.3 HAULAGE CROSSCUT
78	" No.2 " "
79	" No.1 " "
80	1100 NORTH VENT DRIFT
81	OXIDE ELECTRICAL SUB STATION No.1
82	No.1 EXTRACTION VENT SUB STATION
83	150 DECLINE SUB STATION
84	100 MUCK BAY

1	OXIDE HOIST
2	OXIDE SHAFT
3	1100 No.6 SHAFT CROSSCUT
4	VENT SHAFT No.6
5	1100 MAIN HAULAGE WEST
6	200 No.2 HAULAGE CROSSOVER
7	No.10 CONCRETE HOLE
8	1100 MAIN HAULAGE NORTH
9	500 NORTH DRIFT
10	200 No.1 HAULAGE CROSSOVER
11	CAM-BACK DUMP, TYP
12	SUMP SYSTEM
13	CRUSHER SYSTEM
14	CRUSHER CONVEYOR, TYP.
15	SULFIDE POCKET, TYP
16	100 DECLINE STATION CROSSCUT
17	500 VENT CROSSCUT
18	100 SUMP ACCESS DRIFT
19	900 TRANSFER STATION
20	200 DECLINE STATION
21	200 HAULAGE ACCESS
22	SULFIDE EXTRACTION DRIFT, TYP
23	SLUSHER DRIFTS, TYP., OXIDE
24	500 WEST CROSSCUTS No.1 & 3
25	400 ORE PASS DRIFT
26	350 CROSSCUT OVER SOUTH DECLINE
27	350 DECLINE STATION
28	500 SOUTH DRIFT
29	500/400 ACCESS RAMP
30	500/250 ACCESS RAMP
30-A	1100 D.D. STATION No.2
30-B	1100 REFUGE STATION
30-C	No.1 EXTRACTION VENT CROSSCUT
30-D	No.2 " " "
30-E	500 SUB STATION
31	500/250 VENT RAMP
32	500 SLOT DRIFT
33	500 EAST CROSSCUTS No.4-5
34	500/600 RAMP
35	500 TO DECLINE VENT RAISE CROSSCUT
36	500 WEST CROSSCUT
37	500 DECLINE STATION
38	500 MAINTENANCE BAYS
39	500 SWITCH STATION
40	500 EAST EXHAUST CROSSCUT
41	700 DECLINE STATION
42	950/1100 RAMP
43	1000 VENT CROSSCUT
44	CONCRETE HOLE No.9
45	VENT SHAFT No.1
46	" " No.2
47	SERVICE SHAFT No.3
48	VENT SHAFT No.4
49	" No.5
50	ORE PASS
51	950 DECLINE STATION
52	1400 " "
53	1600 " "
54	1700 MATERIAL HANDLING BAYS
55	NORTH DECLINE
56	SOUTH DECLINE
57	MAIN OFFICE STRUCTURE
58	NORTH DECLINE HEADFRAME & PORTAL
59	SOUTH DECLINE PORTAL
60	HOIST HOUSE
61	500/550 VENT BY-PASS
62	500 No.9 HOLE CROSSCUT
63	950 POWDER MAGAZINE
64	950 MUCK BAY
65	1100 No.1 S. DRIFT

COLOR CODE

735	DECLINES, DECLINE STATIONS & SUMP SYSTEM
745	500 LEVEL DEVELOPMENT
1265	1100 " "
740.5	ORE HANDLING SYSTEM
737	VENT SHAFTS & RAISES

REV. L

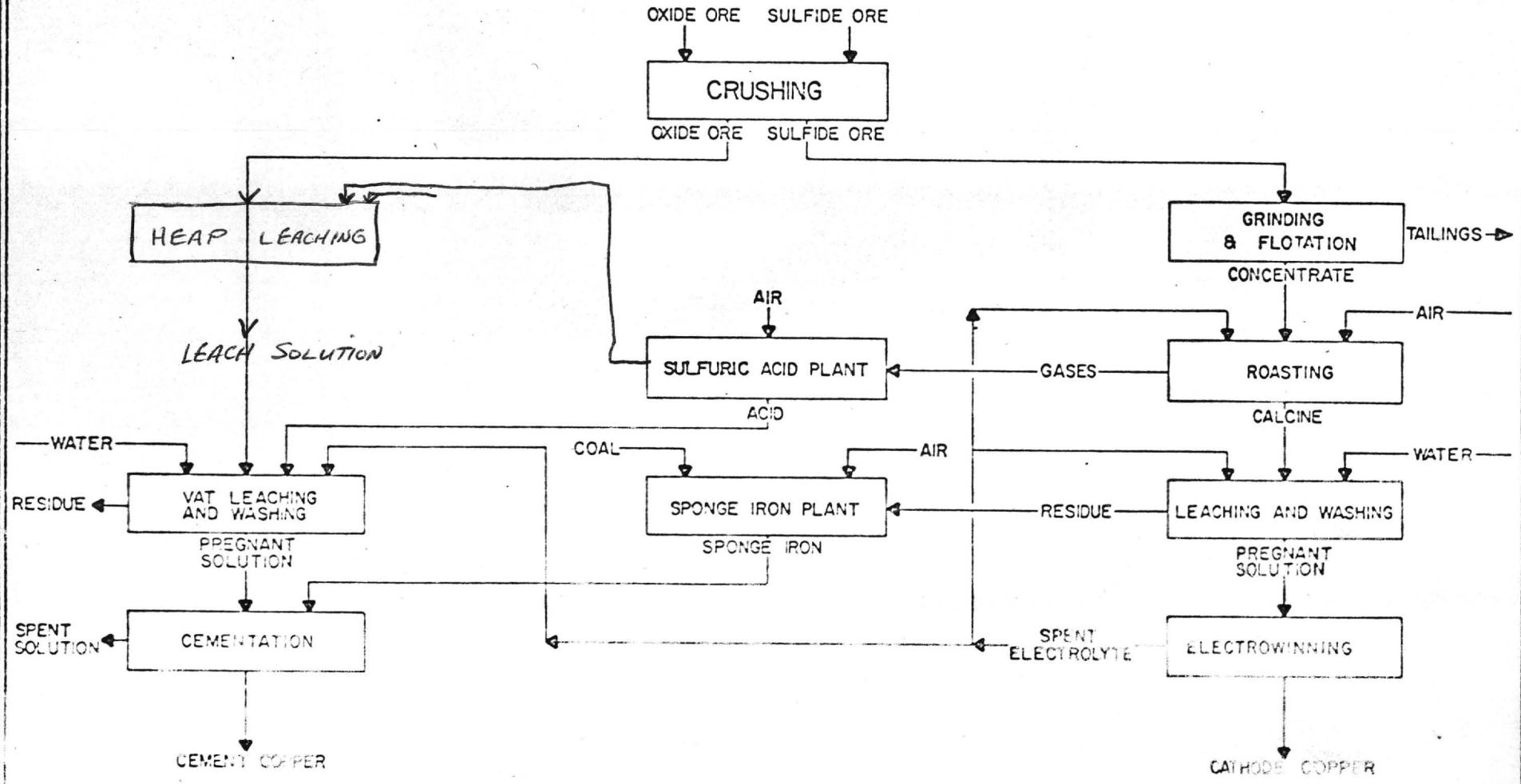
DWG. No. 002-B

Modifications

PROPOSED PLANT SURFACE FACILITIES

HECLA MINING COMPANY
LAKESHORE MINE
CASA GRANDE, ARIZONA

Lakeshore Project
Plant Flowsheet



3 copies

Walt 12/15/69
Don C DBC

El Paso Natural Gas Company

El Paso, Texas 79999

November 28, 1969

HEINRICHS GEOEX GEOPHYSICAL ENGINEERS TUCSON, ARIZONA

RECD DEC 1 1969

BOX 5671 TUCSON, ARIZONA 85703

Phone: (AREA 602) 623-0578

Mr. E. Grover Heinrichs
Vice President
Heinrichs Geoexploration Company
P. O. Box 5671
Tucson, Arizona 85703

Dear Mr. Heinrichs:

In answer to your request I am enclosing a copy of the paper on exploration at Lakeshore that I prepared for the annual meeting of the New Mexico Mining Association which was held in El Paso on November 16 - 19, 1969.

Thank you.

Sincerely,

Claude E. Barron
Senior Mining Geologist
Mining Division

CEB:mp

H.C.

SF
Hecla

EXPLORATION AT LAKESHORE MINE

Pinal County, Arizona

By

Claude E. Barron
Senior Mining Geologist
El Paso Natural Gas Company

ABSTRACT

As the result of a general reconnaissance of the Slate Mountain area, an interpretation of the geology was made that assumed (1) the oxide tactite ore body in the Lakeshore Pit had been overturned by tilting to the northwest, (2) that these metasediments would be in place underlying the andesite west of the pit and would trend generally northwest parallel to the trend of the Slate Mountains, and (3) that the strong northwest and north-south fault and fracture system which was exposed in the pit would offer channels for migrating mineralized solutions permitting the deposition of sulphides at depth.

A proposed correlation of this interpretation with Induced Polarization anomalies involved an area that extended to the south and northwest of the Lakeshore Pit. This area was recommended for deep drilling to test the weak I. P. anomalies for sulphide mineralization.

Contour maps based on assay and geological data from gyroscopically surveyed drill holes offered control for delineation and computer evaluation of the discovered ore body.

EXPLORATION AT LAKESHORE MINE

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INTRODUCTION

The Lakeshore mineral deposit outcrops on the southwest piedmont of the Slate Mountains in Section 25, T10S, R4E, Pinal County, Arizona. This location is in the Papago Indian Reservation, approximately 30 miles south of Casa Grande, Arizona.

In the Basin and Range Province of southwest Arizona, the Slate Mountains form an arcing outcrop that trends from northwest to north, and reaches an elevation of 3330 feet at Prieta Peak near the center of the range. The Lakeshore Mine, about 2 miles south of Prieta Peak, is at an elevation of approximately 1800 feet. Vegetation in the valley is of the desert variety, capable of surviving in the hot summer temperature and the few inches of annual precipitation.

PREVIOUS WORK

Rocks in the Slate Mountains were described in an unpublished thesis by Hogue (1) in 1940. The Lakeshore copper deposits were investigated by the U. S. Bureau of Mines (2) in 1950. Precambrian and Paleozoic sedimentary rocks of the area were described by McClymonds (3) in 1959. Geologic maps prepared by the Arizona Bureau of Mines (4) in 1960 show rocks in the Slate Mountain area range in age from Precambrian to Quaternary. Sedimentary rocks of the northern Slate Mountains have been described in detail in an unpublished thesis by Hammer (5) in 1961. Other work describing surface geology and sub-surface data obtained from shallow drilling is contained in several unpublished reports made by consultants for Transarizona.

HISTORY

The mineral outcrop, consisting primarily of copper silicates and iron oxides, was located by Trout and Atchison in the early 1880's. Abandoned in 1884, the property was relocated by B. S. Wilson in 1905. In 1914 Wilson sold the property to Frank M. and Charles Leonard.

The Leonards, who developed the ore body on three levels while working through a 225 foot vertical shaft, leased the property in 1917. This lease was terminated in 1919. The next noteworthy work to be conducted was an examination of the property by the U. S. Bureau of Mines in 1942 which initiated an investigation that started in 1948 and concluded with a report in 1950.

In November 1955, the three patented claims of the Lakeshore property and the Drake claims, consisting of three patented and 19 unpatented claims, were obtained by George Freeman under a lease-option agreement from Treasure State Mining Company. In 1956, a 580 acre lease surrounding these claims was obtained from the Bureau of Indian Affairs by Dwight McClure and George Freeman. In 1960 the Bureau of Indian Affairs approved an assignment of the lease to Transarizona Resources Inc.

El Paso Natural Gas Company's interest in the property was initiated by an invitation to examine the property in September 1962. At that time, the writer made an examination of the mine and plant. Transarizona had developed the mine as a small open pit. Exploration drilling on a closely-spaced drill pattern indicated $\pm$ 1.5 million tons of $\pm$ 1.75% copper oxide. Level maps and cross-sections prepared from the drill data indicated the mineral deposit formed a V-shaped trough that plunged to the southwest, and was controlled by faults.

The Plant had been designed for a copper segregation process that was followed by flotation.

As a result of the examination, a recommendation for a more complete evaluation of the property was made but the request was not approved. However, in June 1963, a limited amount of drilling was conducted in the open pit and a feasibility study of the segregation process was made.

In August 1966, under the direction of the Mining Division of El Paso Natural Gas Company, an induced Polarization survey was conducted on the Lakeshore property by McPhar Geophysical Limited and, at the same time, the writer began a general geological survey of the area.

In September 1966 a core drilling program was initiated to investigate the I. P. anomalies that were discovered on the property.

In February 1969, El Paso Natural Gas Company announced an agreement with Hecla Mining Company for development of a major new copper discovery made by the Mining Division on the Lakeshore property.

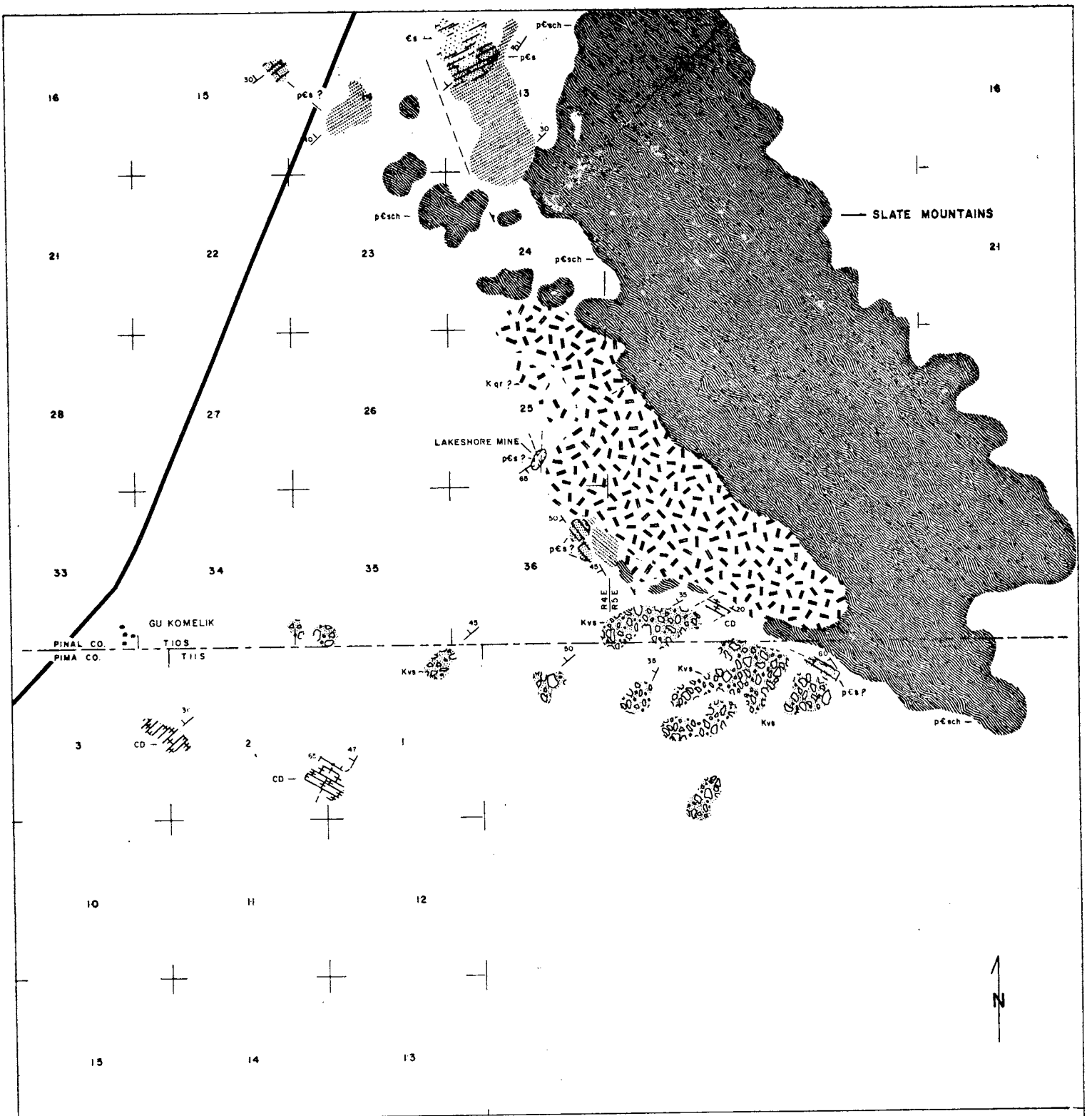
GENERAL GEOLOGY

Reconnaissance of the Slate Mountain Area

The Slate Mountains (Fig. 1), composed primarily of the Pinal Schist formation of Precambrian age (4), strike N $\pm$ 45W and dip $\pm$ 50° NE. Near the center of the mountains, an elongated mass of quartz diorite has intruded the schist. This intrusive mass tends to parallel the foliation of the schist and was identified as being Precambrian in age (4). However, recent work by P. E. Damon and R. L. Mauger (6) has dated this intrusive by the potassium-argon process as Laramide (Cretaceous-Tertiary). Along the northeast slopes of the mountains, the schist dips under the alluvium and fanglomerates at the edge of the valley.

At the north end of the Slate Mountains, the Pioneer Shale, the Dripping Springs Quartzite, and the Mescal Limestone of the Precambrian Apache Group (4) strike N $\pm$ 40° E and dip $\pm$ 45° NW. These northwest dipping metasediments overlie the northwest trending Pinal Schist with angular unconformity. Overlying the Apache Group is the Abrigo Limestone and Troy Quartzite of Early Cambrian age (4) and the limestone, quartzite and shales of Devonian and Carboniferous age (4). Along the southwest slope of the Slate Mountains and to the southeast, outcrops of these formations generally dip to the southwest and strike parallel with the trend of the mountains.

Around the southwest periphery of the Slate Mountains and protruding through the valley fill, are outlying hills of Devonian and Carboniferous limestone, Cretaceous volcanic and sedimentary rocks and Tertiary andesite and breccia (4). The Devonian



0 4000
SCALE IN FEET

- QUATERNARY ALLUVIUM
- CRETACEOUS SEDIMENTARY AND VOLCANIC ROCKS
- CRETACEOUS? GRANITE (QUARTZ DIORITE)
- CARBONIFEROUS AND DEVONIAN LIMESTONE
- CAMBRIAN BOLSA QUARTZITE
- YOUNGER PRECAMBRIAN MESCAL LIMESTONE
- YOUNGER PRECAMBRIAN DRIPPING SPRINGS QUARTZITE AND PIONEER SHALE
- OLDER PRECAMBRIAN PINAL SCHIST

- ATTITUDE OF BEDS
- FOLIATION
- FAULT OR SHEAR ZONE
- OPEN PIT
- SECTION CORNER

GENERALIZED GEOLOGIC MAP OF THE SLATE MOUNTAIN AREA PINAL CO., ARIZONA

MODIFIED FROM GEOLOGIC MAP OF PINAL CO., ARIZONA BY THE ARIZONA BUREAU OF MINES, 1959

BASE MAP FROM U.S.G.S. TOPOGRAPHIC MAP

C.E.B. 9-11-69

Fig. 1

and Carboniferous limestone and dolomite have been folded along an apparent northwest trending axis and then tilted to the northwest. In the area southwest of the Lakeshore mine, the breccia and the underlying Cretaceous volcanic and sedimentary rock strikes N ± 50° E and dips ± 45° NW.

Small faults have apparently displaced sedimentary bedding and igneous and sedimentary contacts in these outlying hills. However, any evidence of large faults has been covered by the alluvium. The poles of the measured attitudes of joints and fractures, plotted on a stereographic projection, indicates a preferred orientation of N 30° E with 45° SE dip, N 40° E with 45° NW dip, and N 65° E with 66° SE dip.

Geology of the Lakeshore Pit

At the Lakeshore Mine, a small open pit was excavated by Transarizona (Fig. 2). Near the center of the pit, mineralized banded tactite overlaid by a fine-grained quartzite, striking N ± 50 E and dipping ± 60° SE, was exposed. These metasediments terminate on the east side of the pit where they are in contact with diorite along a very strong oblique slip dip fault that strikes NW and dips 65° SW. Merging with this fault is a strong north-south fault that dips 74° W.

Along the west wall of the pit, altered and fractured andesite occurs on the footwall of an andesite and metasediment contact which shows slickensides. This contact, striking N ± 40° E and dipping ± 50° SE, forms the footwall of the oxide ore body.

OC-5 U.S.B.M. DRILL HOLE

ALLUVIUM

ANDESITE

GRANITE (QUARTZ DIORITE)

METASEDIMENTS (TACTITE)

BANDED METASEDIMENTS

ATITUDE OF METASEDIMENTS

FOLIATION

FAULT

Fig. 2

GENERAL GEOLOGY
OF THE
LAKESHORE PIT

SEPTEMBER 1966

SCALE 1" = 100' C.E.B.

At the north end of the pit, a fine-grained, banded quartzite, striking N $\pm$ 10° W with vertical dip, has been exposed in contact with the diorite on the footwall side of the NW striking fault zone.

The south end of the pit has been cut through highly altered and fractured andesite with foliation striking N $\pm$ 30° E and dipping $\pm$ 45° SE. This andesite overlays the metasedimentary rock and forms the hanging wall of the oxide ore body.

Drill hole data from close space drilling, conducted by Transarizona, indicated that the northeast end of the ore body had been offset to the northwest on the footwall side of the NW striking fault zone.

Drilling conducted by the U. S. Bureau of Mines (2) in 1948 had encountered quartzite underlying andesite at 460 feet in hole C-2, and at 270 feet in hole C-4. In hole C-5, from 455 feet to 545 feet, copper oxides were encountered in a section described by the Bureau as a shear zone (Fig. 3).

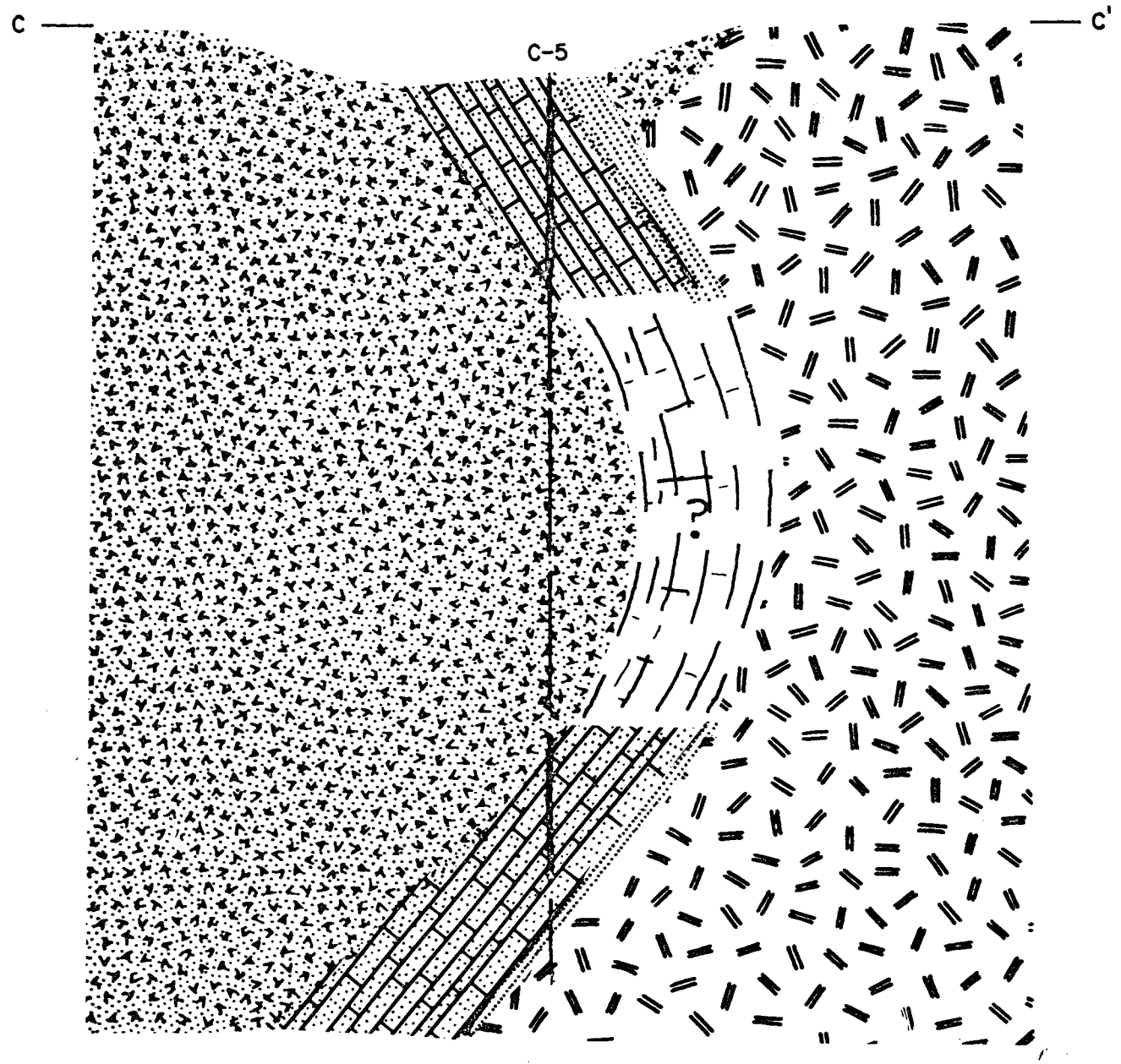
GEOPHYSICAL SURVEY

Induced Polarization Survey

During August and September of 1966, a combined resistivity and induced polarization survey was conducted on the mineral lease and the claims southwest of the Slate Mountains (Fig. 4).

A dipole-dipole electrode configuration, with 500 foot electrode spread length, was used to apply current and measure potential along parallel north-south lines, with $\pm$ 1200 foot east-west separations. Alternating current of 0.3 and 5 cycles per second were used to determine the I. P. effect. In addition to the north-south survey, an east-west survey, using shorter electrode spread lengths, was made over the Lakeshore fault system.

Fig. 3



CROSS-SECTION C-C'
LOOKING N 55 E
SCALE 1" = 100'

INTERPRETATION, BY THE WRITER, OF THE MINERALIZATION ENCOUNTERED BY THE U.S.B.M. IN CHURN DRILL HOLE No. C-5

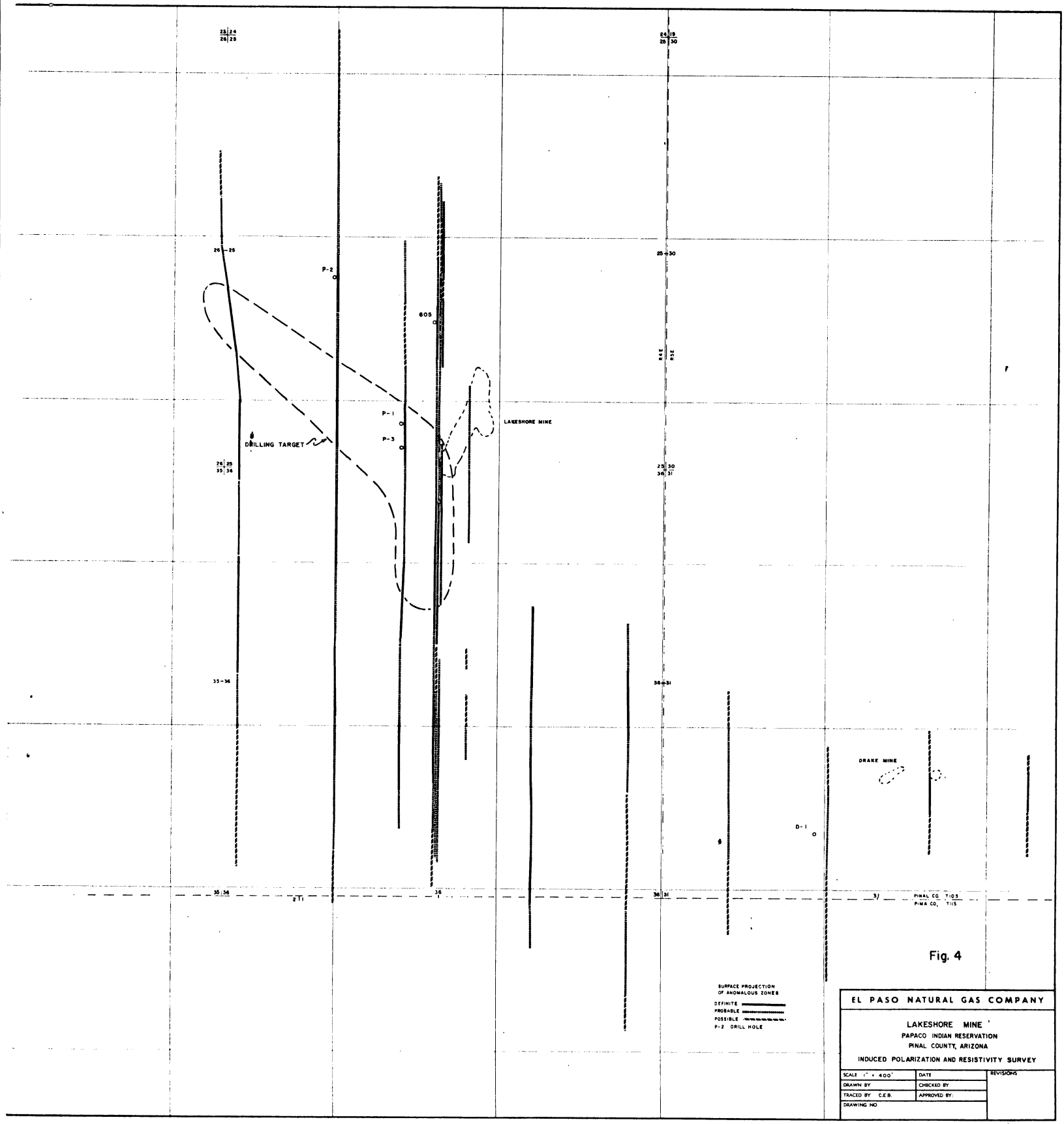


Fig. 4

EL PASO NATURAL GAS COMPANY

LAKESHORE MINE
PAPAGO INDIAN RESERVATION
PINAL COUNTY, ARIZONA
INDUCED POLARIZATION AND RESISTIVITY SURVEY

SCALE 1" = 400'	DATE	REVISIONS
DRAWN BY	CHECKED BY	
TRACED BY C.E.B.	APPROVED BY:	
DRAWING NO.		

Testing I. P. Anomalies

Several I. P. anomalies were recorded along the north-south survey lines. To test the anomalies, core drilling began at locations D-1 and 605 (Fig. 4). Core hole D-1 was located in the area of a reported anomaly ± 1200 feet southwest of the Drake oxide pit. This test hole was cored for 500 feet through andesite breccia without encountering sulphide mineralization and then abandoned. Hole 605 was an old rotary drill hole which had been terminated in a weakly mineralized porphyry at a drill depth of ± 288 feet. This location was on an I. P. anomaly ± 750 feet north of the Lakeshore pit. Core drilling began at 288 feet and copper oxide mineralization was encountered along fractures in an altered biotite porphyry and in and near the contacts of the biotite porphyry and sections of altered andesite of varying thickness. This hole was anandoned at 790 feet because of drilling conditions without encountering sulphide mineralization.

With the completion of D-1 and 605, the testing of two additional I. P. anomalies began at locations P-1 and P-2 (Fig. 4). Drill hole P-2 was located on an I. P. anomaly ± 1500 feet northwest of hole 605. Core drilling was conducted through 800 feet of fanglomerate without encountering oxide or sulphide mineralization, and the hole was abandoned. The fanglomerate consisted of angular to sub-angular fragments of sedimentary and volcanic rock that was weakly cemented but did not display the prominent high-angle slickenside fracture system that had been encountered in hole 605.

At Hole P-1, located on an I. P. anomaly ± 700 feet west of the Lakeshore pit, low grade copper oxide mineralization was encountered in a fractured and altered andesite and andesite breccia. These andesites had been intruded by a few thin sill-like masses of biotite porphyry. At a drill depth of 750 feet where the drill was still in oxides, a re-evaluation of the I. P. data and a review of the geology was made.

INTERPRETATION OF GEOLOGY

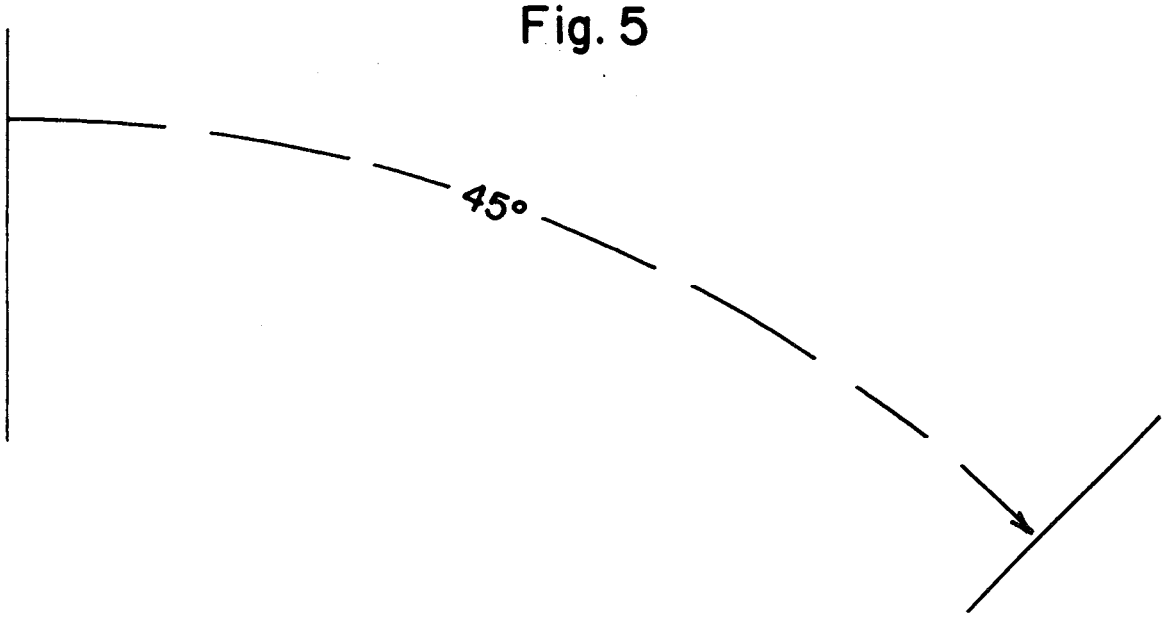
In an attempt to correlate surface geology with subsurface data obtained from core holes, the writer assumed:

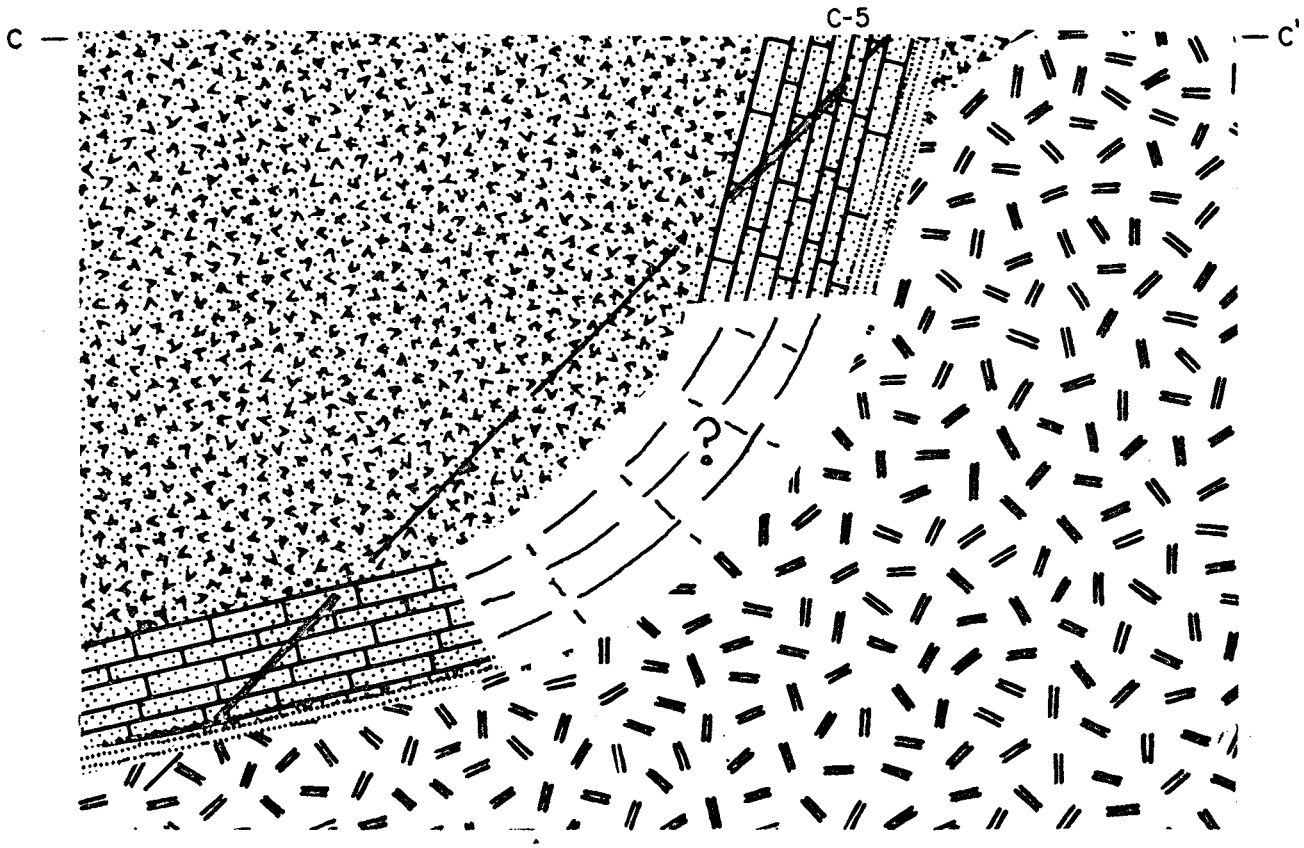
(1) The andesite and breccia encountered in drill hole P-1 are extrusive and the biotite porphyry encountered in hole 605 and P-1 is younger than the andesite and younger than the biotite hornblende porphyry that has intruded the Pinal Schist to the east;

(2) The high angle slickenside fracture system encountered in hole P-1 and 605 is parallel to the fault and fracture system observed in the Lakeshore pit;

(3) The present attitude of the Cretaceous volcanic and sedimentary rocks cropping out southwest of the Slate Mountains represents the youngest structural trend in the area, and that this trend, striking N ± 50° E and dipping ± 45° NW, has been superimposed on the older structural system in the area;

Fig. 5





CROSS-SECTION C-C'

LOOKING N 55 E

SCALE 1" = 100'

ASSUMED ATITUDE OF THE METASEDIMENTS
PRIOR TO TILTING TO THE NORTHWEST

At Hole P-1, located on an I. P. anomaly ± 700 feet west of the Lakeshore pit, low grade copper oxide mineralization was encountered in a fractured and altered andesite and andesite breccia. These andesites had been intruded by a few thin sill-like masses of biotite porphyry. At a drill depth of 750 feet where the drill was still in oxides, a re-evaluation of the I. P. data and a review of the geology was made.

INTERPRETATION OF GEOLOGY

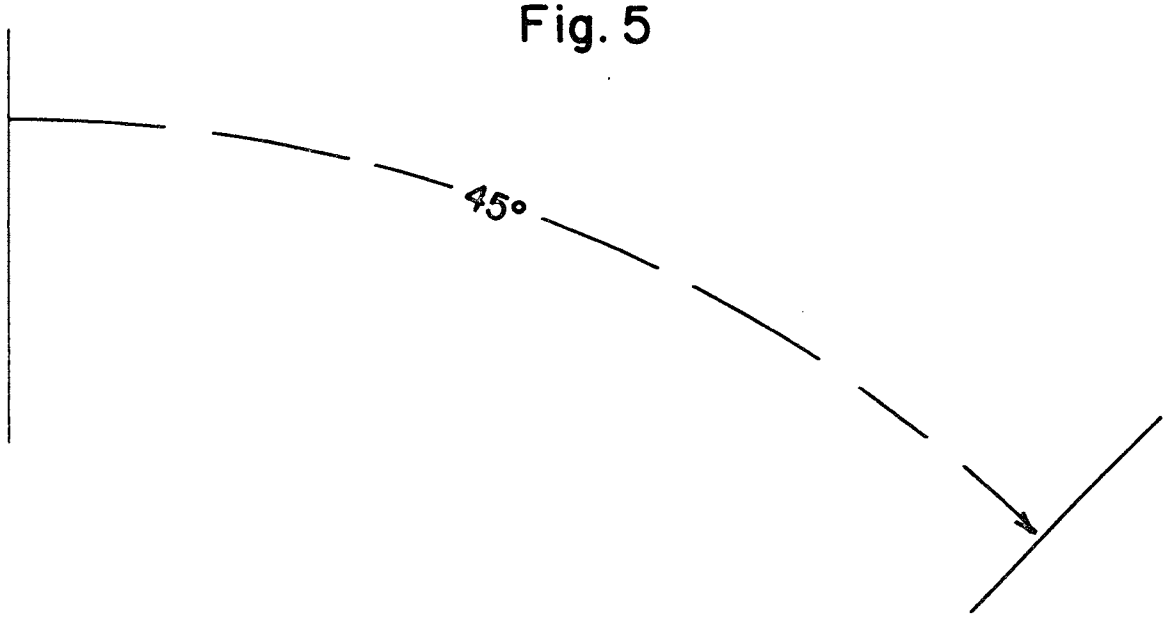
In an attempt to correlate surface geology with subsurface data obtained from core holes, the writer assumed:

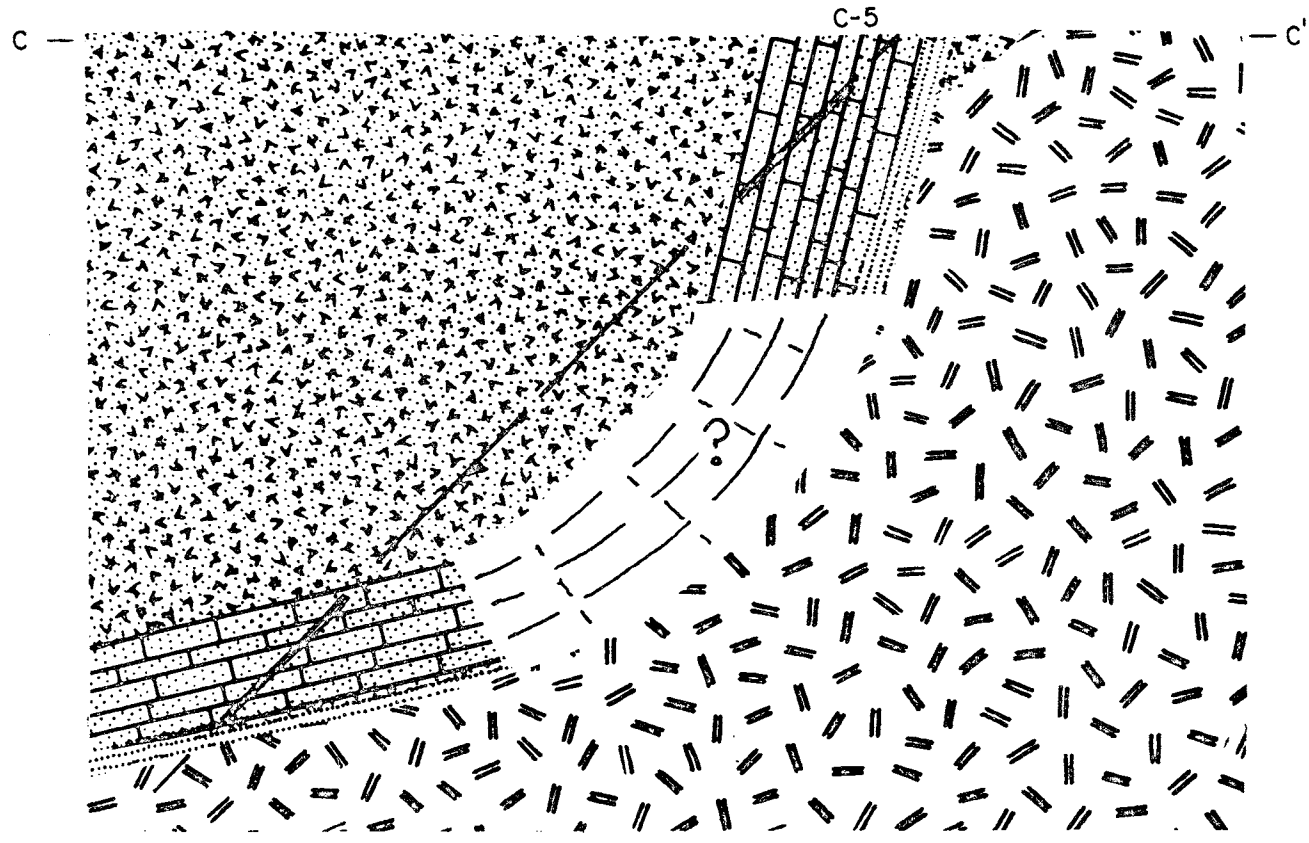
(1) The andesite and breccia encountered in drill hole P-1 are extrusive and the biotite porphyry encountered in hole 605 and P-1 is younger than the andesite and younger than the biotite hornblende porphyry that has intruded the Pinal Schist to the east;

(2) The high angle slickenside fracture system encountered in hole P-1 and 605 is parallel to the fault and fracture system observed in the Lakeshore pit;

(3) The present attitude of the Cretaceous volcanic and sedimentary rocks cropping out southwest of the Slate Mountains represents the youngest structural trend in the area, and that this trend, striking N ± 50° E and dipping ± 45° NW, has been superimposed on the older structural system in the area;

Fig. 5





CROSS-SECTION C-C'

LOOKING N 55 E

SCALE 1" = 100'

ASSUMED ATITUDE OF THE METASEDIMENTS
PRIOR TO TILTING TO THE NORTHWEST

(4) If the metasediments outcropping in the Lakeshore pit were rotated about a horizontal axis trending N 50° E to a pre-45° tilt attitude, the metasediments would then be dipping steeply to the northwest and be overlaid by the andesite (Fig. 5).

(5) The mineralization, encountered by the U. S. Bureau of Mines (2) in churn drill hole C-5 at a drill depth of 455 feet to 545 feet, is the continuation down dip of the mineralized metasediments and these metasediments would continue to the northwest to underlie the andesite (Fig. 3).

In summation then, this interpretation requires that the metasediments extend down dip from the oxide outcrop and lie under the andesite to the northwest. The trend of the metasediments is controlled by the northwest trend of the Slate Mountains, the strong northwest and north-south fault and fracture system, and the intrusive. Movement of mineralized solutions were controlled by this physical environment and sulphide mineralization should be encountered at depth.

RECOMMENDED DRILLING TARGET

To try to correlate this interpretation with the indicated I. P. anomalies, the plotted anomalies extending to the south of the Lakeshore pit and the anomalies in echelon to the northwest of the pit were encircled. This enclosed an area $\pm$ 1000 feet wide extending from near the center of Section 36 north to Section 25, then northwest to the west line of Section 25 (Fig. 4). This area offered the best possible correlation of projected geology and plotted I. P. anomalies. The enclosed area was recommended as the drilling target for the Lakeshore project.

DISCOVERY OF SULPHIDE MINERALIZATION

Following the review of I. P. and geological data, the decision was made to continue drilling P-1 and preparations were made to drill an offset hole 300 feet south of hole 605. However, before a drill could be moved to this location, sulphide copper mineralization was encountered in P-1 at a depth of ± 850 feet in andesite and andesite breccia. The prepared drill location south of hole 605 was abandoned and a drill was moved to location P-3, 300 feet south of P-1. Drilling at P-1 continued to a depth of ± 1100 feet where it was abandoned because of drilling conditions.

On location P-3, drilling conditions were the same as those encountered in hole P-1. Fractured and altered andesite and andesite breccia was difficult to drill but core recovery was consistently high. Mineralization consisted of low grade copper oxide and silicate plus hematite, calcite, and gypsum occurring along fracture planes. Silification seems to be the dominate type of alteration. Andesite and breccia continued to a drill depth of 1080 feet where the drill penetrated a thick section of sericite and then entered highly altered limestone or dolomite. These altered carbonate rocks continued to a drill depth of 1147 feet.

At 1147 feet, massive magnetite with pyrite and chalcopyrite in banded tactite was encountered. This marked the discovery of sulphide mineralization in metasediments west of the Lakeshore pit. The mineralization continued for 90 feet and had an average assay value of 1.75% copper.

DELINEATION OF MINERALIZATION

Drilling and Recording of Data

With the encounter of sulphide mineralization in metasediments, an accelerated drilling program began. Rotary drilling was used to penetrate the andesites and breccias. When the rotary hole was completed to a pre-determined depth, casing was set and a wire line diamond drill was then moved onto the prepared location. NX size tools (2-1/8 inch core diameter) were used until drill depth or drilling conditions required the hole diameter to be reduced; then BX size tools (1-5/8 inch core diameter) were used. Average recovery of core was over 90%.

From the recovered core, the following data and observations were recorded and sketched on the logs: rock type, alterations, mineralization, amount of fracturing, angle of fracturing and pitch of the slickensides, fault breccia and gouge, and contacts of major rock type changes.

When core holes were completed, they were surveyed for drift and inclination with a multiple-shot gyroscopic survey instrument. Degree of inclination and bearing of drift were recorded on 100 foot intervals and at major contacts.

With this drill hole survey data, the assay and geological data could be plotted in both vertical and horizontal positions with a high degree of accuracy (Fig. 6).

Subsurface Mapping

To maintain control of drilling and indicate attitude and limits of assay and geological data, the following subsurface contour maps were prepared:

(1) The andesite-tactite contact

(2) The tactite-quartzite contact

(3) The quartzite-diorite contact

(4) The top and bottom of mineralization within the tactite

(5) The upper contact of the mineralized biotite porphyry

(6) The top and the lower drilling cut off of sulphide

(7) The top and bottom of oxide

(8) Base of the fanglomerate

With the above contoured data, isopach maps were drawn indicating direction and thickness of high grade oxides, sulphides, tactite, and mineralization within the tactite.

With the same contour maps, cross-sections could be drawn in any direction without regard to drift or alignment of core holes.

Interpretation of Subsurface Data

From the subsurface data, the following interpretations were made:

(1) The contours of the andesite-tactite contact form a subsurface that strikes $\pm$ north and dips $\pm$ 30° W (Fig. 7).

(2) The contours at the tactite-quartzite contact form a subsurface that strikes N $\pm$ 20° W and dips $\pm$ 20° SW, then turns to the northeast and dips to the northwest (Fig. 8). The curving contours

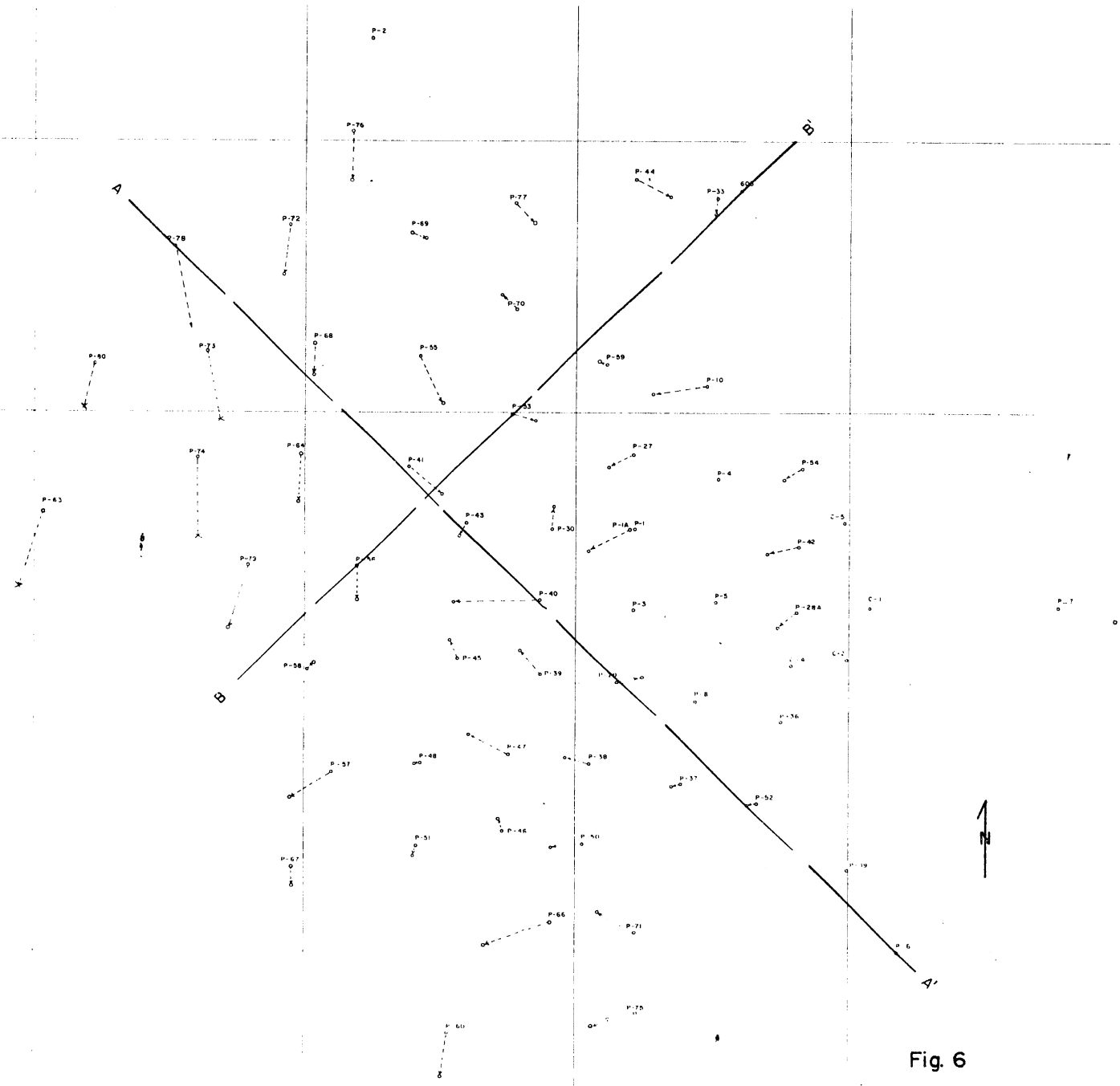


Fig. 6

EL PASO NATURAL GAS COMPANY		
LAKESHORE MINE PAPAGO INDIAN RESERVATION PINAL COUNTY, ARIZONA MAGNETIC AND GYROSCOPIC DRIFT SURVEY		
SCALE 1" = 200'	DATE 2/21/69	REVISIONS
DRAWN BY C.E.B.	CHECKED BY	
TRACED BY	APPROVED BY	
DRAWING NO.		

Subsurface Mapping

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(1) The andesite-tactite contact

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With the above contoured data, isopach maps were drawn indicating direction and thickness of high grade oxides, sulphides, tactite, and mineralization within the tactite.

With the same contour maps, cross-sections could be drawn in any direction without regard to drift or alignment of core holes.

Interpretation of Subsurface Data

From the subsurface data, the following interpretations were made:

(1) The contours of the andesite-tactite contact form a subsurface that strikes ± north and dips ± 30° W (Fig. 7).

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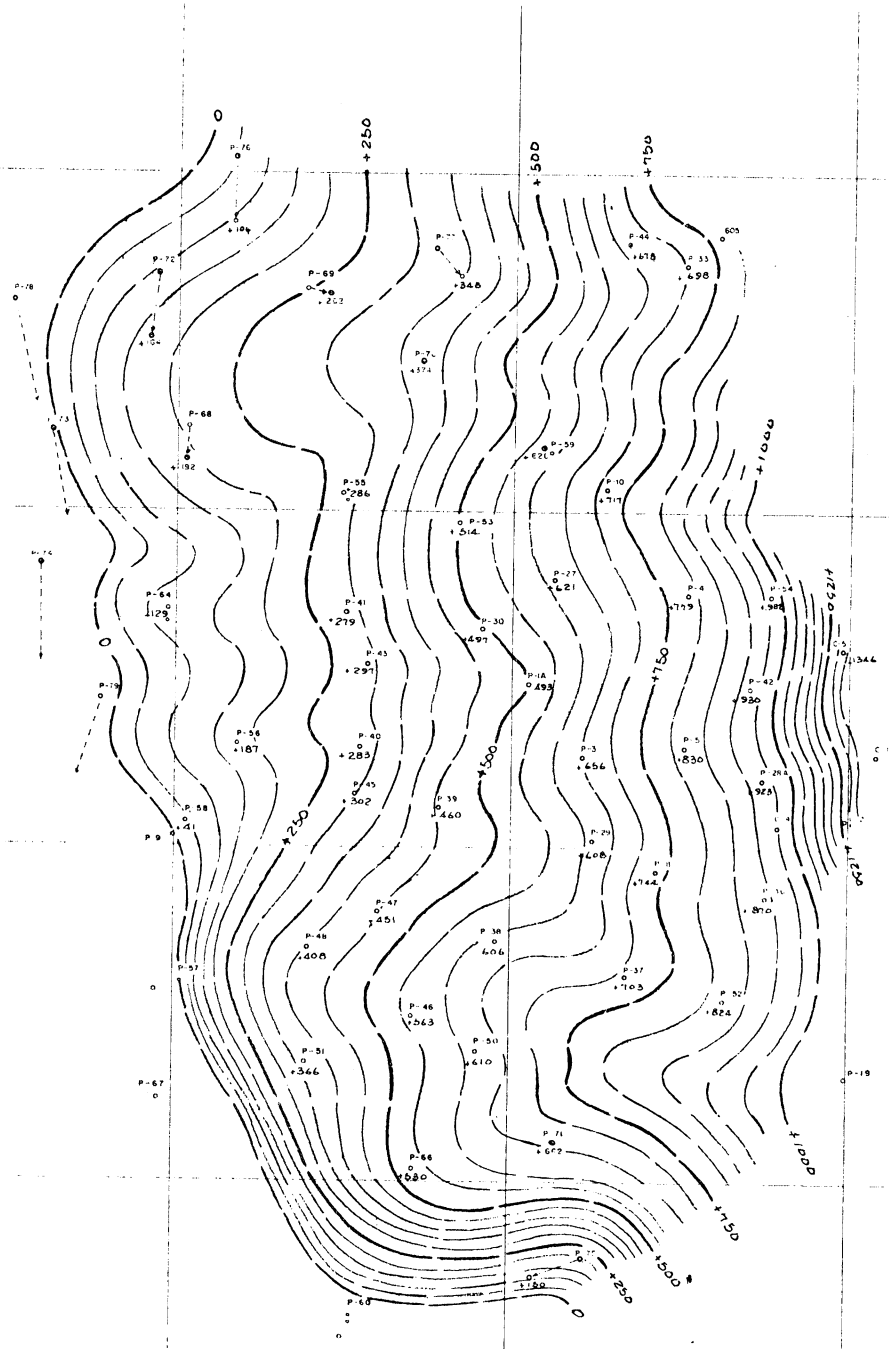

Fig. 7

EL PASO NATURAL GAS COMPANY		
LAKESHORE MINE PAPAGO INDIAN RESERVATION PINAL COUNTY, ARIZONA CONTOURS ON TOP OF TACTITE CONTOUR INTERVAL 50 FEET		
SCALE 1" = 200'	DATE 2/18/69	REVISIONS
DRAWN BY C.E.B.	CHECKED BY	
TRACED BY	APPROVED BY	
DRAWING NO. GEOLOGY BY C.E. BARRON		

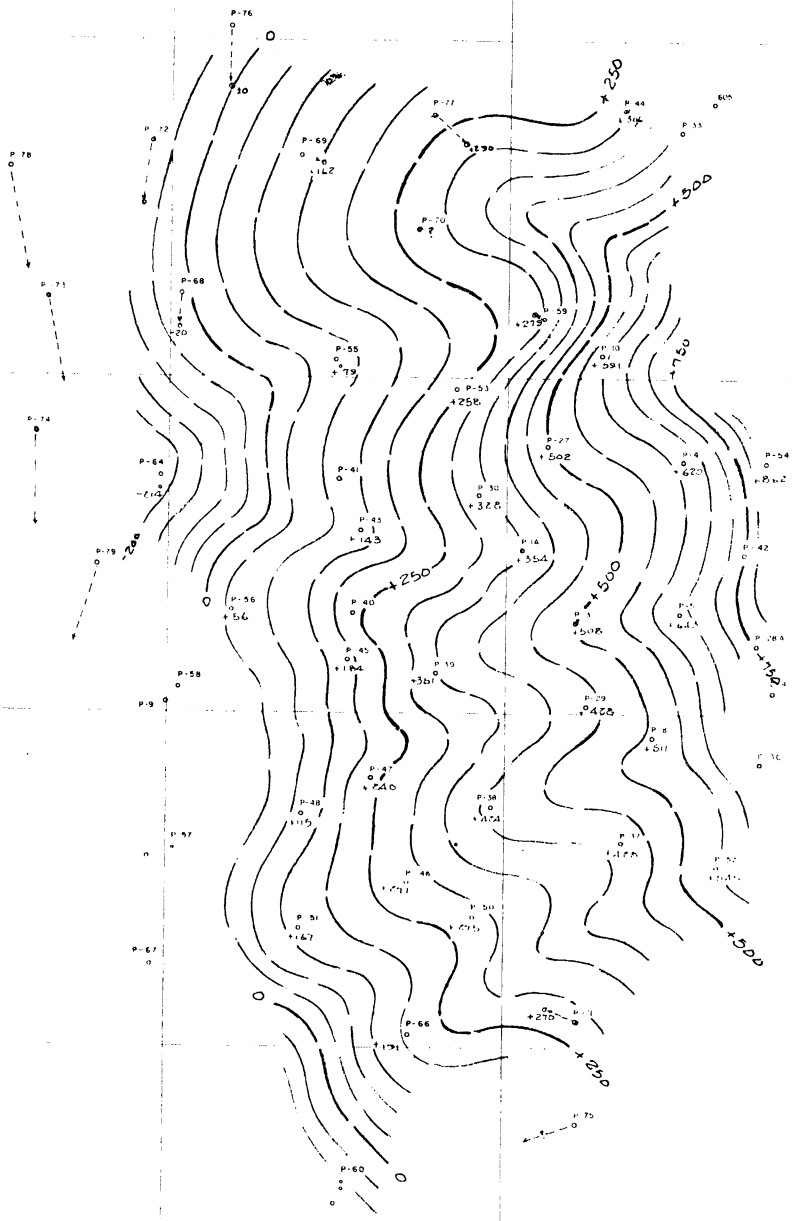

Fig. 8

EL PASO NATURAL GAS COMPANY

LAKESHORE MINE
PAPAGO INDIAN RESERVATION
PINAL COUNTY, ARIZONA
CONTOURS ON TOP OF QUARTZITE
CONTOUR INTERVAL 50 FEET

SCALE 1"=200'	DATE 2/19/69	REVISIONS
DRAWN BY E.E.B.	CHECKED BY	
TRACED BY	APPROVED BY	
DRAWING NO.		
GEOLOGY BY C.E. BARRON		

form a weakly nosing subsurface structure that plunges to the southwest. As the overlying andesite-tactite contact approaches this plunging structure, a thinning of the tactite occurs along a northeast trend and wedge-like thicknesses of tactite occur to the northwest and southeast of this zone of thinning. This thickening and thinning is best illustrated by an isopach of the tactite (Fig. 15).

(3) The more consistent thickness of mineralization, within the tactite, occurs in the wedge-like thickness southeast of the zone of thinning. Contours on the top and bottom of this mineralized thickness conform with the N 20 W strike and 20° SW dip of the underlying quartzite. The line of intersection of this mineralization with the overlying andesite trends NE and plunges SW, and terminates this thickness of mineralization in the zone of thinning. To the south and southeast of the zone of thinning, an increasing thickness of massive garnet and epidote occurs over the mineralization, and the mineralized horizon is divided into an upper and lower mineral thickness by an interbedded, fine-grained quartzite. Underlying this sulphide mineralization, a black and gray banded tactite is in contact with the underlying quartzite. This sequence of metasediments, which has been intruded by diabase and biotite porphyry, continues to the south and southeast until it has apparently been displaced by a major fault that trends N $\pm$ 20 W.

(4) To the east the metasediments are in contact with the diorite. Contours on this contact form a north trending subsurface that dips ± 60° W (Fig. 9).

(5) To the west the metasediments have been intruded by the biotite porphyry along a northeast trending contact zone. Along this contact zone the intrusive forms sills of irregular masses that occur in both the metasediments and the andesite. Better grade mineralization occurs along this zone of multiple sills (Fig. 16).

(6) Northwest of this contact zone the stock-like intrusive forms a more homogenous emplacement within the andesite but continues to form sills within the metasediments. Further to the northwest, the intrusive again forms a contact zone of multiple sills within the andesite (Fig. 16).

(7) Contours on top of the oxidized intrusive trend N 55 E and form a ± 40° slope along the northwest side (Fig. 10). On the southeast side the contours indicate a much steeper slope, and to the southwest, the intrusive apparently has been displaced in this horizon by a high angle normal fault that strikes ± N 20 W. Limits of the intrusive have not been determined to the north and northeast.

(8) Contours on top of the oxide mineralization form an irregular horizon in the subsurface west of the Lakeshore pit; then this horizon forms a northwestern dip and passes through the top of the mineralized intrusive. As the oxide zone passes through the

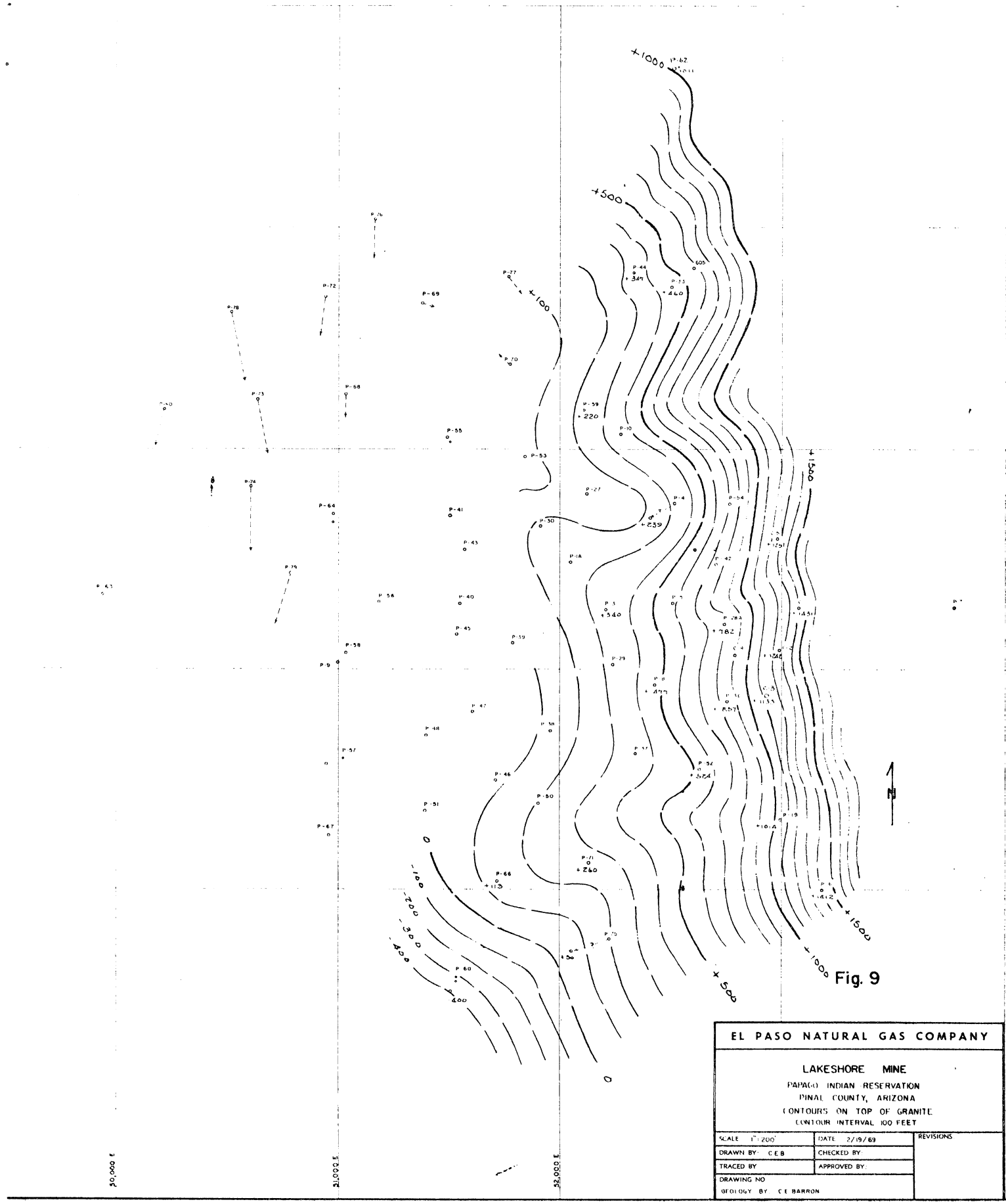

Fig. 9

EL PASO NATURAL GAS COMPANY		
LAKESHORE MINE PAPAGO INDIAN RESERVATION PINAL COUNTY, ARIZONA CONTOURS ON TOP OF GRANITE CONTOUR INTERVAL 100 FEET		
SCALE 1" = 200'	DATE 2/19/69	REVISIONS
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GEOLOGY BY C E BARRON		

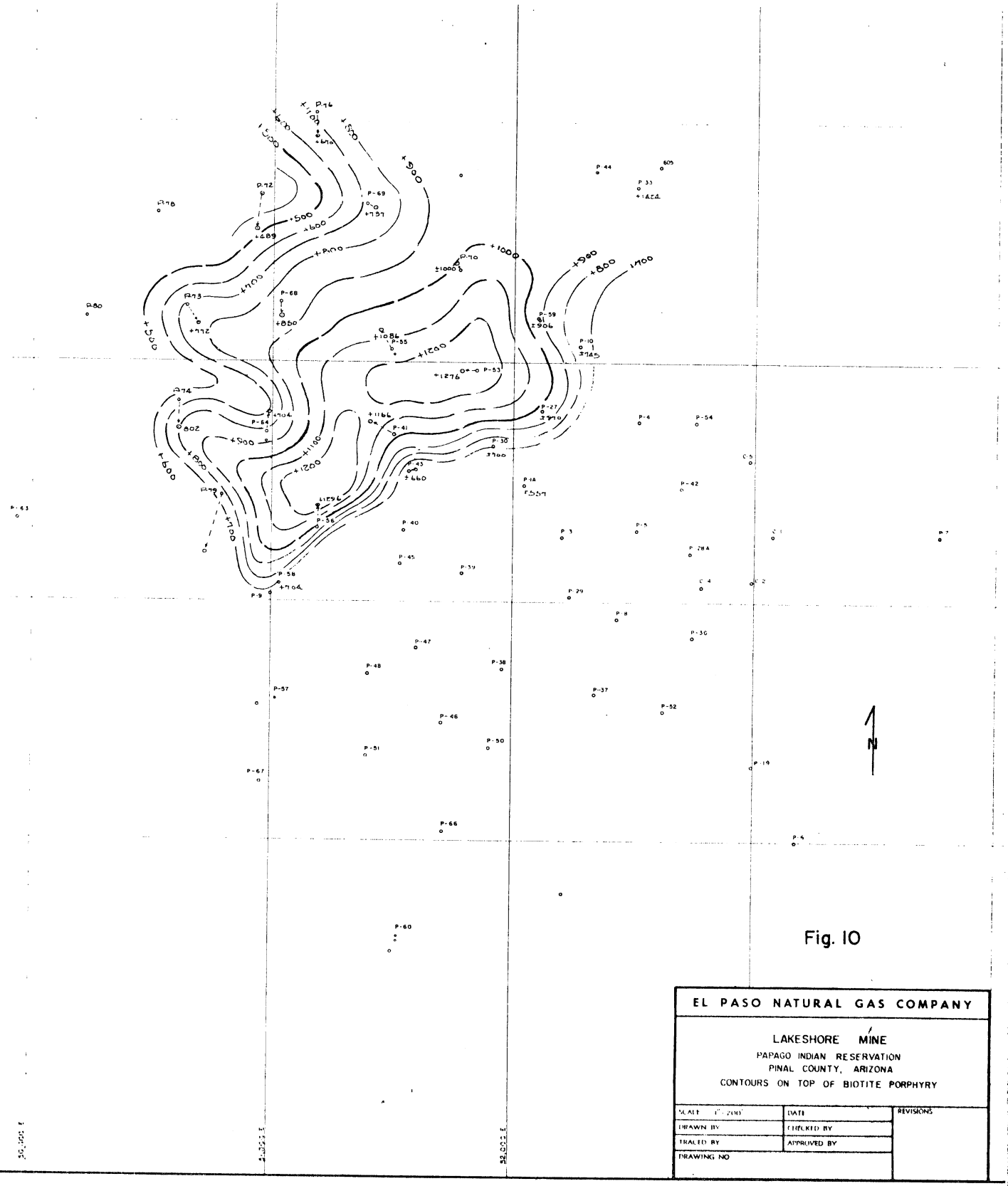

Fig. 10

EL PASO NATURAL GAS COMPANY		
LAKESHORE MINE PAPAGO INDIAN RESERVATION PINAL COUNTY, ARIZONA CONTOURS ON TOP OF BIOTITE PORPHYRY		
SCALE 1" = 200'	DATE	REVISIONS
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DRAWING NO		

upper part of the intrusive, a ± 100 foot thick blanket of ± 1.5% copper oxide mineralization occurs at the base of the oxides. This mineralization trends to the northeast along the top of the intrusive and dips to the northwest. As the dip of the oxide mineralization increases to the northwest, the high grade oxide mineralization thins and a zone of chalcocite has formed an enriched upper thickness of sulphide mineralization (Fig. 11).

(9) Contours at the top of sulphide mineralization form a low trough that plunges to the southwest along the southeast flank of the biotite porphyry intrusive. This oxide-sulphide transition horizon then climbs to its highest elevation within the top of the intrusive and forms a northeast trend that dips to the NW. To the southwest the contours turn sharply to the northwest or southeast and form a N ± 20° W trending horizon that dips ± 70° SW (Fig. 12).

(10) The isopach of the sulphides indicates a wedge-like thickness of mineralization. The thin edge, ± 300 feet thick, occurs along the northeast trending contact zone of the intrusive and the metasediments. To the northwest of this contact zone and along the apparent fault zone, the mineralized zone thickens to over 1000 feet. Some core holes in this zone have an average assay value of .85% copper for 1000 feet of recovered core. The limits of mineralization to the northwest and north of this area have not been determined (Fig. 14).

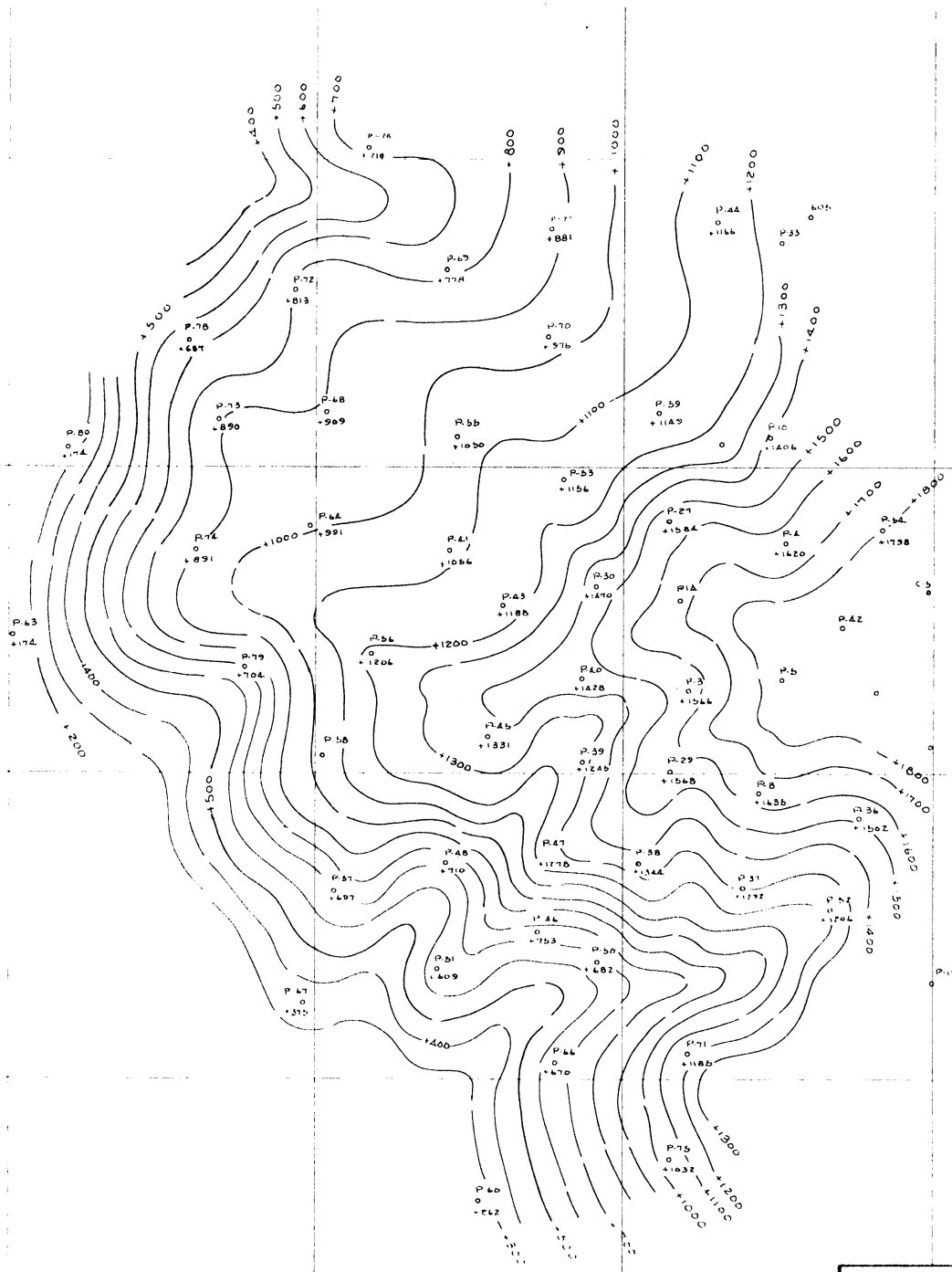

Fig. 11

EL PASO NATURAL GAS COMPANY		
LAKESHORE MINE PAPAGO INDIAN RESERVATION PINAL COUNTY, ARIZONA CONTOURS ON TOP OF OXIDES CONTOUR INTERVAL 100 FEET		
SCALE 1" = 200'	DATE 2/19/69	REVISIONS
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DRAWING NO. GEOLOGY BY C.E.BARRON		

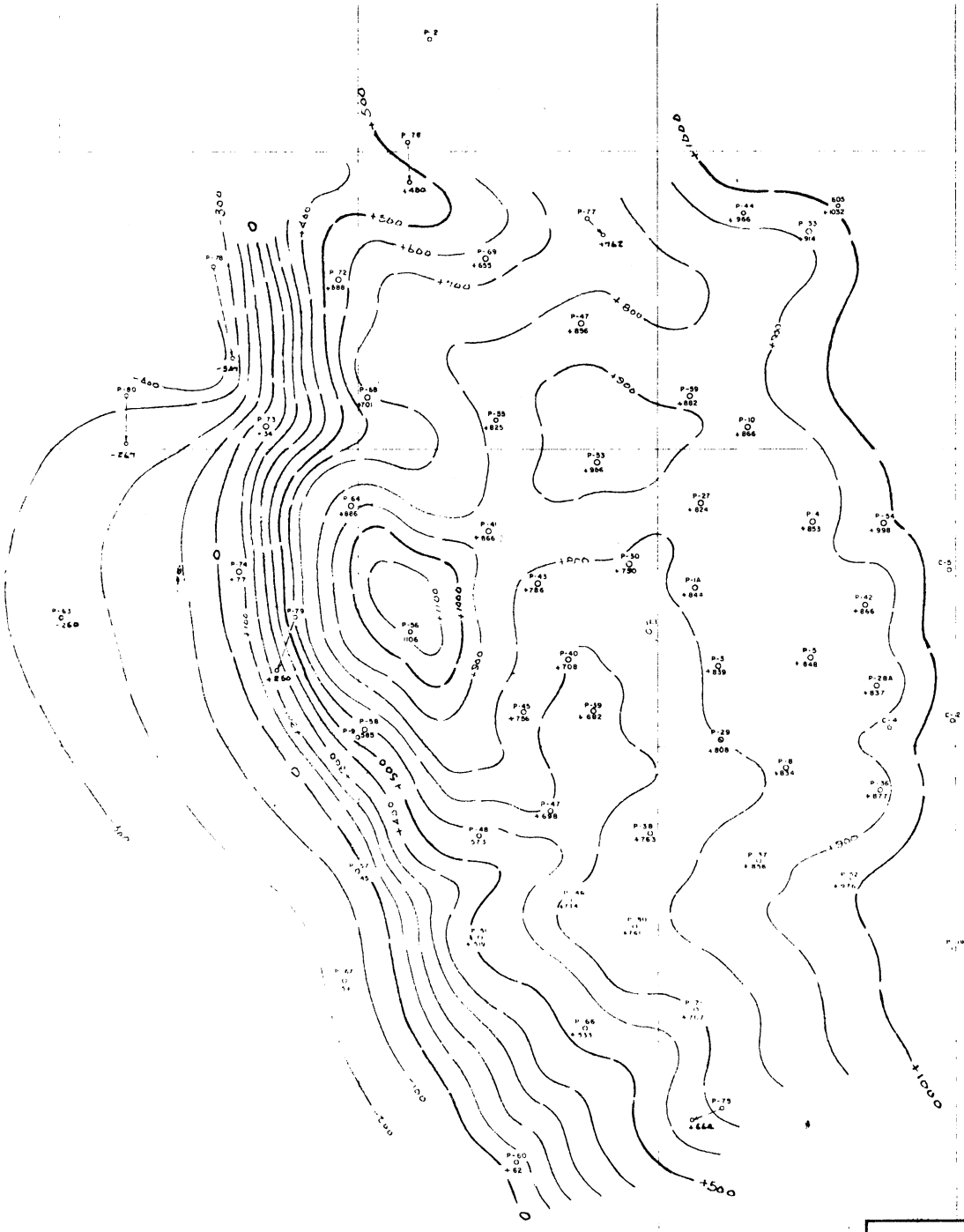

Fig. 12

EL PASO NATURAL GAS COMPANY		
LAKESHORE MINE PAPAGO INDIAN RESERVATION PINAL COUNTY, ARIZONA CONTOURS ON TOP OF SULPHIDES CONTOUR INTERVAL 100 FEET		
SCALE 1" = 200	DATE: 2/19/69	REVISIONS
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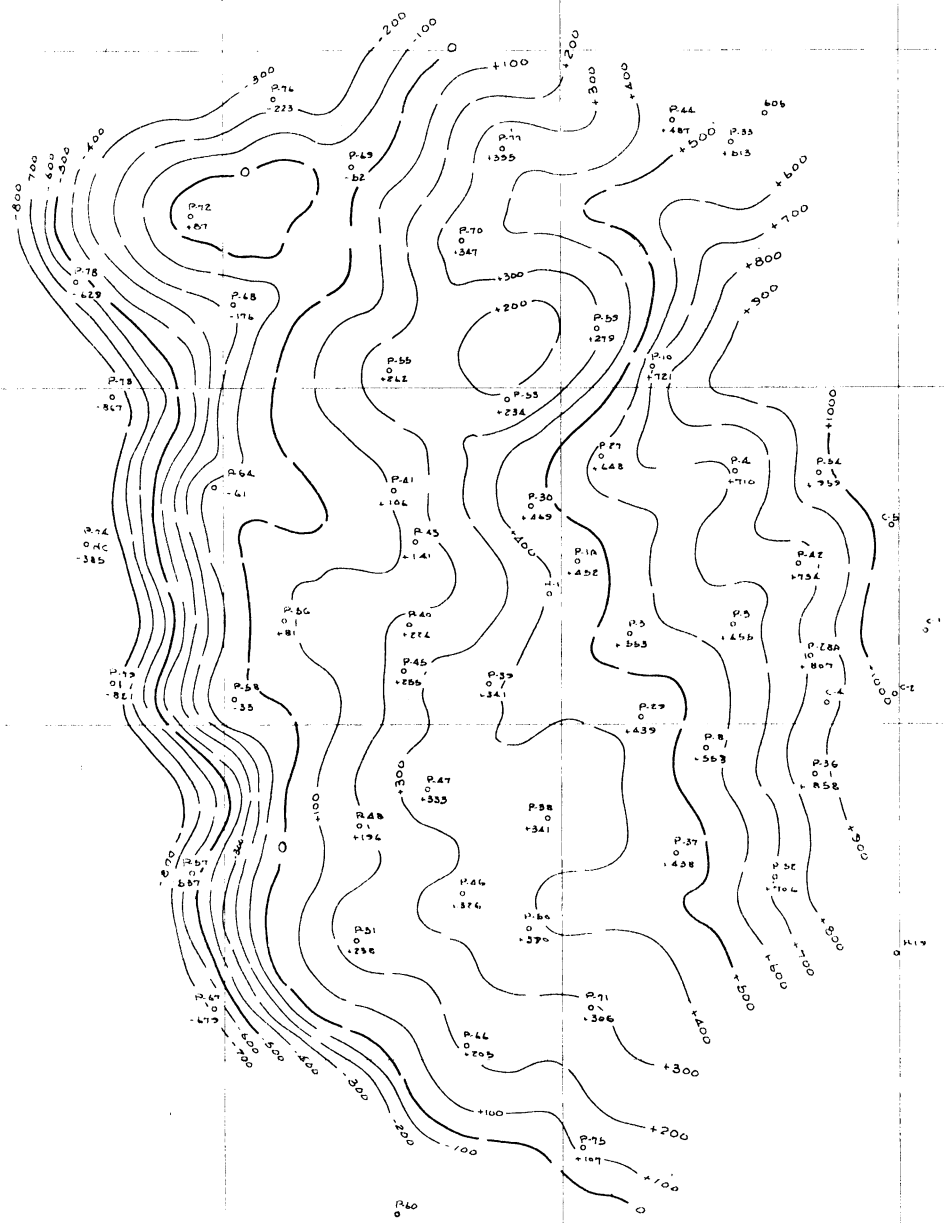

Fig. 13

EL PASO NATURAL GAS COMPANY		
LAKESHORE MINE PAPAGO INDIAN RESERVATION PINAL COUNTY, ARIZONA CONTOURS AT LOWER SULPHIDE CUT-OFF CONTOUR INTERVAL 100 FEET		
SCALE 1" = 200'	DATE 2/19/69	REVISIONS
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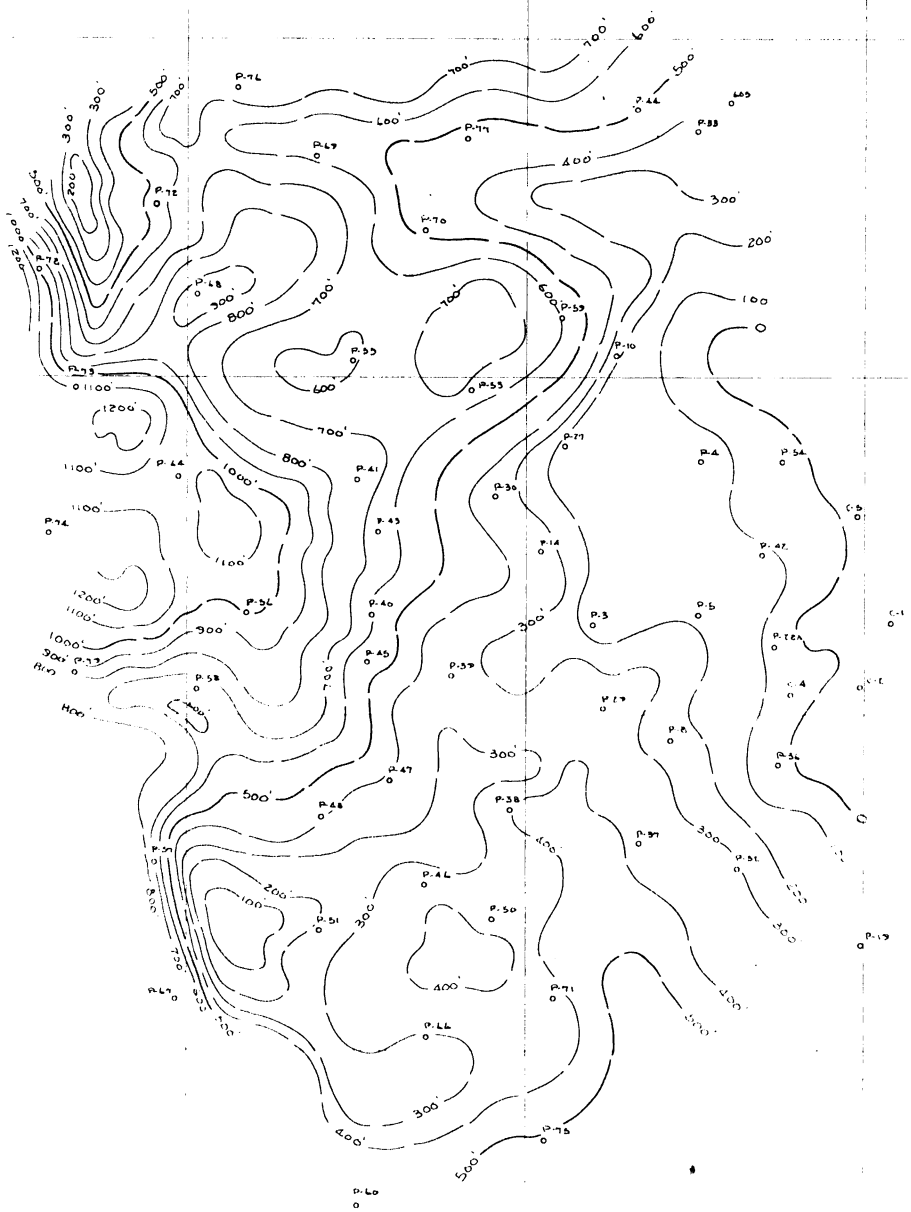

Fig. 14

EL PASO NATURAL GAS COMPANY		
LAKESHORE MINE PAPAGO INDIAN RESERVATION PINAL COUNTY, ARIZONA ISOPACH OF SULPHIDES CONTOUR INTERVAL 100 FEET		
SCALE 1" = 200'	DATE 2/19/69	REVISIONS
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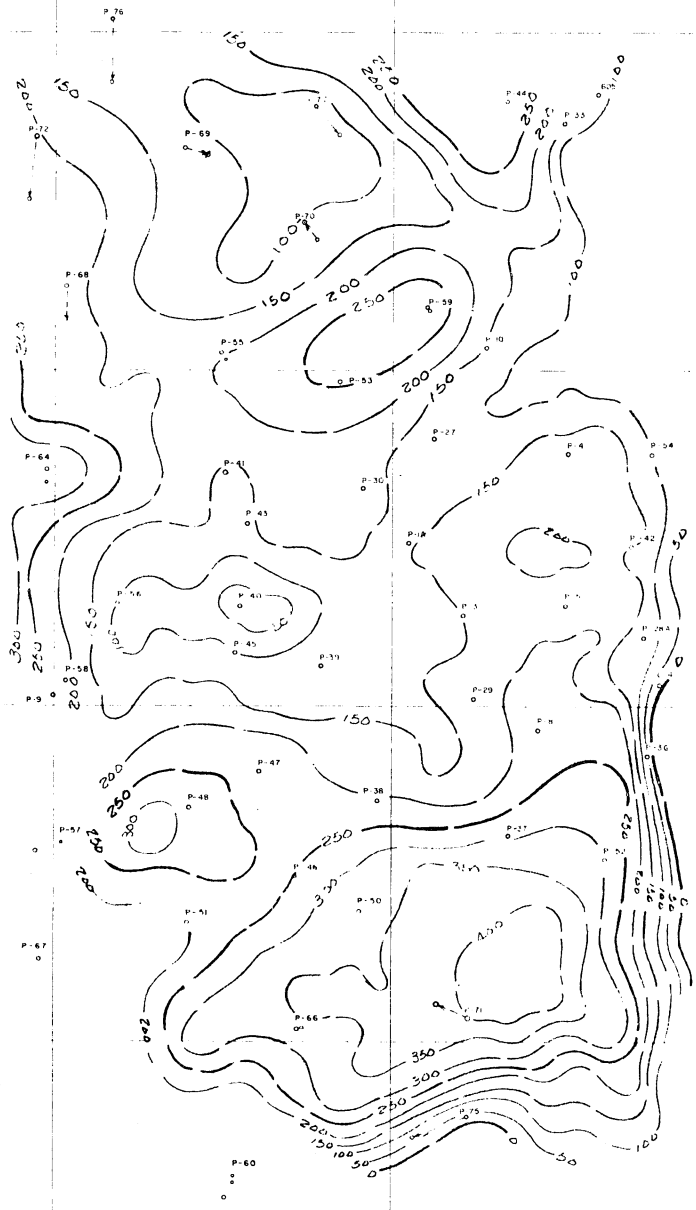

Fig. 15

EL PASO NATURAL GAS COMPANY

LAKESHORE MINE
PAPAGO INDIAN RESERVATION
PINAL COUNTY, ARIZONA
OUTCROP OF TACTITE
CONTOUR INTERVAL 50 FEET

SCALE 1"=200'	DATE 2/19/69	REVISIONS
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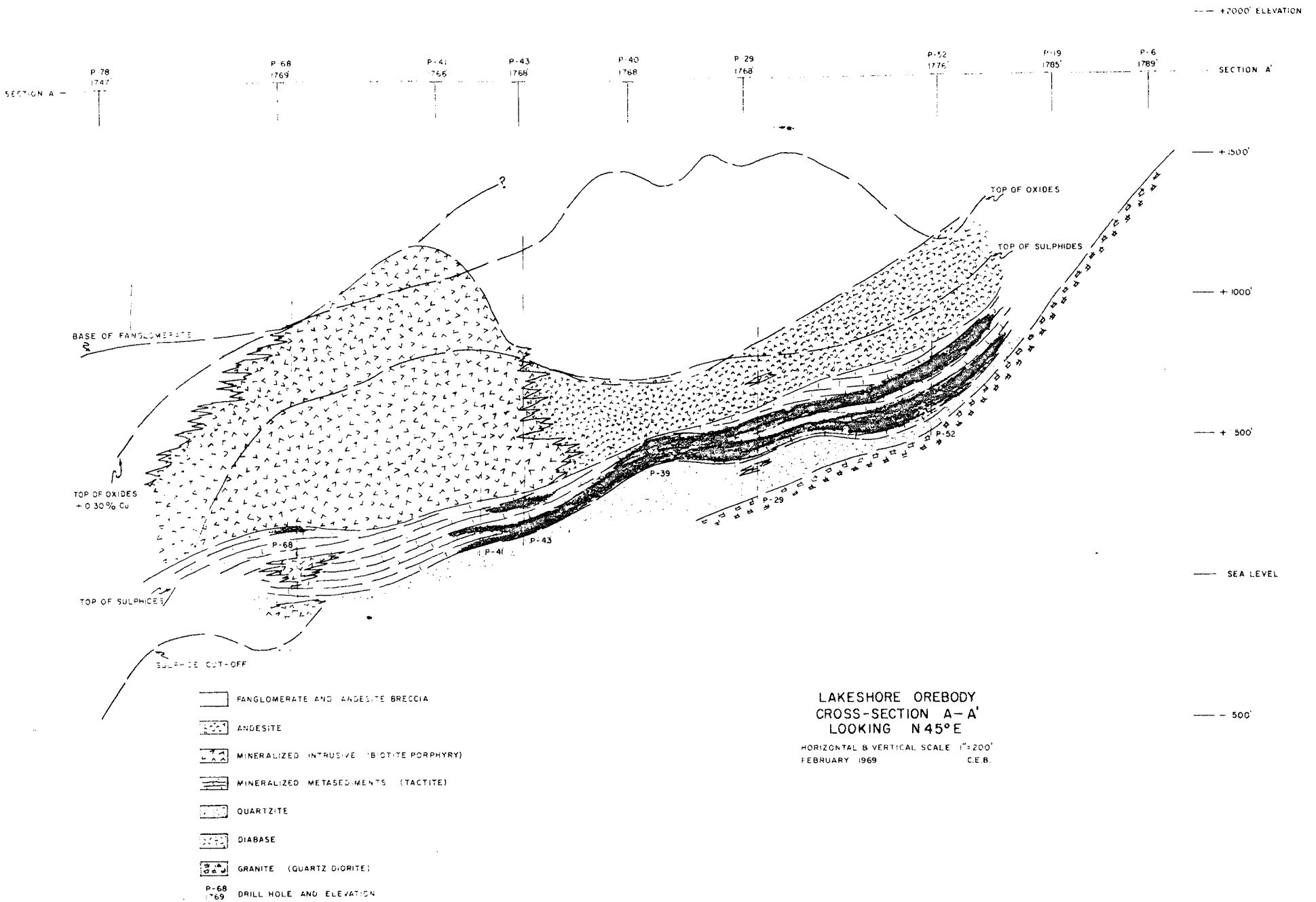
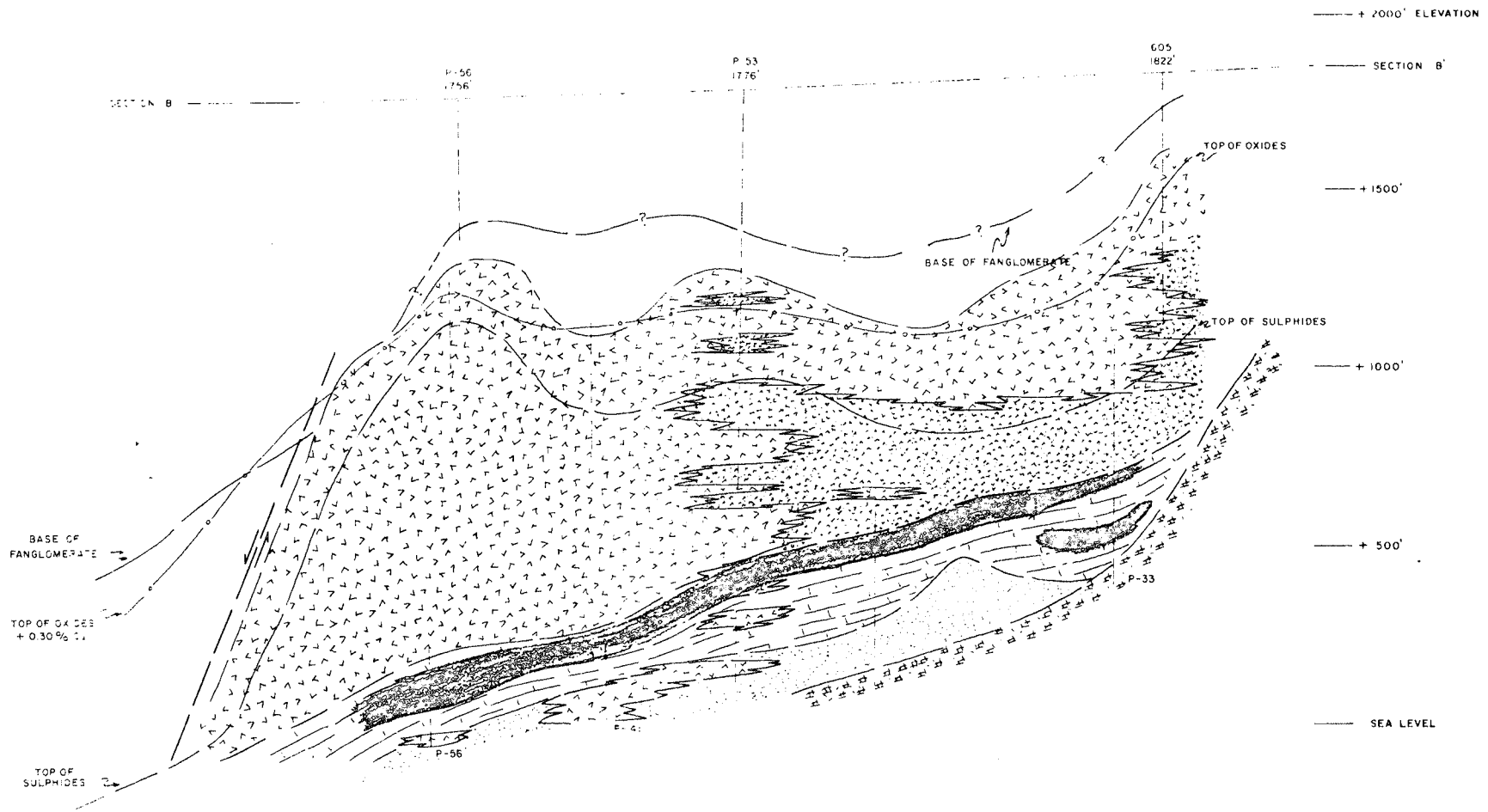
GEOLOGY BY C.E. BARRON		



LAKESHORE OREBODY
CROSS-SECTION A–A'
LOOKING N45°E

HORIZONTAL & VERTICAL SCALE 1"=200'
FEBRUARY 1969 C.E.B.

Fig. 16



LAKESHORE OREBODY
CROSS-SECTION B-B'
LOOKING N45°W

HORIZONTAL & VERTICAL SCALE 1"= 200'
FEBRUARY 1969 C.E.B.

Fig. 17

(11) Overlying the highly fractured and altered andesite, biotite porphyry and tactite is a relatively unfractured, weakly cemented fanglomerate that thickens from ± 100 feet at the edge of the valley to ± 1500 feet around the southwest end of the biotite porphyry and is apparently in contact with the altered and oxidized top of this intrusive.

In summation, the geological data indicates the occurrence of mineralization at Lakeshore to be the result of the emplacement of a weakly mineralized biotite porphyry. This stock-like mass formed a multiple sill contact with eroded and deformed metasediments and the overlying andesites and breccia. The processes of contact metamorphism formed tactite or skarn in the metasediments and a higher grade of sulphide mineralization was deposited in the more favorable carbonates. Post-mineral faulting and fracturing formed channels for erosion, leaching, and enrichment of mineralization. This mineral deposit was tilted to the northwest and underwent a second period of erosion and oxidization. This oxidized and fractured surface was then buried by the present overlying fanglomerate (Fig. 17).

COMPUTER EVALUATION

During March and April of 1968, a computer evaluation of the assay and geological data from 23 core holes was performed by an independent consultant (7). This evaluation provided the following information:

(1) Ore reserves, tonnage and grade of the sulphide and oxide mineralization for various cut-off grades and thicknesses;

(2) Level plans at various vertical intervals showing contours of sulphide copper values;

(3) Vertical cross-sections of the sulphide copper values;

(4) A confidence interval analysis to determine future drilling requirements; and

(5) A financial analysis based on ore reserves of varying cut off grades, and the following parameters - mining cost and mining methods, concentrator capacity and recovery, metal prices, capital requirements and financing, royalty, sales agreements, and taxation.

In May 1968, ore reserves based on assay and geological data from 23 holes was reported as follows:

1. Tactite reserves, based on a cut-off grade of 0.75% copper, were 13.7 million tons with an average grade of 1.84% copper.

2. Porphyry reserves including tactite, based on a cut-off grade of 0.50% copper, were 59 million tons with an average grade of 0.99% copper.

During September 1968, the assay and geological data was again submitted to an independent consultant (8) for computer evaluation. The following reserves were reported:

1. Porphyry reserves based on mineralization with a thickness greater than 200 feet and a cut-off grade of 0.50% copper were 86 million tons with an average grade of 0.81% copper. This included tactite material lying under the porphyry.

2. Tactite reserves, outside the porphyry area and with a cut-off grade of 1.00% copper, were 10 million tons with an average grade of 1.73% copper.

In November 1968, with the data from 42 core holes, the following up-dated ore reserves, classified as a total of proved and probable, were reported:

1. Porphyry reserves based on mineralization with a thickness greater than 200 feet and a cut-off grade of 0.50% copper, were 132.0 million tons with an average grade of 0.81% copper. This included 9 million tons of tactite material lying under the porphyry.
2. Tactite reserves, outside the porphyry area and with a cut-off grade of 1.00% copper, were 10 million tons with an average grade of 1.73% copper.
3. Oxide reserves, based on a cut-off grade of 0.50% copper, were 85 million tons with an average grade of 0.81% copper.

On February 7, 1969, with data from 51 core holes, the following ore reserves classified as a total of proved and probable, were reported:

1. Porphyry reserves, based on a cut-off grade of 0.40% copper, were 241 million tons with an average grade of 0.70% copper.
2. Tactite reserves, based on a cut-off grade of 1.00% copper, were 24 million tons with an average grade of 1.69% copper.
3. Oxide reserves, based on a cut-off grade of 0.40% copper, were 207 million tons with an average grade of 0.71% copper.

CONCLUSION

In the opinion of the writer, the discovery of sulphide mineralization at Lakeshore was the result of a successful interpretation of combined geologic and geophysical data. The rotation of the mineralized metasediments to an assumed pre-tilt attitude gave a reason for projecting these metasediments to the northwest. The I. P. anomalies were correlated with this assumed northwest projection.

At the end of this phase of the exploration program, the majority of mineralized core holes have been collared within or near the limits of the proposed drilling target (Fig. 18). The interpretation that assumed overturning of metasediments by tilting to the northwest has been strengthened by three core holes which were collared in the oxide ore body and again entered mineralized metasediments at depth after penetrating the andesites. The discovery of the mineralized tactite led to the discovery of sulphide mineralization in the biotite porphyry intrusive and a "porphyry copper" deposit.

The gyroscopic drift survey of drill holes accurately located the subsurface position of the assay and geologic data that was obtained from the diamond drill cores, and gave the necessary vertical and horizontal control for the preparation of subsurface maps and cross sections and for computer evaluation of the mineral deposit.

Computer evaluation proved to be an efficient and rapid method of obtaining and updating grade and tonnage estimates during the exploration program.

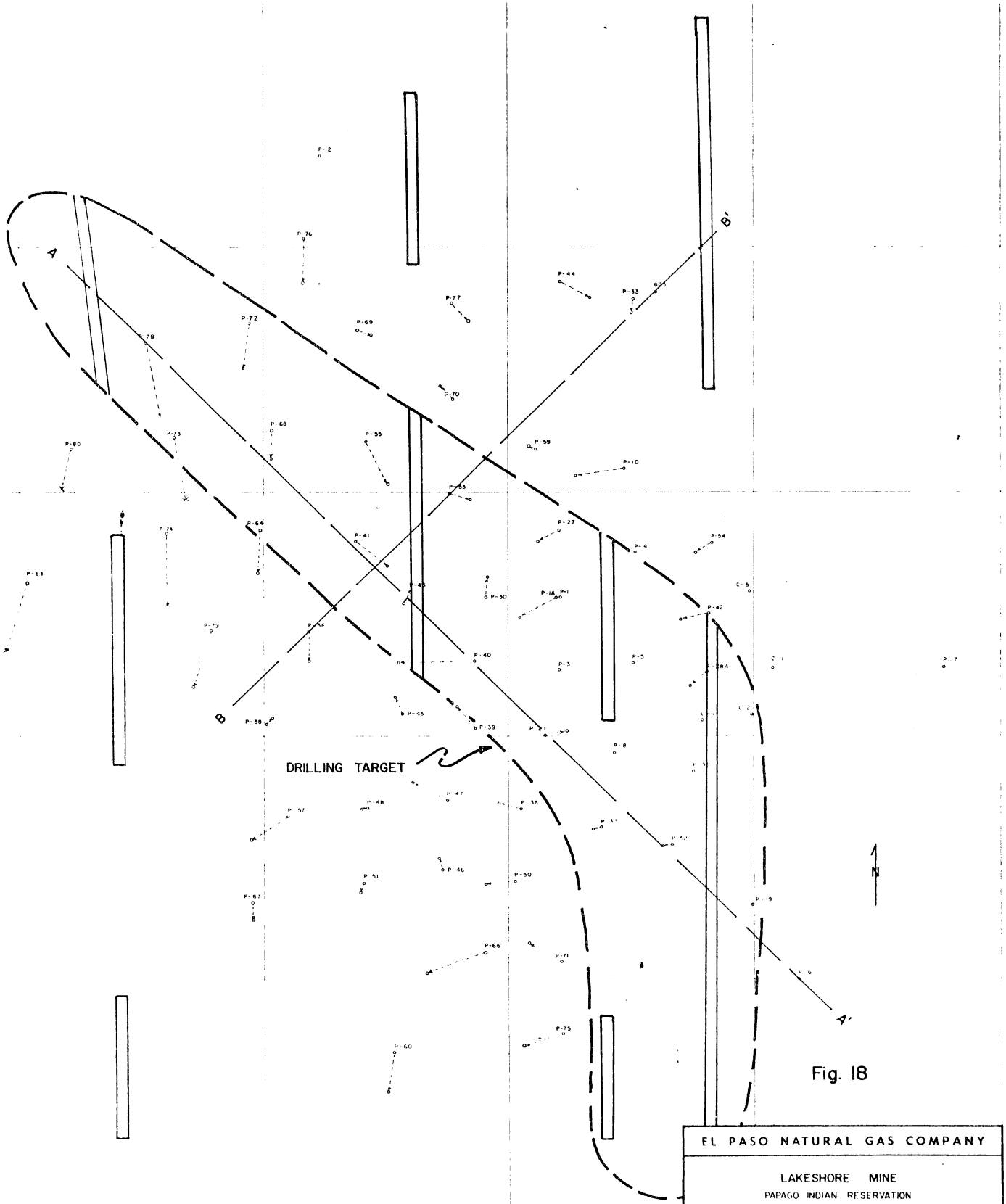


Fig. 18

EL PASO NATURAL GAS COMPANY

LAKESHORE MINE
PAPAGO INDIAN RESERVATION
PINAL COUNTY, ARIZONA
MAGNETIC AND GYROSCOPIC DRIFT SURVEY

SCALE 1" = 100	DATE 2/19/69	REVISIONS
DRAWN BY C.F.B.	CHECKED BY	
TRACED BY	APPROVED BY	
DRAWING NO.		

ACKNOWLEDGMENTS

The author wishes to thank the members of the Mining Division of El Paso Natural Gas Company for helpful comments and criticism on the paper; and is grateful to Doctors W. S. Strain and Earl M. P. Lovejoy of the Geology Department, University of Texas at El Paso, for reading the paper and suggesting improvements.

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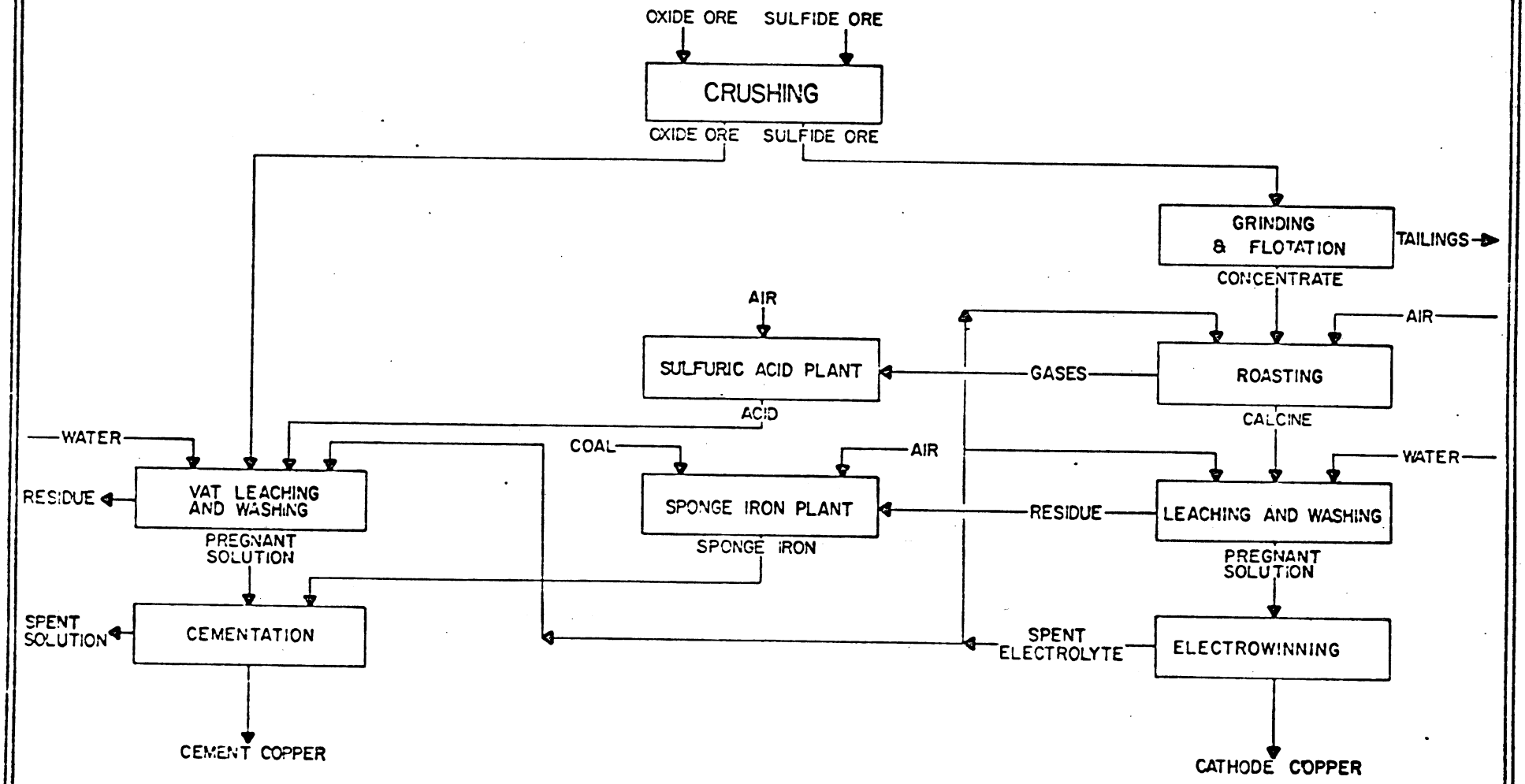
PROPOSED PLANT SURFACE FACILITIES

HECLA MINING COMPANY

LAKESHORE MINE

CASA GRANDE, ARIZONA

Lakeshore Project
Plant Flowsheet



L A K E S H O R E

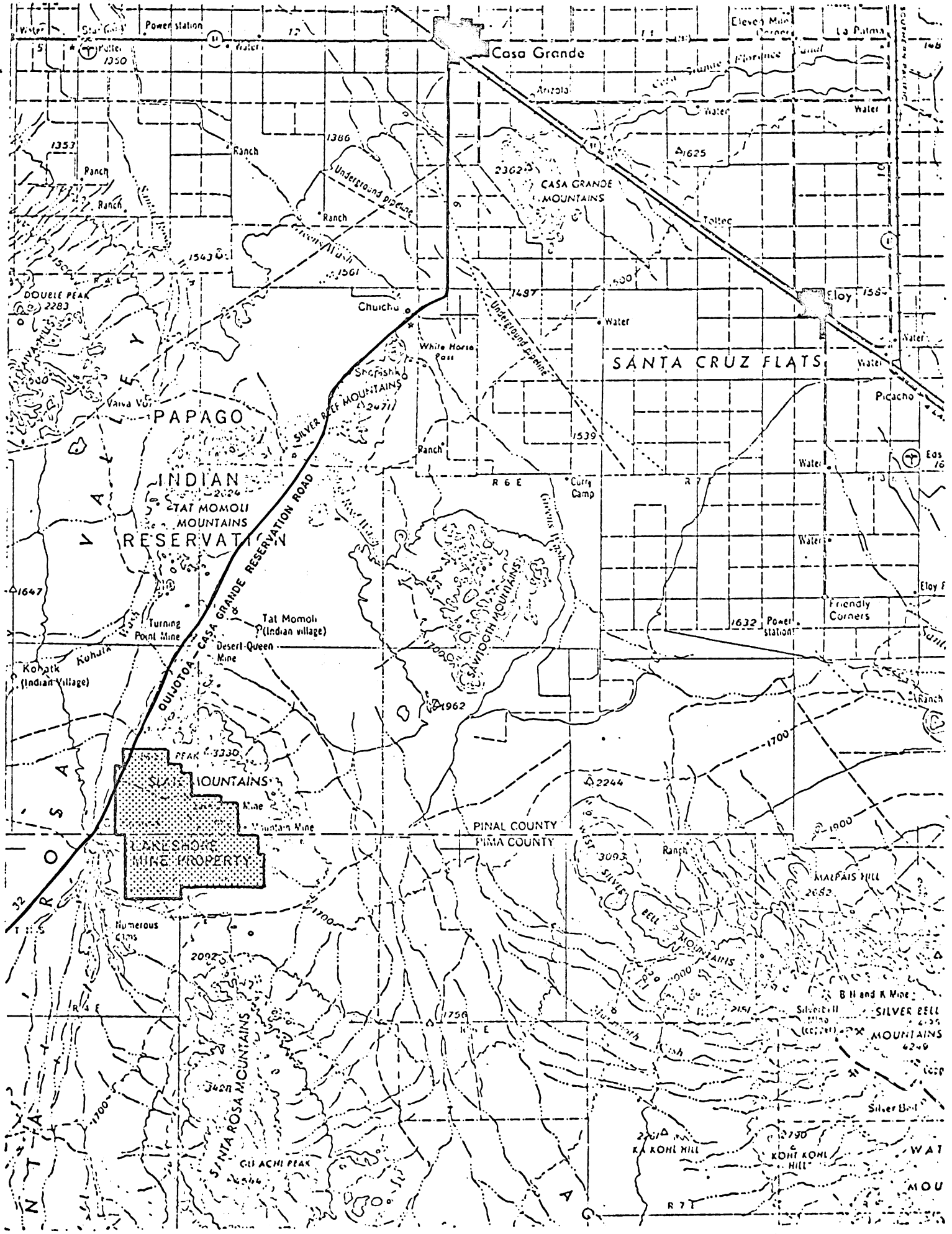
AT A GLANCE

Location:	Slate Mountains 28 miles south-southwest of Casa Grande, Arizona 70 miles south of Phoenix, and 60 miles northwest of Tucson.
Elevation:	1900 feet above sea level
Ecosystem:	Typical Sonoran Desert
Temperature Range: (1970 - 1973 records)	22° F Low 116° F High
Annual Precipitation:	8 inches
Property:	10,500 acres
Ownership:	Leased from The Papago Tribe by El Paso Natural Gas Co. (50%) and Hecla Mining Co. (50%)
Operator:	Hecla Mining Co.
Work Force:	1200 maximum (construction and development phase) 1200 (production)
Mining Method:	Underground
Ore Treatment:	Hydrometallurgical
Planned Production:	9,150 tons/day sulfide ore 6,450 tons/day oxide ore

March 1974

LAKESHORE MINE

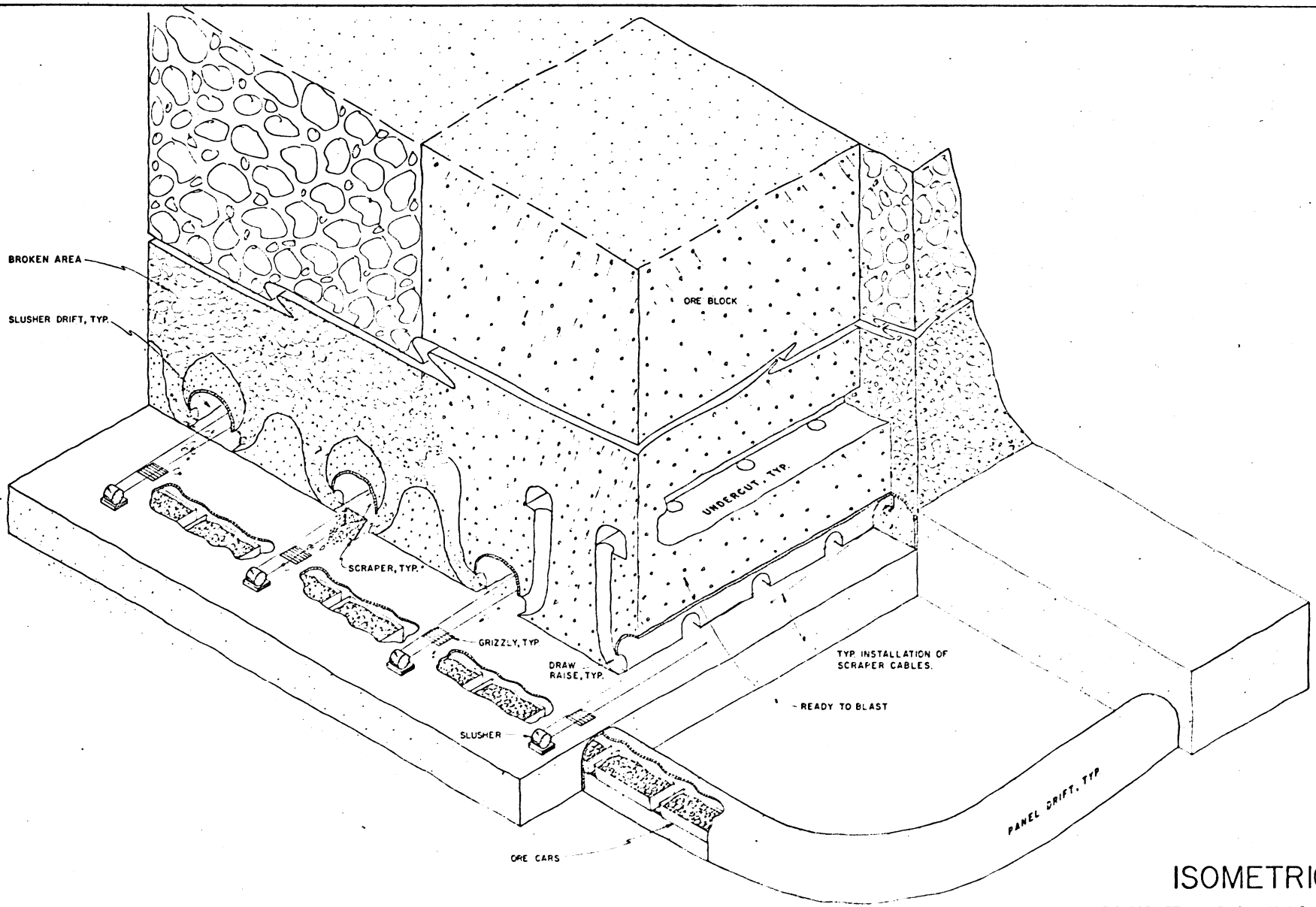
HECLA MINING COMPANY



INDEX MAP SHOWING LOCATION OF LAKESHORE MINE PROPERTY

SCALE: 1" = 4 miles

Fig. 1



ISOMETRIC OF OXIDE CAVING SYSTEM

HECLA MINING COMPANY
LAKESHORE PROJECT

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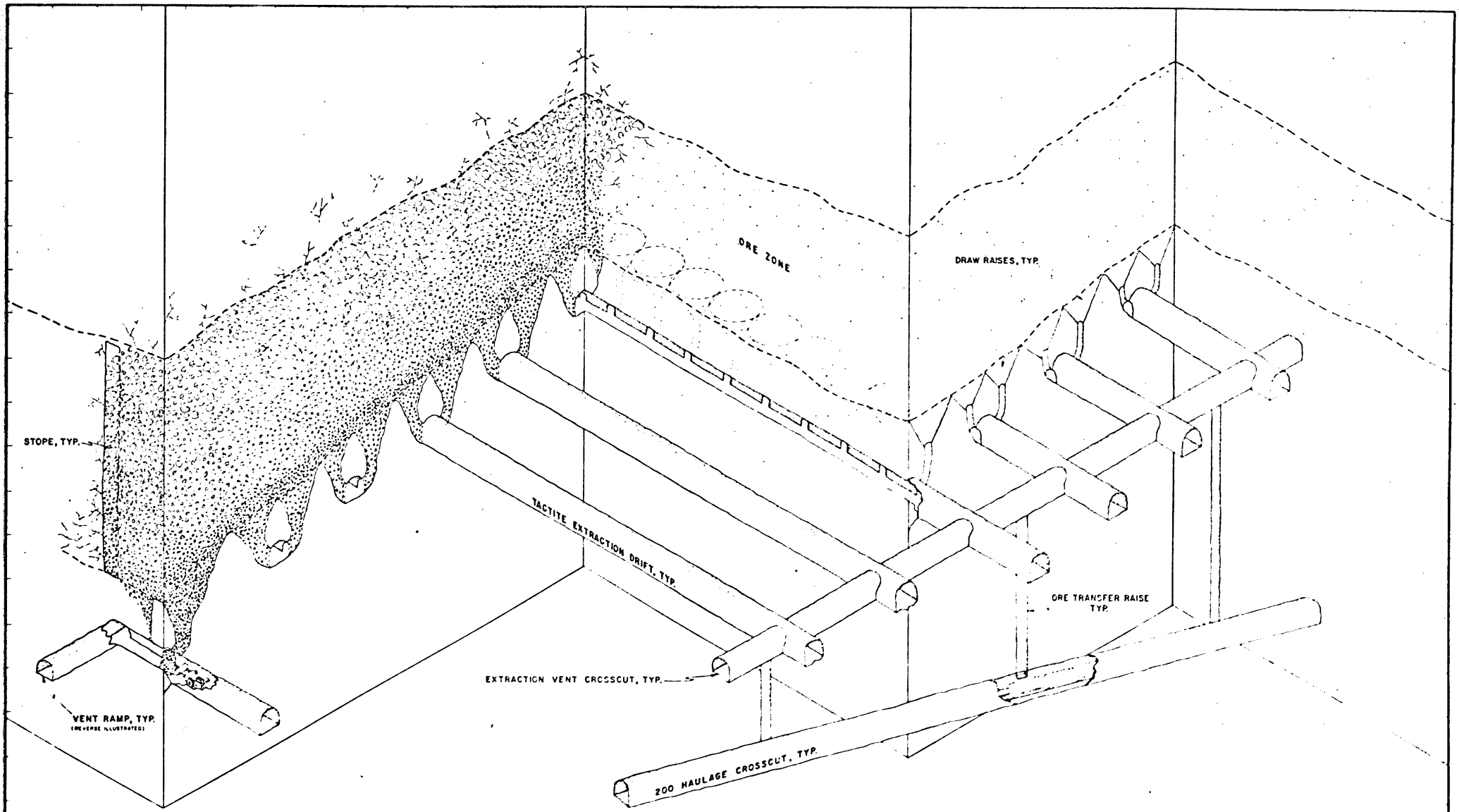

ISOMETRIC OF SULFIDE CAVING SYSTEM

HECLA MINING COMPANY
LAKESHORE PROJECT

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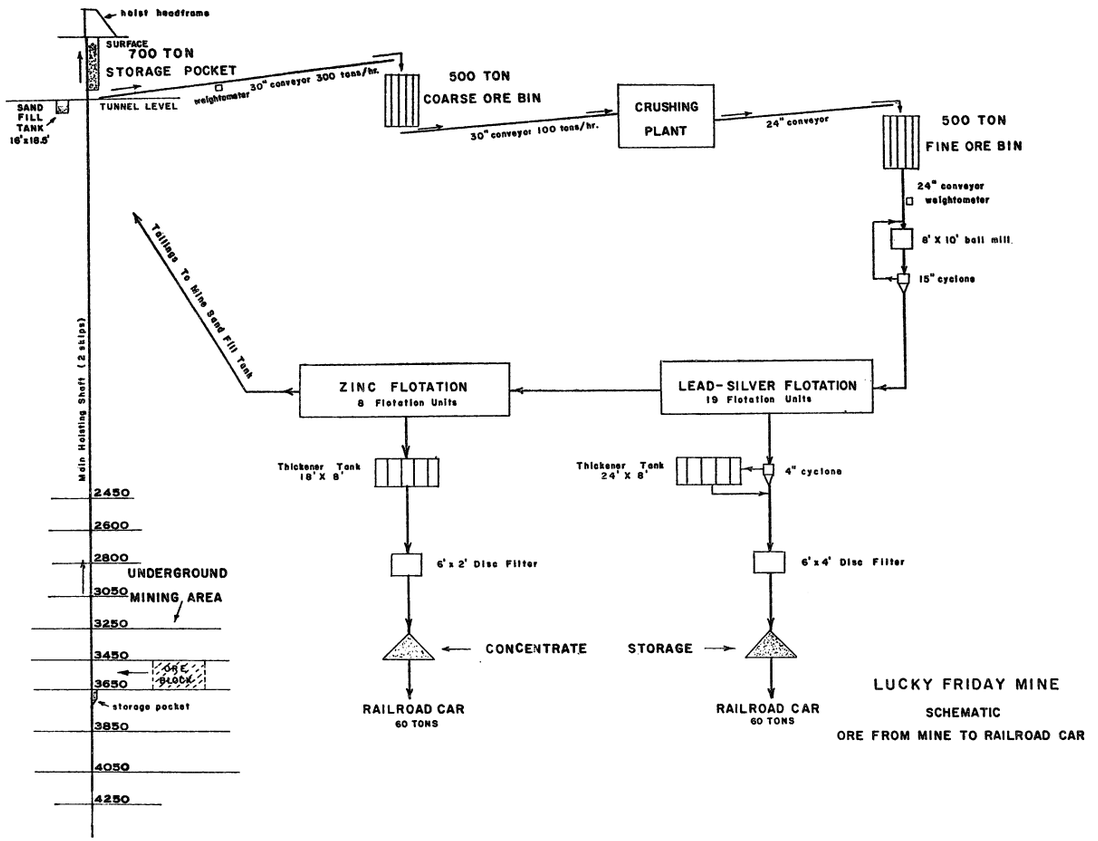
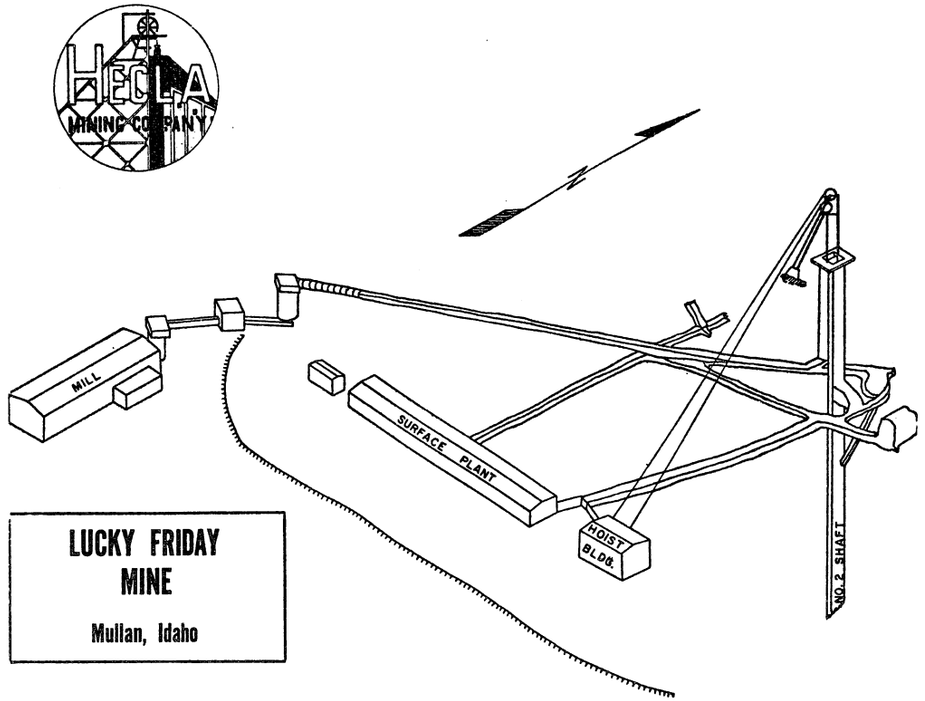
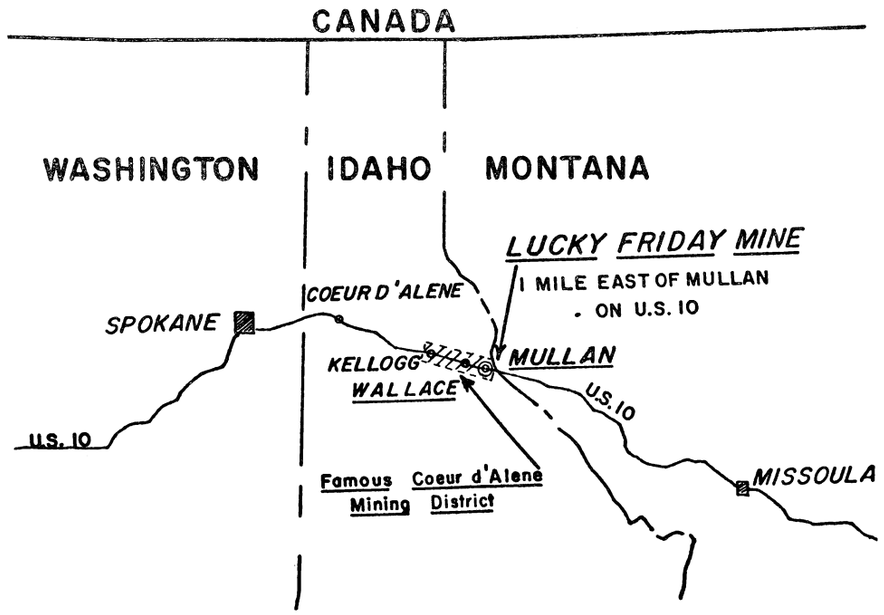

hoist headframe
SURFACE
700 TON
STORAGE POCKET
TUNNEL LEVEL
weightometer
30" conveyor 300 tons/hr.
500 TON
COARSE ORE BIN
30" conveyor 100 tons/hr.
CRUSHING
PLANT
24" conveyor
500 TON
FINE ORE BIN
24" conveyor
weightometer
8' X 10' ball mill
15" cyclone
SAND
FILL
TANK
16'x16.5'
Tailings To Mine Sand Fill Tank
ZINC FLOTATION
8 Flotation Units
LEAD-SILVER FLOTATION
19 Flotation Units
Thickener Tank
18' X 8'
Thickener Tank
24' X 8'
4" cyclone
Main Hoisting Shaft (2 skips)
2450
2600
2800
UNDERGROUND
3050
MINING AREA
3250
3450
ORE
BLOCK
3650
storage pocket
3850
4050
4250
6'x 2' Disc Filter
6'x4' Disc Filter
CONCENTRATE
STORAGE
RAILROAD CAR
60 TONS
RAILROAD CAR
60 TONS
LUCKY FRIDAY MINE
SCHEMATIC
ORE FROM MINE TO RAILROAD CAR


HECLA
MINING COMPANY
MILL
SURFACE PLANT
HOIST
BLDG.
NO. 2 SHAFT
LUCKY FRIDAY
MINE
Mullan, Idaho


CANADA
WASHINGTON
IDAHO
MONTANA
LUCKY FRIDAY MINE
1 MILE EAST OF MULLAN
ON U.S. 10
COEUR D'ALENE
SPOKANE
KELLOGG
WALLACE
MULLAN
U.S. 10
U.S. 10
MISSOULA
Famous Coeur d'Alene
Mining District

The Lucky Friday Mine

The Lucky Friday mine east of Mullan, Idaho is an outstanding example of a property in the famous Coeur d'Alene Mining District where a small and insignificant-appearing silver-lead-zinc vein discovered on the surface has been developed at depth into a large vein of great importance. The Lucky Friday vein has little, if any, surface expression and above the 1200 level the ore shoots are small and discontinuous. Between the 1200 level and 4250 level, the lowest developed level, the main ore shoot has shown remarkable improvement on each succeeding lower level, and today the mine is one of the major lead-silver producers in the Coeur d'Alene district.

The principal claims of the Lucky Friday group were located between 1899 and 1906 and patented in 1926. During this period the property was held by two different companies, and the claims were explored by trenching and shallow underground workings. This early work was not encouraging, and the property remained idle from 1927 to 1938 when it was acquired by the Lucky Friday Silver-Lead Mines Company.

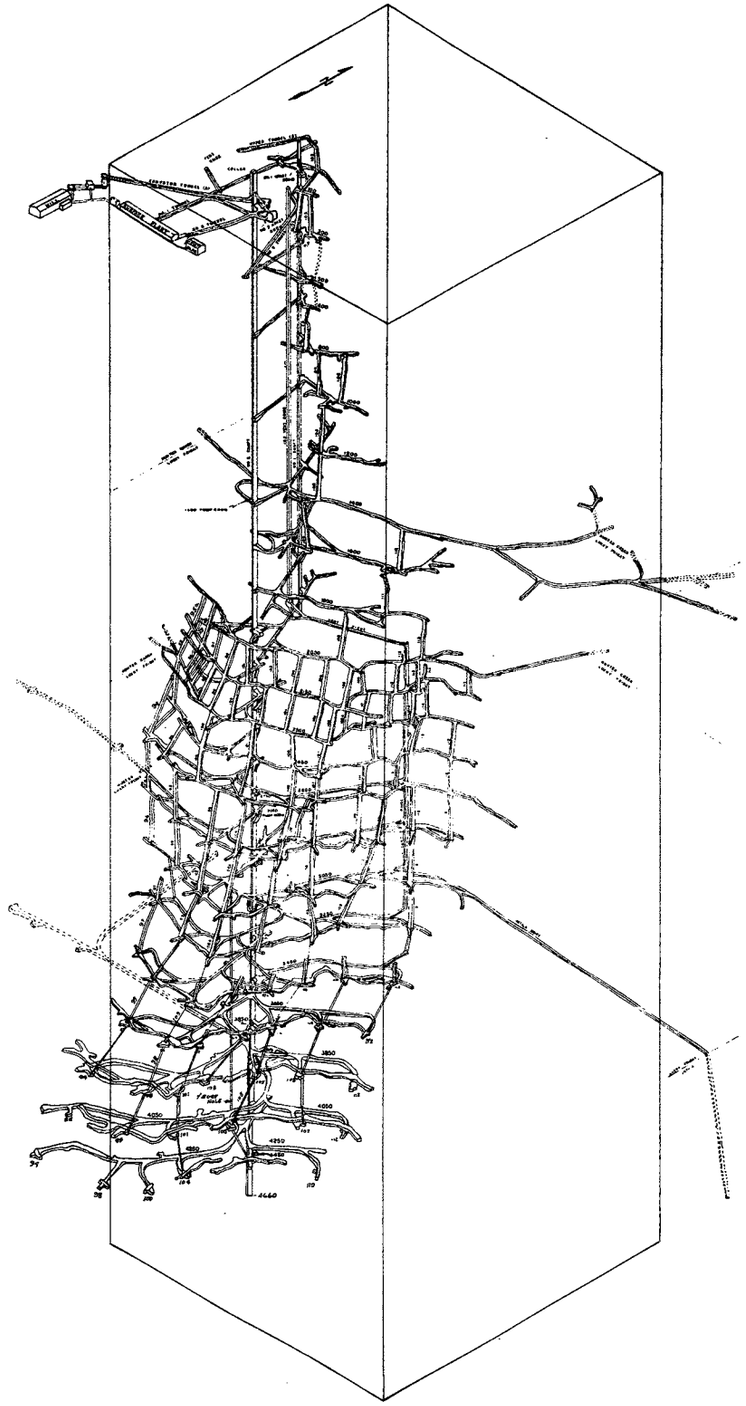
This company was incorporated in 1939, and a shaft was started from the tunnel level to explore and develop the vein at depth. The first commercial ore was found on the 300 level in 1941 in a narrow ore shoot which was only 25 feet long. However, deeper exploration continued without interruption, and the vein has now been developed to a depth of 4,250 feet. Since the first ore shipment of 500 tons on January 30, 1942, the net smelter returns have totaled approximately 149,315,000 as of December 31, 1974.

The Lucky Friday mine has recently experienced two periods of major expansion. The first period (1953-1957) consisted of a new 3,161-ft. three-compartment shaft, a 400-h.p. double drum hoist capable of hoisting from a maximum depth of 3,000 feet, a new mine water pumping system capable of pumping 700 gallons of water per minute, and the development of ore reserves of about 750,000 tons. Production during this period was gradually increased to a rate of 180 tons per day.

The second period of expansion took place in 1959 following development of the 3050 level, which resulted in sufficient ore reserves to warrant construction of a new and modern mill. This program was designed to increase tonnage to about 750 tons per day at an investment of about $1,000,000. The construction program consisted of the following: A new 750-ton per day concentration mill, an underground conveyor system to eliminate track haulage from the shaft to the mill, surface plant buildings, and an underground sandfill system.

The most recent improvement at the mine was installation of a new 1250-h.p. Nordberg double-drum hoist, designed to maintain mine production at approximately 750 tons per day at depths below the 3050 level. The hoist is capable of 5,000 feet of vertical depth. It hoists 5-1/2-ton capacity skips at a speed of 1,750 feet per minute and was installed at a cost of about $500,000.

In 1964, Lucky Friday Silver-Lead Mines Company was merged into Hecla Mining Company.



The Lucky Friday Mine

The Lucky Friday mine employs 211 men and produces 700 tons per day of mine run ore on a five-day-a-week basis. The day shift and the night shift are the two production shifts. A small crew on the graveyard shift takes care of necessary shaft repairs and miscellaneous work. The mill operates on a 24-hour/three-shift basis, on the same five-day-per-week schedule. The breakdown of employees is shown as follows:

Underground crew.	168
Service crew (electricians, mechanics, yard, etc.). .	11
Mill crew	10
Engineering and geology, office and supervision. .	22
Total	211

The ore occurs in a tabular "vein" or fissure, varying in width from a few inches to several feet. The maximum length of ore developed on the vein is about 1,450 feet.

The ore is developed at vertical intervals (called "levels") by a system of laterals, crosscuts and drifts. The levels are connected by driving openings called "raises", at intervals along the vein.

The resulting ore "blocks" are then "stoped" (mined out) by removal of successive horizontal slices, starting at one level and working gradually up to the next level. After each slice is removed, the resulting void is sand-filled (using mill tailings). The next slice is then mined, using the sandfill as a floor.

Broken ore is hauled to the shaft, hoisted to the surface, crushed, ground, and concentrated in the mill by a flotation process.

The mill produces a silver-lead concentrate and a zinc concentrate. The concentrates are shipped to the Bunker Hill Company smelter near Kellogg, Idaho. The smelter extracts the final product of the metals as silver, lead, and zinc.

The mining industry is constantly faced with the problem of maintaining production through development of additional ore reserves. Otherwise, the ore will be completely depleted and the miner out of business. A mine is quite unlike a trading concern in which the merchant continuously replaces his inventory of saleable merchandise, thus enabling him to remain in business.

The miner is therefore engaged in a high risk industry with a limited life, unless he is able to discover and bring into production profitable new ore to replace that which he is presently depleting.

SILVER, COPPER, LEAD AND ZINC MARKETS
AND
HECLA MINING COMPANY

BY PHILIP LINDSTROM, INVESTMENT MANAGER, HECLA MINING COMPANY

Presented before the Portland Society of
Financial Analysts - February 19, 1976
Benson Hotel, Portland, Oregon

Good afternoon, and greetings from Wallace, Idaho, the silver capital of the world.

I come as a miner and an American, not to present a scientific and technical speech, but to talk plainly about our fascinating business. If you want to delve deeper into the economics of silver, for instance, I suggest that you read my annual review on silver published again in the March, 1976 issue of Engineering and Mining Journal.

If you will leave me your business card or address, I'll send you a copy.

THE MINER'S PLACE IN SOCIETY

We miners, and that includes all the people involved in extraction starting with geologists and ending with metallurgists, produced only about $5 billion worth of raw metals in the U.S. last year, although the value of all mineral raw materials including fuels was $63 billion, or 14% more than in 1974. This doesn't look like very much when compared to our Gross National Product of $1500 billion.

Imagine, making so much fuss over metals when they amount to only 1/3 of 1% of G.N.P.!

However, we must import $21 billion of mineral raw materials which, when combined with the $63 billion is the basis for the subsequent production of over $270 billion a year in energy and processed materials.

SOME ECONOMIC NOTES

As I drove the 85 miles from Wallace to the Spokane airport and jet-planed over here in less than an hour, I marvelled at what technology has made possible. It would have been impossible without metals. Therefore, we miners expect to be around for a long time.

The earth and its resources have been barely tapped. We can soar to the moon, but we can't go into the earth 3 miles. Even so, I marvelled that Hecla miners reached 8,000 feet below the surface in the Star mine at Burke, Idaho last month.

People who say that we are running out of resources and say that there is or will be a shortage make me disgusted. Such small-minded concepts stem from negative types of people, or lack of knowledge and straight thinking.

I've been asked why we don't leave everything in the ground and save it for the future. "What if this had been done in the past?", I retort. This reply usually turns on the light.

There is no shortage of anything. What is usually meant - there isn't enough for someone who wants to pay too little.

Pricing has a wonderful way of balancing supply and demand in a free market.

Substitution is a fine way for people to adjust to an economic burden. Wasn't it sad how we ran out of whale oil and buffalo chips? Yet, we found even better substitutes in kerosene, gas and electricity. Many exciting developments lie ahead - even in mining technology we've barely started; using such tools as physics and chemistry.

Let's reflect on our Nation's place on the globe. We have about 5-1/2% of the population, 7% of the land and consume about 25% of the raw materials. Yet we produce 40% of the world's new wealth. The net result is the export of goods, services and capital.

THE AMERICAN WAY OF LIFE

It is especially appropriate in this 200th birthday-year that we pause and reflect how much has been done under the great system of free enterprise and liberty that our forefathers have left us. Beware of the liberals, socialists, communists, Keynesians and other travelers who would feed you their false ideologies of state planning, government regulation, central controls,

deficit spending, fiat money creation, price controls, higher and higher taxes, confiscation of property and loss of liberty.

If you want to strike a blow for freedom this year, I suggest that you start by writing to The Foundation for Economic Education (FEE) at Irvington-on-Hudson, New York. They will send you the monthly magazine "The Freeman" at no charge.

The way I look at this world is that we should all be working for each other. A consumer must also be a producer in the life-cycle. Our biggest and most costly problem is politicians and academic types who interfere in commerce by frustrating trade between people. Your elected officials need help. Why not give the good ones more support and vote the free-spending liberals out?

THE MINER'S PROBLEM WILL BE YOUR PROBLEM

We miners have a big problem and that's why I've been talking as I have these past few minutes.

There is absolutely no reason to mine except that somebody wants the metals and will pay for them. So long as we can find metals and make a profit we will do so, and the world's people will live better. We can find metals only where God put them and He made them once. There is no alchemy or way to make gold, silver, copper, lead and zinc.

The next fact of life that confronts the miner is that he must have free access. The highest use in most cases exists in the value beneath the surface and in most cases all other uses can be enjoyed simultaneously.

I submit that economics is part of the ecosystem. J. Allen Overton, Jr., President of the American Mining Congress, has pinpointed one of the pressing problems that our nation is facing when he said:

> "Bit by bit, acre by acre, vast tracts of the public lands of the United States are being withdrawn from entry for mineral exploration. The various federal bureaus and agencies have sharply accelerated this

"withdrawal process since 1968, without coordination and without regard for the cumulative effect on future production of metals and minerals from domestic sources.

"Unbelievable as it may seem, an area larger than that encompassing 25 of the 27 states east of the Mississippi River is no longer accessible even for mineral exploration, not to mention development for mining. That is to say, no longer accessible for mineral exploration is a land mass equivalent to Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, New Jersey, Delaware, Michigan, Ohio, Illinois, Indiana, Kentucky, West Virginia and Virginia, Maryland, North and South Carolina, Tennessee, Mississippi, Alabama, Georgia and Florida. We're talking here about over 390 million acres of public lands that are not open to exploration under federal mining laws and over 520 million acres not open under the mineral leasing laws.

"Significant additional acreage can be considered withdrawn due to the severe restraints upon exploration; these are de facto withdrawals.

"Much of this withdrawn land is in regions where mineral deposits of economic significance are most likely to occur - in the western United States and Alaska especially.

"Accelerating demand worldwide for minerals will inevitably require heavy reliance by the United States on domestic sources. This it would appear that this trend to 'lock up' public lands that are an essential part of the nation's potential mineral base is contrary to the national interest.

"It is our responsibility to carry this message to our national leaders and to the people.

"The trend must be reversed. The task will be difficult, but it is one of utmost importance."

One of the major reasons this situation has occurred is the lack of any mechanism for assessing the cumulative impact of thousands of discrete withdrawal actions. Each interest group working to have more land withdrawn does not consider the cumulative impact of its, and other group's, successful efforts. Rather, it tends to see its own reasons for withdrawing lands as more important and more in the national interest than land needs for mineral exploration and development.

These withdrawals have long-term consequences and may not be felt for several decades, as our failure to evaluate resources catches up with us and we are at the mercy of foreign cartels of supply and prices instead of giving to our land the wise and careful use that it should have.

HECLA MINING COMPANY

Turning to Hecla Mining Company, I must say that we are a 78-year-old Washington Corporation with an Idaho history known for its production of non-ferrous metals such as gold, silver, copper, lead, zinc, uranium, cadmium and antimony.

Presently, a total of 2,500 people are working at mines such as the Lakeshore copper mine in Arizona, Lucky Friday and Star in Idaho's Coeur d'Alene mining district and Ace Concrete in Spokane.

There are over 16,000 shareholders and the 6.7 millions shares are widely held except for about 17% owned by The El Paso Company.

Over half of Hecla's metal sales income is derived from silver. Half of the Lakeshore copper sales will be to Hecla's credit and will therefore have greatest effect on earnings.

Hecla is a western company with interests in the western states and in British Columbia through the 35%-owned Granduc Mines and a major interest in a 300-million-ton 1/2% copper ore body known as Liard-Schaft Creek.

LAKESHORE MINE

El Paso Natural Gas Company in early 1968 discovered, by drilling, a major porphyry-type copper ore body.

Hecla was successful in obtaining a half interest in the deposit, which is on the Papago Indian Reservation 30 miles south of Casa Grande, Arizona. The price was 1 million shares of Hecla stock and agreement to develop and operate the mine and plant and finance the project.

Later, to expedite the project, El Paso supported 50% of the financing.

Originally, it was thought that the waste material and low grade could be removed so that the mine could be an open pit.

A combination of separate higher grade copper oxide and higher grade copper sulfide ore bodies made the underground concept more economic because of lower capital outlay and quicker capital return.

Lakeshore Development

In December, 1969, 2 parallel 15° sloping declines 100 feet apart were started and ultimately were driven 1-1/2 miles each. The sulfide ore will be transported on a conveyor in one of the declines. A standard gage railroad is in the other decline.

Oxide ore is hoisted thru a vertical 14-foot circular shaft and 12-foot diameter vertical bore holes are used for ventilation.

Target production is 65,000 tons of copper per annum contained in 30,000 tons of electro-won cathodes produced at the mine site and 35,000 tons in cement copper which will be shipped to an ASARCO smelter. These precipitates contain about 60 to 70% copper in pellet form.

The total project cost, including $15 million working capital, is $195 million. Duplication of this mine development and plant would be now over $300 million.

The Mine

The Lakeshore ore body essentially consists of 3 parts. The central core is a thick sulfide zone comprising typical porphyry-type mineralization. Tactite sulfide ore occurs at the base and marginal to the thick sulfide zone, and an oxide ore zone, formed by oxidation of a secondarily enriched chalcocite blanket, overlies the thick sulfide zone and is marginal to it on the northwest. In the early stages of the operation, the thinner tactite sulfide ore will be mined, while the thick sulfide ore is developed for mining in later stages. The oxidized ore will be mined concurrently with the tactite sulfide ore and later with the thick disseminated porphyry ore. The mine is being developed to produce 11,000 tons per day of sulfide ore and 6,500 tons per day of oxide ore.

Sulfide ore will be mined by a caving method and transported to an underground primary crusher. After coarse crushing, the sulfide ore will be moved to the surface coarse ore stockpile on a 42-inch, 7200-foot belt conveyor installed in one of the declines.

Oxide ore will be mined by a panel-caving method and trucked from the vertical shaft to the coarse ore stockpile area.

Surface Plant

The oxide and sulfide ores will be crushed in a secondary crushing plant.

A 6,500-ton-per-day vat leaching plant will treat oxide ore by leaching with sulfuric acid followed by precipitation of copper with sponge iron.

An 11,000-ton-per-day flotation concentrator will produce 400 tons of copper sulfide concentrate per day. This concentrate will be treated by roasting, leaching, and electrowinning. The electrowon cathodes will be shipped to Southwire for fabrication into wire. The sulfide concentrate roasting operation will also produce 200 tons of by-product sulfuric acid per day which will all be consumed in the oxide ore leaching operation.

The sulfide concentrate treatment facility will also produce 250 tons per day of an iron-bearing by-product, which will be converted into sponge iron used in the treatment of the oxide ore.

Hecla has financed its half of the project from earnings and $48 million of revolving credit notes from 4 major banks lead by Chase Manhattan Bank. The loans will be converted into 5-year term notes payable in semi-annual installments.

The Lakeshore mine is a very unique situation where oxide and sulfide ores can be mined in balance so that copper can be produced in final form at the mine site without a smelting contract.

Production is gradually growing as the caving system evolves.

Copper prices of 63¢ for cathodes are sufficient for cash flow but will not cover debt repayment. However, this current price is about the lowest in 40 years, relative to U.S. mining costs, and are considerably below average price trend.

Copper Economics

Copper is one of the most important industrial world commodities and will become increasingly so. Our country is fortunate in being nearly self-sufficient in copper. The state of Arizona produces more copper than any other nation except Russia.

I've included an Arizona Mining Association pamphlet called "Copper Facts" in the packet of material for you today.

World mine production in 1975 is estimated by Copper Studies at 8.1 million short tons, a fall of nearly 7% from the 1974 peak of 8.7 million tons. Free world mine production dropped 9% from 6.9 to 6.3 million tons and U.S. mine production dropped 12% from 1.6 to 1.4 million tons. Lakeshore production will be 4% of U.S. mine production.

World refined production, which includes some of the scrap recovery, likewise fell; 7% from the peak 9.8 million tons to 9.0 million tons.

World consumption of refined copper fell by 13% from 9.3 million tons in 1974 to 8.1 million tons in 1975. The peak consumption year was 1973 when world refined consumption was 9.7 million tons.

The sharpest consumption cuts have been in North America and Japan, and are the most severe in the post-war period, or 37% in the last 2 years.

Now, we come to the real problem that affects all commodities, the world copper stock build-up.

1975 year-end inventories are about 2.2 million tons in the non-socialist world. Of course, working stocks are necessary, so these stocks represent less than 2 months' consumption and would quickly disappear as demand picks up. There will be an over reaction as consumers rush in to rebuild their inventories.

Copper prices have been fluctuating in a 2 to 4-year cycle. London Metal Exchange prices, the basis for our Granduc Mines sales to Japan, were at a peak of $1.52 in early 1974, dropped to a low of 52¢ and are 54¢ now. The U.S. producers' price is on an average lower than LME. After U.S. price controls severely distorted the market, the producers' price rose from 50¢ in 1972 to 87¢ in 1974 and is now at a very depressed 63¢ per pound.

You might ask how a U.S. miner can get 63¢ for his copper when the world price is 9¢ less. The difference is not that great because it costs perhaps 5¢ to import the copper. The big factor is the availability of copper for customers who stick with a supplier and the chance, then, to buy at a relatively low price when the demand is great.

Stockpile

A very significant factor in the next copper cycle price increase will be the absence of the U.S. strategic reserve.

After the Korean war, we wisely accumulated metals, including copper, so that we wouldn't be at the mercy, and delay of foreign shipments. Political weakness caused the destruction of our defense copper stocks. What was once 1 million tons was reduced 500,000 tons by President Johnson and his Congress, and finally the last 1/4 million tons was sold by President Nixon and his Congress. The copper held by individuals and banks in commodities warehouses will not be as easily given up because it is in part "monetized" as a hedge against inflation.

Copper's Future

Population growth of 2.8%/year compounded in 25 years will be double. About 25% of the energy we use now is electrical and this is expected to double to 50%. We can expect a 4-fold increase by the year 2000. Electricity can be generated in so many different ways and is very dependent on copper.

Aluminum has taken most of the copper uses on transmission lines, so this substitution is over.

Copper production requires only about a third of the energy required to produce an equivalent amount of aluminum. Therefore, rapidly rising energy costs has reduced aluminum's competitive position on price.

Copper Miners' Problems

One of the biggest problems, after finding the ore, is the difficulty in raising capital. A few years ago, most mining companies had no debt. Now, many are at debt limits and the copper price must rise to take care of capital needs. A 90¢ price is now needed to justify new production.

A huge problem in copper economics is the government control of perhaps 40% of free world production. Where private enterprise cannot survive without profit, production at any cost may be more important to governments run by planners with social objectives rather than efficiency and economic restraints. Their production excesses not only eventually burden themselves

but the rest of the world's producers because they take the consumer for all they can and frustrate the carefully-engineered uses of copper.

Too much of the producers' income is being taken for social programs thru "transfer" payments.

Increasing concern for the environment has caused curtailed output, great-non-productive capital expenditures and raised havoc with smelting and refining operations. Much of the EPA restrictions are needless because they are beyond practical and commercial feasibility.

Production costs will finally have an effect on price. There will be plenty of copper for those who will pay for it.

Outlook

Price predictions are an exercise in futility. There are too many unknown variables that effect metal prices. When we see increased industrial use and decreasing inventories we can expect a price increase.

Hopefully by year end 1976, copper prices will be rising. There are signs of increasing automobile and industrial production.

The next full price swing may peak at over $2.00 per pound in London because of inflation and the myriad factors that bring higher copper price. Let us hope that war is not one of the factors.

It is interesting to note the tell-tale exposure that metallic money does to show the decreasing value of inflating fiat money. The U.S. penny has an intrinsic value of contained copper and zinc in excess of its 1¢ face value when the copper price is over $1.52. We can expect Gresham's law to operate just as it did when silver coins became more valuable for metal content than face value.

I think that in view of the thieving nature of governments we will find an ore reserve of copper in the United States of growing value with time.

SILVER

About 40% of the nation's silver is mined in the Coeur d'Alene mining district.

Silver price volatility in 1975 exceeded that of any previous year except the record 1974 fluctuations.

Silver closed 1975 at $4.16 per ounce for an annual 21 cent decrease, compared with the 1974 advance of $1.11. The price dropped below $4.00 in January, rose to a peak of $5.22 in August and dropped below $4.00 again in December. The average Handy & Harman price in 1975 was $4.42 vs. $4.71 in 1974.

There is no shortage of silver. Inventories in New York, Chicago and London commodity exchange vaults total 85, 40 and 16 million ounces, respectively.

Notable in silver economics is the 1975 gap of 120 million ounces between an estimated 235 million ounces of new free world production and 355 million ounces of consumption. This gap is closed by refining of old scrap and coins and the reduction of above-ground inventories.

Another peculiarity of silver is the relative ineleasticity in both supply and demand. Over 75% of mined silver production is a by-product of base metal production and there is insufficient primary silver production available to meet price increases.

Silver is also relatively inelastic in demand because so little silver is required in many uses such as photography, electronics and plating. Therefore, pricing does not have a direct effect on such uses.

In 1958, our government held 2,300 million ounces of silver. This has been all sold except for only 139.5 million ounces in the strategic reserve. There is not much chance that this silver sill be released in 1976.

The combined forces of uncertain monetary developments, speculative interest, decreasing production and consumption and a June 30, 1976 unbalanced U.S. budget of over $74 billion indicates a rising trend in price with volatile movements.

LEAD AND ZINC

These 2 fine industrial metals, too, have their inventory and political problems. There is pricing pressure, but demand and inflation will carry the price upward. The lead battery outlook is very good. Tetraethyl lead remains an important use, and the salvage is excellent.

Zinc use in galvanizing has great potential, and world producers maintain good production discipline.

Americans today consume 4-billion tons of minerals a year. In 1950 it was 2-billion tons, but by the year 2000 mineral consumption may well reach 10-billion tons!

U.S. dependence on raw materials has grown from 16% in 1950 to 25% today. We welcome trade but not to the point of our vulnerability.

U.S. dependence on foreign sources of oil rose from 13% in 1948 to 36% in 1973 and it is even higher today. Let's hope that we don't let the Arab oil lesson be repeated in metals and minerals.

We miners have to be optimists or we wouldn't be in business.

PROPOSED PLANT SURFACE FACILITIES

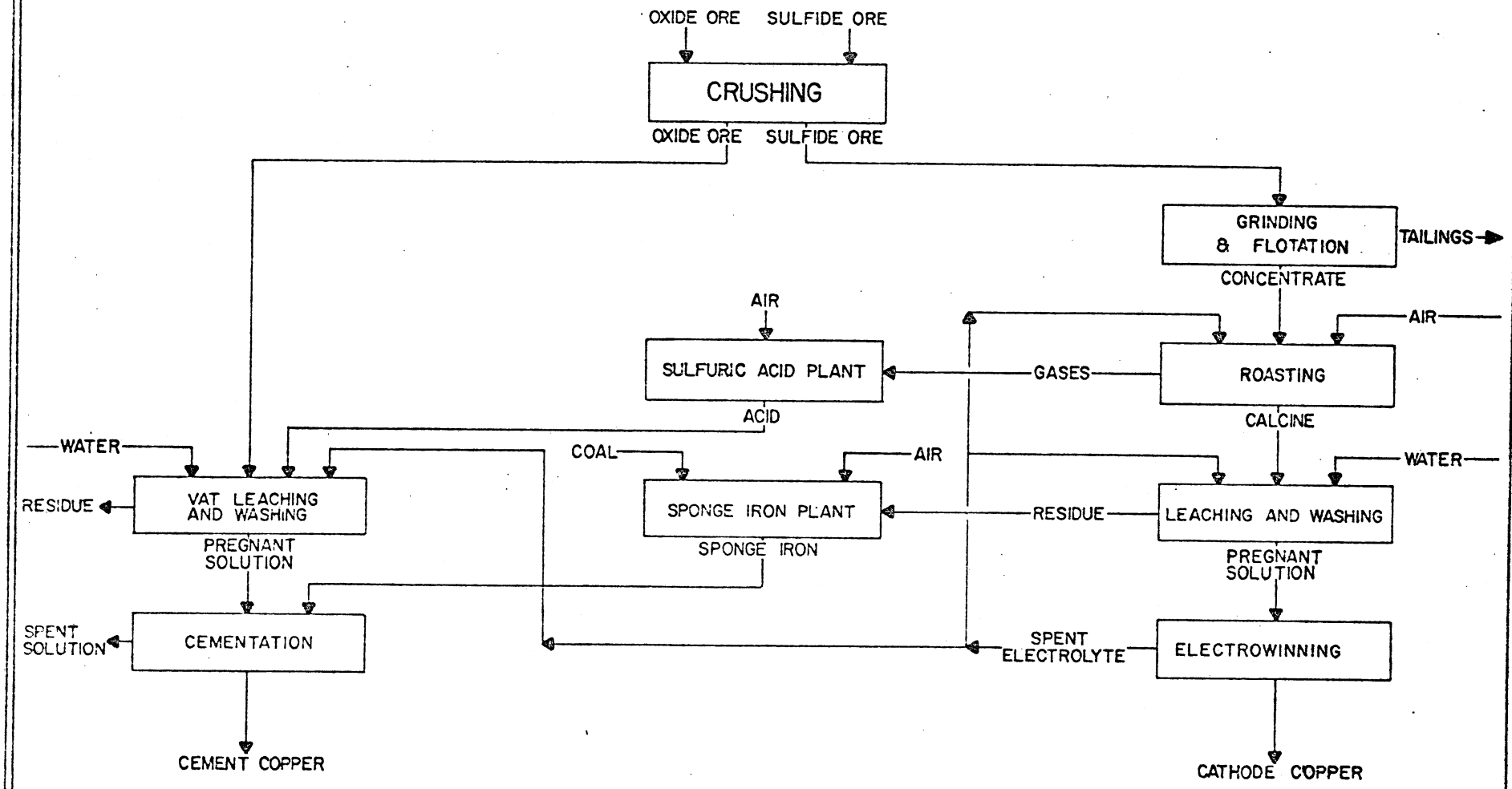
HECLA MINING COMPANY

LAKESHORE MINE

CASA GRANDE, ARIZONA

1974

Lakeshore Project
Plant Flowsheet



L A K E S H O R E

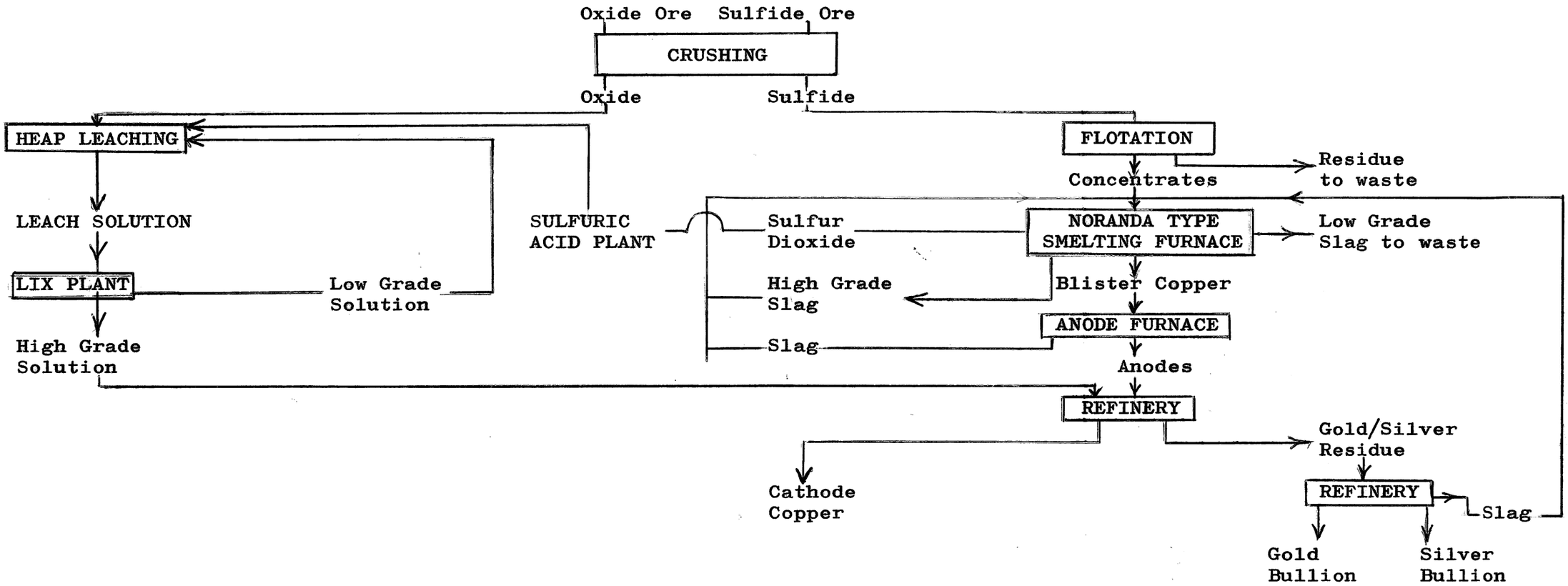
AT A GLANCE

Location:	Slate Mountains 28 miles south-southwest of Casa Grande, Arizona 70 miles south of Phoenix, and 60 miles northwest of Tucson
Elevation:	1,900 feet above sea level
Ecosystem:	Typical Sonoran Desert
Temperature Range: (1970-1973 records)	22° F Low 116° F High
Annual Precipitation:	8 inches
Property:	10,500 acres
Ownership:	Leased from The Papago Tribe by El Paso Natural Gas Co. (50%) and Hecla Mining Co. (50%)
Operator:	Hecla Mining Co.
Work Force:	1,200 maximum (construction and development phase) 1,200 (production)
Mining Method:	Underground
Ore Treatment:	Hydrometallurgical
Planned Production:	11,000 tons/day sulfide ore 6,450 tons/day oxide ore

SUGGESTED LAKESHORE FLOWSHEET

11/13/75

To Improve The End Product

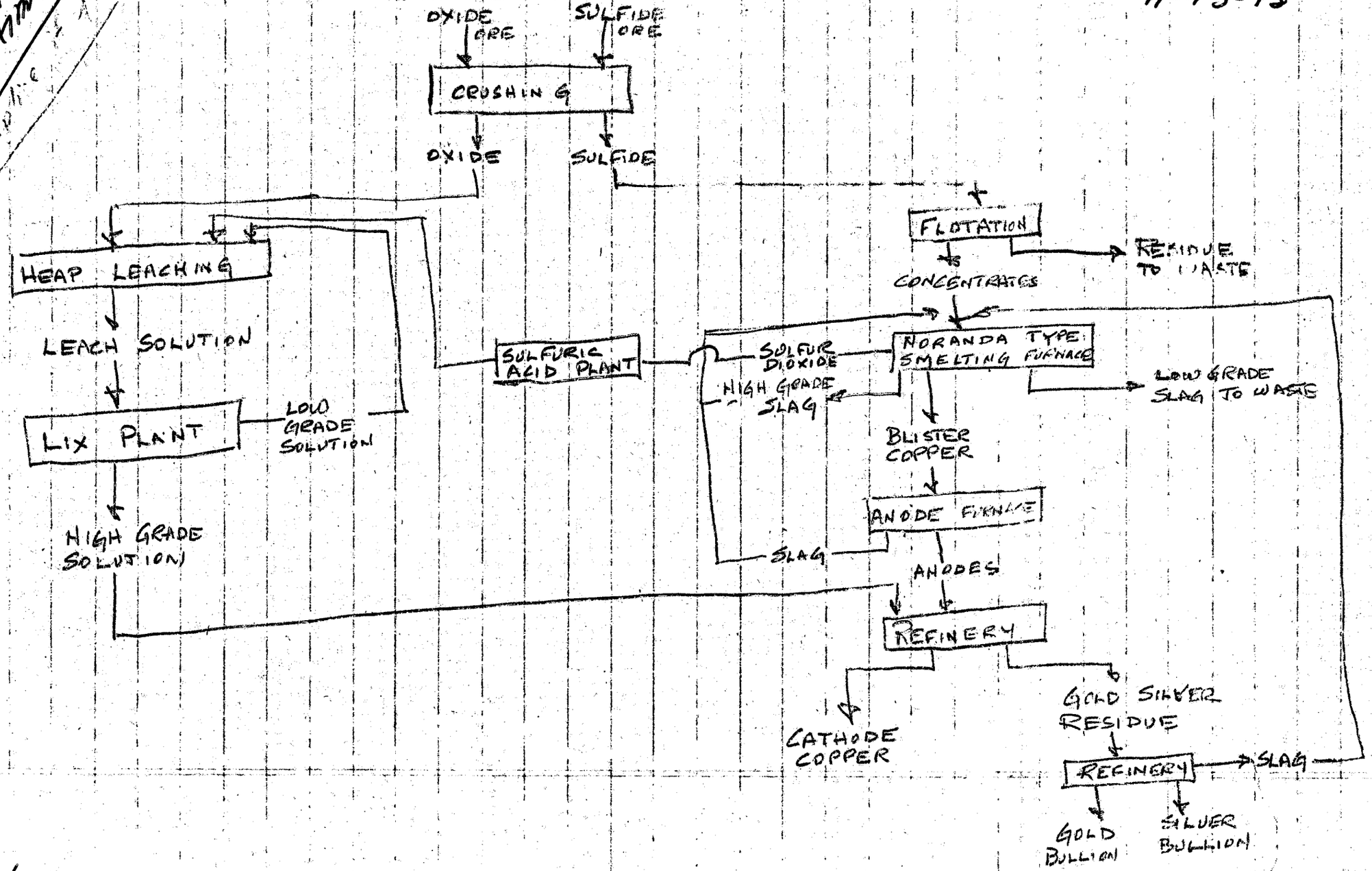


LJL/rpj

Tom
Please type
if you get time

SUGGESTED LAKE SHORE FLOW SHEET
To Improve the end Product

11-13-75



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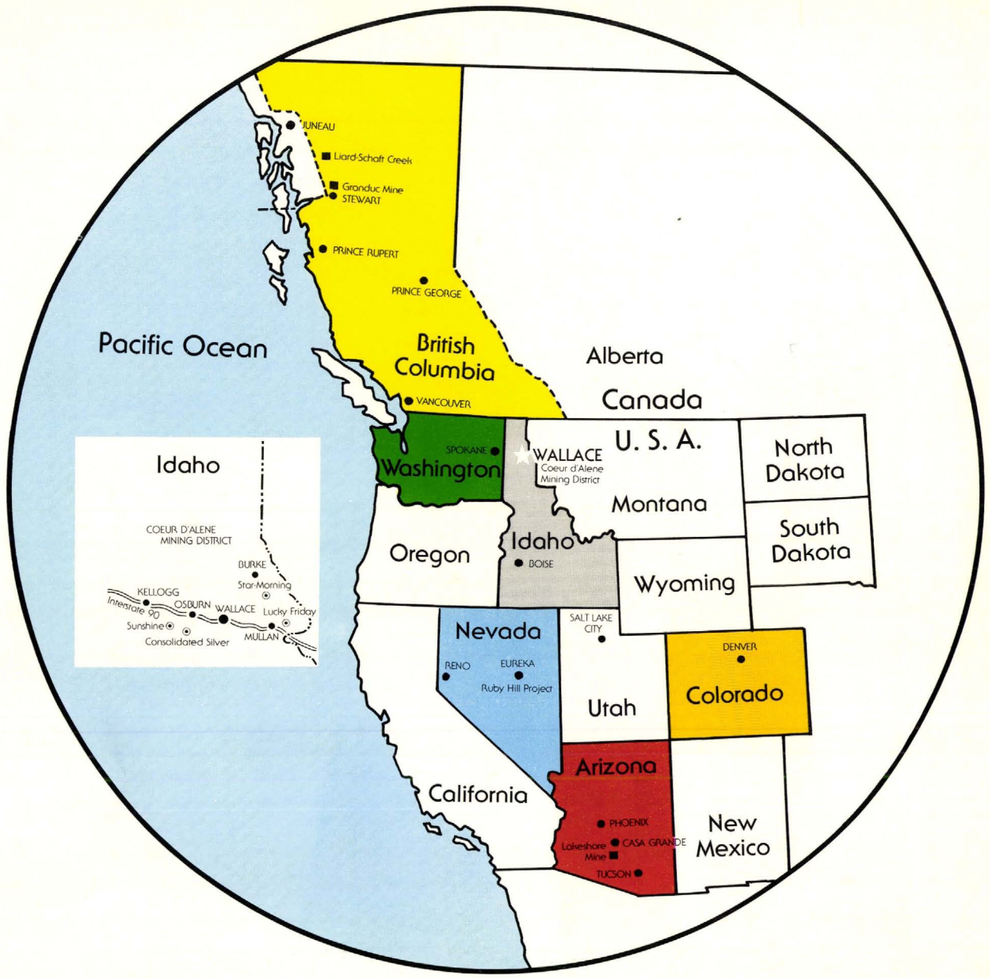


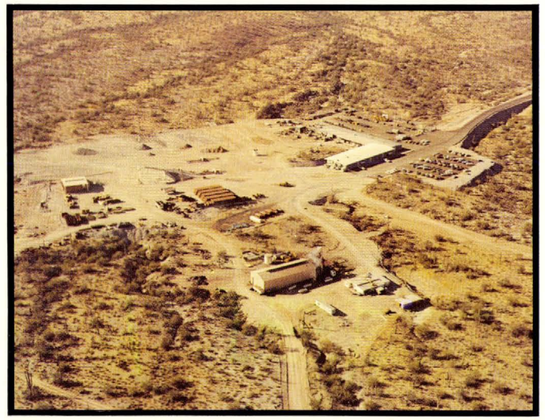
LOCATION INDEX

- British Columbia: Granduc Mine
  Liard-Schaft Creek Project
  Vancouver—Exploration Office
- Spokane, Washington: Ace Concrete Co.
- Wallace, Idaho: (Four Mines on Insert Map)
- Nevada: Eureka—Ruby Hill Project
  Reno—Exploration Office
- Arizona—Lakeshore Mine
- Colorado: Denver—Exploration Office

See Report for Description of Above Operations

HECLA MINING COMPANY ANNUAL REPORT 1975

About the front cover—
Aerial view of the Lakeshore Copper Mine's surface facilities, looking northerly, as they existed in November 1975 with production to commence during the first quarter of 1976. In order to illustrate the progress made since development started over six years ago, previous aerial views are shown below.



This is a copy of the photograph on the cover of the 1971 annual report, looking southerly, showing the major portion of the surface facilities supporting the underground activities. The entrances to the declines and the hoist house are shown in the left center and the office shops in the right center. The roast-leach-electrowinning pilot plant and assay laboratory are shown in the foreground.

This is a copy of the photograph on the cover of the 1969 annual report, looking southerly. This showed the initial activity at the Lakeshore mine site—preparing to drive the twin declines for access to the underground ore zone.

Officers

William H. Love
President and Chief Executive Officer
Gordon M. Miner
Vice President—Operations
Herbert E. Harper
Vice President—Exploration
William A. Griffith
Vice President—Metallurgy
William J. Grismer
Vice President—Finance & Sec.-Treas.

Directors

*Horton Herman
Partner in Paine, Lowe, Coffin, Herman and O'Kelley, Attorneys at Law, Spokane, Washington.

**William H. Love
President and Chief Executive Officer of Hecla Mining Company, Wallace, Idaho.

William T. Pettijohn
Senior Staff Consultant with engineering firm of Parsons-Jurden Corporation; formerly General Manager of Mines with New Jersey Zinc Company.

*Lester J. Randall
Formerly Chairman of the Board of Hecla Mining Company (Retired December, 1972), Worley, Idaho.

Edward McL. Tittmann
Formerly Chairman of the Board and Chief Executive Officer of American Smelting and Refining Company (Retired April, 1971), Reno, Nevada.

W. Burney Warren
Director, Executive Vice President and Treasurer, The El Paso Company, whose principal business (generally operating through subsidiary companies) is the production, distribution and marketing of natural gas, manufacture of petrochemicals and the production and marketing of fabrics and copper products.

*Member of Executive Committee
**Chairman of Executive Committee

Management Staff

Corporate Headquarters and Idaho Operations Wallace, Idaho
President and Chief Executive Officer William H. Love
Vice President—Operations Gordon M. Miner
Vice President—Exploration Herbert E. Harper
Vice President—Metallurgy William A. Griffith
Vice President—Finance and Secretary-Treasurer William J. Grismer
Chief Engineer Wallace E. Crandall
Controller and Assistant Treasurer Thomas T. Giles
Investment Manager Philip M. Lindstrom
General Mill Superintendent Bill E. McKee
Assistant Secretary Wayne L. Schoonmaker
Personnel Manager Gus Voltolini

Star-Morning Unit Burke, Idaho
Manager William Anderson
General Mine Foreman Ray Sprute
General Mill Foreman Harold Sanders

Lucky Friday Mine Mullan, Idaho
Manager Arthur Brown
General Mine Foreman Norman A. Graham
General Mill Foreman Leland Pehan

Lakeshore Project Casa Grande, Arizona
General Manager James H. Hunter
Assistant General Manager George L. Wilhelm
Administrative Assistant Gilberto I. Valdez
Metallurgical Manager Paul M. Musgrove, Jr.
General Plant Superintendent J. Gordon Craig
Mine Superintendent Steve Milne
Chief Engineer Thomas W. Phillips
Administrative Manager Terrance L. Kiser
General Maintenance Superintendent Derk Perdock
Industrial Relations Manager Reinhold Leske

Ace Concrete Co.—Spokane, Washington
Manager William Mahorney

Exploration Offices
Vancouver, B.C.
Manager Philip I. Conley
Denver, Colorado
Manager James S. Hastings
Reno, Nevada
Manager William P. Johnston

(as adjusted for stock dividends) of authorized and unissued capital stock for that purpose. The options are to be granted for a period of five years, exercisable during the first two and one-half years as to one-half the number of shares and during the second two and one-half years as to the then remaining unexercised number of shares. Options for 88,332 shares (as adjusted for stock dividends) were granted in 1974 under this plan. No options granted under the plan have been exercised to date. Option status at December 31, 1975 is as follows:

	No. of Shares	Option Price Per Share	Option Price Total
Shares under option at December 31, 1975	88,332	$18.87 - $22.28	$1,773,538
Options presently exercisable	44,166	$18.87 - $22.28	886,769

No amounts are reflected in income in connection with the grant or exercise of options.

9. Pension Plans:

The Company and its wholly owned subsidiaries have pension plans covering substantially all employees. Total pension expense charged to income was $514,000 for 1975 and $526,200 for 1974. Based upon the latest actuarial information available, the unfunded past service costs were approximately $1,800,000.

10. Litigation:

On May 2, 1972, a disastrous fire occurred at the Sunshine Mine in which ninety-one miners lost their lives. As a result, suits were brought in Federal Court by certain of the widows and heirs of the deceased miners and a suit was also brought by Sunshine Mining Company claiming that certain manufacturers of products used in the mine and the U.S. Bureau of Mines were negligent in allowing certain flammable materials to be in the mine. Two of the manufacturers have filed third party complaints against Hecla and twelve others claiming that these parties had joint control with Sunshine and negligently failed to exercise due care as mutual agents and principals in the operation of the Sunshine Mine and asking for contribution in the event that the plaintiffs are successful in their claims. The Company and its counsel are preparing a motion for Summary Judgment, which they believe will result in dismissal of the Third Party Complaints against it.

It is the opinion of the Company and its counsel that the outcome of the suit above mentioned and of other miscellaneous litigation and proceedings now pending will not materially affect the operations or the financial position of the Company or of any of its subsidiaries.

HECLA MINING COMPANY ANNUAL REPORT 1975

Annual Report

of the Directors of
Hecla Mining Company
for the year ended
December 31, 1975.

Annual Meeting

The annual meeting of shareholders will be held at the Ridpath Hotel, Spokane, Washington, on Tuesday, May 4, 1976 at 9 A.M., Pacific Daylight Time.

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At year end 1975:
Shareholders of Record 15,772
Employees 2,513

Financial Highlights

	1975	1974	1973
Sales	$29,282,055	$28,917,379	$19,955,717
Net income	$ 5,953,699	$ 8,441,340	$ 4,235,204
Net income per share (1)	$0.89	$1.26	$0.63
Stock dividends per share	2%	2%	2%
Shares of capital stock outstanding at end of period	6,717,334	6,585,621	6,456,492

Note: (1) On weighted average of shares outstanding and adjusted to reflect 2% stock dividends paid.

To the Shareholders of Hecla Mining Company

Consolidated net income for 1975 was $5,953,699 or $0.89 per share. This compares with $8,441,340 or $1.26 per share for 1974. Earnings per share in both years have been adjusted for the 2% stock dividend paid in 1975.

The overall decline in earnings in 1975, as compared with 1974, was primarily the result of decreases in metal prices, substantial increases in contract charges for smelting our concentrates, increases in operating costs, and an increase in Hecla's equity in the net loss of Granduc Mines, Limited.

The average silver price during 1975 dropped to $4.42 per ounce from $4.71 per ounce in 1974 and reached its low for the year of $3.91 per ounce on December 15, 1975. The average lead price declined to 21.5 cents per pound from 22.5 cents per pound, and at year end was 19.0 cents per pound. The average zinc price increased to 38.96 cents per pound from 35.94 cents per pound, but in early January, 1976 dropped to 37 cents per pound.

During the year, new smelting contracts went into effect for lead-silver concentrates and zinc concentrates produced at the Lucky Friday mine. The new agreements were very substantially less favorable to Hecla than were the prior agreements, reflecting not only the effects of inflation on smelting costs, but also the high cost of environmental protection measures being forced on the smelters. It has also become more difficult to negotiate smelting contracts at favorable terms because of a sharp reduction in the number of competing U.S. custom smelters, a consequence of environmental protection and economic pressures.

Although our North Idaho mines operated normally throughout the year, the rapidly escalating cost of wages and fringe benefits, energy, operating supplies, and environmental protection measures have made it increasingly difficult to maintain satisfactory profit margins in these operations. It is only through the continued diligence of our employees and the ingenuity of our technical and supervisory staffs that we have been able to do as well as we have.

Hecla's equity in the net loss of 35.4% owned Granduc Mines, Limited, located in British Columbia, during 1975 amounted to $782,200, or $0.12 per share, compared with an equity in net loss of only $36,000, or $0.01 per share in 1974. A higher world copper price will be required for this venture to show a profit.

The Lakeshore mine in Arizona, a fifty-fifty partnership with El Paso Natural Gas Company, has started operations, and the rate of mining both oxide and sulfide copper ores will gradually increase over the next several months. The ore crushing plant, sulfide ore flotation concentrator, sulfide concentrate roast-leach-electrowinning plant, oxide ore vat-leach-cementation plant, and the reduction portion of the sponge iron plant were all started up without revealing any serious deficiencies. These plants are now in operation at a reduced scale matching the mine production. The remainder of the sponge iron plant will be ready to operate when required. Sales arrangements have been made for the total Lakeshore copper production, and the first

This amount must be recovered by the Lessees before any future share of defined net proceeds will be payable to Granduc.

On an accrual basis of accounting, which was adopted by Granduc Mines, Limited in 1973, such net proceeds amounted to a deficiency in the amount of $347,024 in the year 1975 as compared to income of $3,266,498 for the year 1974. After deducting costs and expenses including amortization of mine development and preproduction expenditures and depletion of mining properties, Granduc Mines, Limited reported an estimated net loss of $2,210,815 for 1975 and $101,602 for 1974.

Hecla has recorded, under the equity method of accounting, its 35.4% share of the allocable losses in 1975 and 1974. The Company's investment in Granduc as adjusted for changes in equity during the period of ownership is substantially equivalent to its equity in the underlying net assets of Granduc.

During the year 1974 and as a result of amendments to the Granduc Mines, Limited Articles of Association, a total of 693,000 5½% preferred shares were purchased by Granduc from Hecla Mining Company in exchange for unsecured notes, bearing interest at 5½% per annum, in the amount of the par value of the shares, together with unsecured notes for preferred stock dividend equivalents accrued thereon to date of purchase. In 1975, $278,378 and in 1974, $1,638,558 were received by Hecla in partial payment of principal of the unsecured notes received for par value of shares exchanged. Comparable amounts were disbursed by Granduc Mines, Limited in repayment of principal of advances owing to the Lessees.

It is uncertain at this time as to what extent and when further royalties from the Granduc Mine operation might be realized by Granduc Mines, Limited.

The auditors' reports on the financial statement of Granduc Mines, Limited as of December 31, 1975 and 1974 have been qualified "subject to the adequacy of future earnings to absorb the amortization of mine development and preproduction expenditures and depletion of mining properties".

7. Properties, Plants and Equipment comprise:

	1975	1974
Lakeshore copper property (see Note 2):		
Mining properties	$ 3,022,989	$ 3,172,989
Deferred development costs	44,548,969	33,390,760
Plants and equipment	56,745,747	44,886,815
	104,317,705	81,450,564
Other:		
Mining properties	1,639,234	1,639,234
Deferred development costs	3,413,874	3,371,155
Plants and equipment	5,875,626	5,662,366
Land	105,931	105,905
	115,352,370	92,229,224
Less, accumulated depreciation, depletion and amortization	10,523,669	15,248,047
	$104,828,701	$ 76,981,177
Depreciation, depletion and amortization:		
Charged to operations	$ 357,573	$ 354,300
Charged to deferred development costs	1,025,612	1,727,132
	$ 1,383,185	$ 2,081,432

8. Stock Options:

In April, 1970 the shareholders approved a stock option plan providing for the issuance of qualified stock options to officers and key employees at 100% of fair market value on the dates the options are granted and reserved 102,332 shares

	1975	1974
Computed "statutory" tax expense	48%	48%
Effect of percentage depletion	(23)	(17)
Minimum tax	5	1
Effect of loss of Granduc Mines, Limited	4	
State and local income taxes	2	2
Other	1	(1)
	37%	33%

For U.S. Federal income tax purposes the Company has operating loss carryforwards amounting to approximately $15,160,000 at December 31, 1975 with $2,560,000 expiring in 1977 and $12,600,000 in 1980.

6. Investment in Granduc Mines, Limited (N.P.L.):

	1975	1974
5½% redeemable cumulative preferred stock, 357,000 shares, $5 par value (100% owned), at cost	$1,650,846	$1,650,846
Common stock, 1,189,700 shares, (35.4% owned at equity)	3,683,942	4,466,142
5½% Notes Receivable (face amounts $1,551,500 and $1,796,755 Canadian)	1,434,895	1,713,273
	$6,769,683	$7,830,261

On October 1, 1965 Granduc leased substantially all of its properties in British Columbia, Canada for a term of 50 years (with an option to renew for 25 years) to Granduc Operating Company, a wholly owned subsidiary of Newmont Mining Corporation, and Asarco, Inc. Under the terms of the lease, the Lessees provided all necessary funds, services and equipment to put the mine into production, and such preproduction costs are not chargeable against Granduc Mines, Limited. Granduc receives a 22½% share of defined net proceeds realized from the Granduc Mine after the date of beginning operations. After 32,500,000 short tons have been milled the percentage is increased from 22½% to 25%. A total of 10,604,000 tons have been milled to December 31, 1975.

"Defined net proceeds" for any period are determined by deducting from the net smelter returns received in cash, the operating expenses and capital expenditures incurred during such period. Any deficiency in net proceeds is deductible from future net proceeds. The "date of beginning operations" was determined to be March 1, 1971.

The Lease Agreement of 1965 provides that a minimum of 80% of the first defined net proceeds received by Granduc Mines, Limited be committed to concurrent redemption of Hecla's shares of 5½% preferred stock, and prior advances made by the Lessees, plus dividends and interest, respectively, accumulating thereon after the date of beginning operations. Hecla waived dividends on its preferred shares and the Lessees likewise waived interest of 5½% on their advances for the period prior to the date of beginning operations.

From March 1, 1971 through December 31, 1973 there was a deficiency in defined net proceeds. The deficiency was recovered in early 1974 and thereafter a share of defined net proceeds became payable to Granduc, which 22½% share of defined net proceeds amounted to $4,272,844 (Canadian) in cash for results attained through the month of September 1974. A further deficiency in defined net proceeds resulted for the three months ended December 31, 1974, as a result of lower world copper prices and increased operating costs. Shares of defined net proceeds occurred twice in 1975 resulting in cash payments to Granduc of $200,637 (Canadian). The Lessees have reported a net deficiency in defined net proceeds at December 31, 1975, of which Granduc's 22½% share was $921,542.

cathode copper was shipped on January 26, 1976.

Total expenditures on the Lakeshore project to December 31, 1975 were $177,771,000, including start-up costs and working capital. The total Project costs to April 1, 1976, at which time the Lakeshore mine and plant will be placed on operational status, are presently estimated at approximately $195,000,000, including start-up costs and $8,300,000 of working capital. It is estimated that additional working capital of approximately $10,000,000 will be required to finance in-process and in-transit materials and accounts receivable.

Although the cost of bringing Lakeshore to production is higher than the $140,000,000 estimated in 1972, I consider that our staff has done an outstanding job in holding costs to this level in view of the drastic escalation of construction costs that has taken place during this period.

Expenditures at Lakeshore are being shared equally by Hecla and El Paso Natural Gas Company. Hecla borrowings for this purpose, under revolving credit agreements with participating banks, amounted to $43,200,000 at year end; the remainder of our share of the costs have been financed out of current earnings. Hecla's presently available line of credit amounts to $48,000,000.

We are hopeful that the present indications of an economic upturn will continue, with consequent favorable adjustments to the prices of silver, copper, lead and zinc. However, with the present depressed copper price, the Lakeshore mine operation will not realize a profit and is expected to generate only a nominal cash flow at full production rates. This situation will materially affect Hecla's earnings beginning with the second quarter of 1976.

The Board of Directors, at their regular meeting on February 13, 1976, voted to increase the number of directors from six to seven. At the Annual Meeting of Shareholders, Management proposes to nominate Mr. John R. (Jack) Williams to fill the vacancy so created. Mr. Williams was Governor of Arizona from 1967 - 1975 and will add a valuable dimension to the Board of Directors.

A description of Hecla's exploration and development activity, mining operations and interests, production analyses, metal markets and prices, and financial analyses are set forth on the following pages of this report.

Our sincere appreciation is expressed to our shareholders for their continued support, and to our employees for their loyalty, skill and continued efforts on behalf of the Company.

W. H. LOVE,
President

February 20, 1976

Description of Exploration and Development Activity

During 1975, Hecla continued its exploration activities in the search for new mineral deposits and mining opportunities. Efforts were directed mainly to the Western United States and Western Canada in areas considered favorable for the occurrence of gold, silver, copper-molybdenum, lead and zinc deposits.

The Company's principal exploration office is at the corporate headquarters in Wallace, Idaho. Other exploration offices are maintained in Reno, Nevada; Denver, Colorado; and Vancouver, British Columbia.

Expenditures on property examinations and exploration and development related to nonproducing properties amounted to $1,149,000 in 1975, as compared to $1,066,000 in 1974 and $866,000 in 1973. These figures include capitalized development expenditures of $43,000, $258,000 and $147,000, respectively, on the Liard-Schaft Creek copper-molybdenum property in British Columbia.

Investigation of several areas in Western Canada and Alaska were carried out during the 1975 field season and this work will be continued in 1976. Work in Canada included participation in a prospecting syndicate in the Northwest Territories and a joint-venture exploration project in the Yukon. No further drilling was done at the Liard-Schaft Creek property during 1975 because of the onerous Mineral Royalties Act proclaimed by the British Columbia government in October 1974 and the depressed copper price. Additional diamond drilling and bulk sampling for metallurgical test work are required before final feasibility studies can be made. No drilling is scheduled for 1976.

In the Coeur d'Alene District of Idaho, Hecla's exploration and development projects include the South Morning and the Alice Consolidated properties east of Wallace; the D.I.A., Abot North, and West Independence properties in the Lucky Friday and Star-Morning mine areas near Mullan; the Chester Area of the Sunshine Mine; and the Consolidated Silver property in the Silver Belt west of Wallace.

The South Morning property, owned by the Star Unit Area (Bunker Hill and Hecla), is being explored by Hecla under an agreement with Bunker Hill. The property lies south of the Star-Morning mine and covers a large block of ground bounded on the north by the Paymaster fault and on the south by the White Ledge fault. The area is being explored on the Morning mine No. 6 Tunnel level by a 1,600-foot westerly lateral and several thousand feet of diamond drilling. The lateral was completed in 1975 and drilling is now in progress. No significant mineralization has been found thus far.

The Alice Consolidated property adjoins South Morning on the south and west. A portion of this property lying south of the White Ledge fault and north of the Osburn fault was explored by a westerly lateral and diamond drilling from the Morning No. 6 Tunnel level. No significant mineralization was found and the agreement was terminated.

The D.I.A. project will explore the Lucky Friday Extension, Gold Hunter, Independence

conversion date are payable on December 31, 1976. Based on amounts of revolving credit outstanding at December 31, 1975, $4,320,000 of the Notes Payable to Banks have been reflected as a current liability.

It is anticipated that the Company will in the near future carry on discussions with the lending Banks concerning possible changes in the amount of the loans, terms and related matters.

In connection with the above Agreement the Company maintained an average of $8,727,500 in compensating balances with the lending Banks during the year 1975. Withdrawal of such amounts is not legally restricted.

4. Marketable Equity Securities:

In accordance with Statement No. 12 of the Financial Accounting Standards Board, the non-current portfolio of marketable equity securities is carried at the lower of cost or market at December 31, 1975. Marketable equity securities at December 31, 1975 consisted of the following:

	Cost	Market	Unrealized Gain or (Loss)
Sunshine Mining Company 3.7% owned	$2,574,087	$2,111,910	$(462,177)
Rosario Resources Corp...	203,890	413,712	209,822
	$2,777,977	$2,525,622	$(252,355)

To reduce the carrying amount of the non-current marketable equity securities portfolio to market, which was lower than cost at December 31, 1975, a valuation allowance in the amount of $252,355 was established by charge to shareholders' equity representing the net unrealized loss.

At December 31, 1974, the non-current portfolio of marketable equity securities was not required to be carried at lower of cost or market at the balance sheet date and was carried at cost. Marketable equity securities included in non-current assets had a market value of $2,670,599 at December 31, 1974.

The cost of securities sold is based on the average cost of all the shares of such security held at the time of sale.

5. Income taxes:

	Federal	State and Local	Total
The 1975 provision includes:			
Current	$	$ 132,000	$ 132,000
Deferred.....	3,111,800	181,200	3,293,000
	$3,111,800	$ 313,200	$3,425,000
The 1974 provision includes:			
Current	$ 439,900	$ 162,100	$ 602,000
Deferred.....	3,235,300	309,900	3,545,200
	$3,675,200	$ 472,000	$4,147,200

Deferred tax expense results from timing differences in the recognition of expenses for tax and financial statement purposes. The sources of the differences and the tax effect of each in 1975 and 1974 were as follows:

	1975	1974
Deferred mine development costs	$2,728,000	$3,197,600
Excess of tax over book depreciation	565,000	125,800
Other		221,800
	$3,293,000	$3,545,200

Total tax expense is less than the amount which would be provided by applying the U.S. Federal income tax rate of 48% to income before tax. The reasons for this difference (expressed as a percentage of pretax income) are as follows:

The price of copper continues to remain at severely depressed levels. At the present copper price the Lakeshore mine operation will not realize a profit, and is expected to generate only a very nominal cash flow at full production rates.

Under the Amended Agreement with El Paso Natural Gas Company, which became effective as of January 1, 1973, El Paso provided all the funds for development of the Property from that point of time until they equaled certain defined expenditures contributed by Hecla through December 31, 1972. This equalizing occurred in early 1974, and since that time each party has contributed equally to the further costs of development and construction at the property which will continue until the beginning of commercial production. Thereafter, Hecla and El Paso will each own a one-half share of production from the property and all costs of such production will be divided equally. Pursuant to the Amended Agreement, in consideration for El Paso having agreed to make contributions earlier than originally anticipated, certain additional tax benefits ($4,000,000) were allocated to El Paso.

Total expenditures on the Lakeshore project to December 31, 1975 were $177,771,000, including working capital and start-up costs. The total Project costs to April 1, 1976, at which time the Project will be placed on operational status, are presently estimated at approximately $195,000,000, including start-up costs and $8,300,000 of working capital. It is estimated that additional working capital of approximately $10,000,000 will be required to finance in-process and in-transit materials and accounts receivable.

3. Notes Payable to Banks:

In December, 1972, as amended in March, 1974, the Company entered into a Credit Agreement with certain major commercial Banks, under which the Company may borrow up to $48,000,000 in revolving credit notes with borrowings to be used to assist in financing Hecla's estimated share of cost to complete the development and construction required to bring the Lakeshore Property into production. Under the terms of the Credit Agreement, the Company must maintain a consolidated net worth of $48,000,000 and may not pay any cash dividends unless after giving effect to such payment, the sum of all such payments made after December 31, 1974 would not exceed 50% of cumulative Consolidated Net Income for the period from December 31, 1974 to the date of payment less the sum of $13,500,000. At December 31, 1975, the Company's net worth exceeded the net worth requirement by $20,274,000; however, no cumulative consolidated net income was available for cash dividend payment purposes. At the completion of the development and construction period, the revolving credit loans will be converted into five-year term notes, payable in semiannual installments. The interest rate on the revolving loans is 3/4 of 1% per annum above the Banks' prime commercial rate, which was 7-1/4% at December 31, 1975, with the interest rate on the term notes to be 1% per annum above the Banks' prime commercial rate. In addition, a commitment fee is payable quarterly at the rate of 1/2 of 1% per annum applied on the average daily unused portions of the revolving credit. The date of conversion of the revolving credit loan to a term loan is to take place not later than June 30, 1976. Under the Agreement there were borrowings of $43,200,000 outstanding at December 31, 1975. Under the terms of the Credit Agreement 10% of the total outstanding borrowings at the

and Abot properties lying north and west of the Lucky Friday mine. The properties will be explored by a long northerly crosscut on the Lucky Friday mine 4050' level. During 1975 the crosscut was driven 656 feet and is now in the Lucky Friday Extension property.

The West Independence property is being explored from the 7300' level of the Star-Morning mine. The 7300 East lateral advanced 123 feet during the year and is now about 2,800 feet east of the Star-Morning No. 4 shaft, with the last 500 feet in West Independence ground. The lateral will be extended an additional 1,500 feet southeasterly to explore for possible ore shoots along the projected trend of the East Morning vein-fault in the West Independence property.

Hecla owns 50.4% of the outstanding shares of Consolidated Silver Corporation, whose property is comprised of Hecla's Silver Summit mine and seven adjoining properties. The combined properties are leased to ASARCO, Incorporated under a 50-50 profit-sharing operating agreement. Hecla owns a one-fourth interest in ASARCO's lease and is the operator of the property. Extensive shaft sinking and lateral exploration on the Silver Summit mine 4000' level were undertaken in 1971, but the property has been inactive since early 1972 due to suspension of operations by the managing Lessee. There are no present plans for resumption of the project, but the property is being maintained on a standby basis.

The Chester Area is a strip of ground 400 feet wide and approximately 1,500 feet in length, adjoining the Sunshine mine on the east, and is leased to the owners of the Sunshine Unit Area. Hecla owns a 54.2% stock interest in Chester Mining, but does not participate as a shareholder in dividends paid by Chester. In lieu thereof, Hecla receives royalty income directly from the owners of the Sunshine Unit Area. There are no significant known reserves remaining in the Chester Area, and future production will depend on results of deeper development, which is now in progress. The Sunshine 5400' level East drift has been extended into the area a short distance and will be continued through the length of the area following completion of raise development in the Sunshine Unit Area.

In Nevada, the Ruby Hill property at Eureka continued on a standby basis during 1975. A limited amount of diamond drilling was done for assessment purposes. Metallurgical test work was carried out during the year and will be continued in 1976. The property is leased by Hecla Mining Company, Cyprus Exploration Company, Richmond-Eureka Mining Company and Silver Eureka Corporation, with Hecla as the operator.

Geological studies and investigations were continued during 1975 in other western states and initial drilling was commenced on two areas in New Mexico.

Mining Operations and Interests

Lucky Friday Mine

Coeur d'Alene District—Idaho

Hecla's wholly-owned Lucky Friday mine produced 173,245 tons of ore assaying 14.96 ounces of silver per ton, 10.71% lead and 1.29% zinc in 1975, compared with 165,695 tons of ore assaying 13.53 ounces of silver per ton, 9.93% lead and 1.18% zinc in 1974. Calculated ore reserves at year end were 505,000 tons, compared with 539,000 tons at the end of 1974.

The development of lateral openings on the new 4250' level was essentially completed and stope preparation work on the level was about 60% completed at year end. The main shaft was extended to the sill of the 4660' level and excavation of the 4660' station was started. Stoping of the orebody continued in a satisfactory manner. The mine is in good condition and it is anticipated that the operation will continue its substantial contribution to the Company's earnings.

A new three-year labor agreement was signed in March 1975 with the United Steelworkers of America, which substantially increased labor costs.

On May 1, a new concentrate sales agreement became effective with The Bunker Hill Company. The terms were considerably less favorable than those of preceding contracts.

Sunshine Unit Area

Coeur d'Alene District—Idaho

Sunshine Mining Company is the operator of the Sunshine Unit Area, which produces the ore owned by Hecla Mining Company, Sunshine Mining Company and Silver Dollar Mining Company. Hecla's 33.25% share of Unit Area production was 62,034 tons of ore assaying 23.97 ounces of silver per ton in 1975 compared with 50,067 tons of ore assaying 24.41 ounces of silver per ton in 1974. Hecla's share of the estimated Unit Area ore reserves at year-end was 312,000 tons, compared with 295,000 tons at the end of 1974.

Mine operations during the year centered primarily on rehabilitation of stopes which had been shutdown since the 1972 fire, improvements in ventilation, and development of additional stoping faces. Although total development footage in the Unit Area was less than normal, four separate ore shoots totaling about 625 feet in combined length have been developed by drifting along the new Copper vein on the 4800' level.

In March 1974, Silver Syndicate, Inc. filed a suit against the Sunshine Unit Area owners claiming that Syndicate owned 50% of the ores in the 625, H and J veins in the Sunshine mine west of a dividing plane established by an agreement in 1943, and further claiming that Hecla and Sunshine conspired to withhold these ores. In 1975, Sunshine filed a cross complaint against its Unit partners Hecla and Silver Dollar, claiming that Sunshine owned 100% of these ores. In Hecla's answer, it has claimed ownership of 33.25% of the ores in question regardless of the outcome of the Syndicate litigation. In November, 1975, the issue of Syndicate's ownership was tried, and on January 22, 1976, the trial court rendered a decision in favor of Syndicate. After Judgment has been filed, the Company's attorneys will determine the next procedural steps to be taken in objection to the decision, including an appeal. The second and third portions of the trifurcated case have not come to trial. Hecla has not reflected any income from the disputed ores, but failure to prove a proportional ownership of such ore in Hecla could have a material bearing on future results to be reported from Hecla's share of Sunshine Unit Area operations.

Notes to Financial Statements

1. Summary of Significant Accounting Policies:

Basis of consolidation—The consolidated financial statements include the accounts of the Company and its wholly owned subsidiaries.

Inventories—Inventories are stated at the lower of average cost or market.

Investments—The Company follows the equity method of accounting for investment in common stock of companies 20% to 50% owned. Marketable equity securities are carried at market in 1975 and at cost in 1974. Other investments not intended for resale or not readily marketable are included in other investments at cost.

Properties, plants and equipment—Properties, plants and equipment are stated at cost. Maintenance, repairs and renewals are charged to operations. Betterments of a major nature are charged to appropriate property accounts. Profits or losses realized from sales or retirements are included in income.

Interest expense—Interest expense on loans from banks applicable to the Lakeshore Project is capitalized as part of Project costs and subsequently will be amortized by charges to earnings over the life of the Project.

Depreciation and depletion—Depreciation on the Lakeshore copper property, which is currently charged to deferred development costs, is computed, generally, on the straight-line method. Depreciation on other properties is computed, generally, on the declining-balance method. Depletion is computed on a unit-of-production basis on estimated ore reserves.

Mine exploration and development—Exploration costs are charged to income as incurred as are normal development costs at operating mines. Major mine development expenditures at operating properties and development expenditures at new mining properties not yet producing are capitalized and amortized over the estimated production benefited.

Pension plans—The Company and its wholly owned subsidiaries have pension plans covering substantially all employees. The Company policy is to fund pension costs to the extent of actuarially computed current service costs plus amortization of prior service costs over 30 years in respect to two plans and on a 10% per year basis for one plan.

Income taxes—Income taxes deferred arise mainly from major mine development expenses which are deferred in the financial statements and deducted currently in the income tax returns. Investment tax credits are treated as a reduction of income tax expense in the year in which the assets to which they apply are placed in operation.

2. Lakeshore Project:

The Company is completing the development of a large copper ore deposit in Arizona (the Lakeshore Property).

Start-up has commenced and mine production of both oxidized and sulfide ores will gradually increase over the next several months. The surface facilities have been essentially completed, and the crushing plant, sulfide ore concentrator, roast-leach-acid plant, electrowinning plant and oxide vat-leach-precipitate plants are operating, although on a reduced tonnage basis. The sponge iron plant construction is very close to final completion and it will be ready to operate when required. The first shipment of copper cathodes from the Lakeshore property was made on January 26, 1976.

Consolidated Statements of Changes in Shareholders' Equity

For the years ended December 31, 1975 and 1974

	Capital Stock* Shares	Capital Stock* Amount	Capital Surplus	Earnings Retained in the Business	Net Unrealized Loss on Marketable Securities
Balances, December 31, 1973 ..	6,456,735	$ 1,614,184	$19,224,044	$33,296,326	
Stock dividend, 2%	129,130	32,282	3,085,194	(3,117,476)	
Net income for year				8,441,340	
Balances, December 31, 1974 ..	6,585,865	1,646,466	22,309,238	38,620,190	
Stock dividend, 2%	131,713	32,928	2,162,289	(2,195,217)	
Net income for year				5,953,699	
Net unrealized loss on noncurrent marketable equity securities (Note 4)					$(252,355)
Balances, December 31, 1975 ..	6,717,578	$ 1,679,394	$24,471,527	$42,378,672	$(252,355)

*On May 6, 1975 the shareholders approved an increase in authorized shares from 8,000,000 to 12,000,000.

The accompanying notes are an integral part of the financial statements.

Report of Certified Public Accountants

To the Board of Directors and
Shareholders of Hecla Mining Company:

We have examined the consolidated balance sheet of HECLA MINING COMPANY and WHOLLY OWNED SUBSIDIARIES as of December 31, 1975, and the related statements of income, changes in shareholders' equity and changes in financial position for the year then ended. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances. We previously examined and reported upon the consolidated financial statements of the Company for the year ended December 31, 1974.

As described in Note 2, Lakeshore, a large copper ore deposit, is nearing completion of development and is scheduled to commence commercial operations in early 1976. Without an increase in the current depressed level of copper prices, it will not be possible for the Company to recover its total investment in the project.

As described in Note 6, the auditors' report on the financial statements of Granduc has been qualified "subject to the adequacy of future earnings to absorb the amortization of mine development and preproduction expenditures and depletion of mining properties".

In our opinion, subject to the ultimate realization of the carrying value of the Company's investments in the Lakeshore Project and Granduc referred to in the preceding paragraphs, the aforementioned statements present fairly the consolidated financial position of Hecla Mining Company and Wholly Owned Subsidiaries at December 31, 1975 and 1974 and the consolidated results of their operations, changes in shareholders' equity and changes in financial position for the years then ended, in conformity with generally accepted accounting principles applied on a consistent basis.

New York, New York
February 11, 1976

Coopers & Lybrand

In July, 1975, Sunshine Mining Company brought suit against Hecla and Silver Dollar Mining Company claiming that Sunshine has incurred certain expenses for the No. 12 shaft and that its Unit partners are obligated to pay their proportional share of these expenses (33.25% in the case of Hecla) plus interest. Hecla's answer and counterclaim states that Hecla should not be charged for the costs of the No. 12 Shaft on the basis that its principal purpose is for development of properties of other companies who have separate agreements with Sunshine. Hecla also contends that certain Unit Area charges by Sunshine were and are improper, and has demanded an accounting with respect to these items. Since 1958 the Unit Area partners have paid the entire costs of certain facilities and mine openings within the Unit Area, including the main No. 10 production shaft. Hecla claims that Sunshine does not have the right to use these facilities and openings for any purpose other than Unit Area operations. The proceedings in this suit are still in the preliminary stages.

Management intends to pursue vigorously all of these matters of litigation to protect Hecla's rights and ownership, and to obtain equitable treatment by Sunshine as the Unit operator.

Star-Morning Unit Area

Coeur d'Alene District—Idaho

Hecla is the operator of the Star-Morning Unit area. Production from the mine is owned 30% by Hecla and 70% by The Bunker Hill Company. Hecla also receives a small royalty on ores mined from the Morning section of the mine.

The mine produced 282,161 tons of ore during 1975, compared with 281,580 tons in the preceding year. Hecla's share of the 1975 production was 84,648 tons of ore assaying 2.49 ounces of silver per ton, 5.00% lead and 5.64% zinc, compared with 1974 production of 84,474 tons of ore assaying 2.45 ounces of silver per ton, 4.77% lead and 6.04% zinc. Hecla's 30% share of the computed ore reserves increased to 394,000 tons at the end of 1975 as compared with 376,000 tons at the end of 1974.

At mid-year, Bunker Hill unilaterally changed the terms of Hecla's concentrate sales agreement, which materially affected revenue and eliminated Hecla's profit from the operation. Hecla has objected to the proposed terms, and discussions with Bunker Hill have led to a joint discussion to arbitrate the matter as provided for in the contract. If the arbitrator upholds Bunker Hill's position, the normal operation of the mine at present metal prices will result in a loss or breakeven situation, and will also cause a substantial reduction of ore reserves.

Production was excellent throughout the year and several new stopes were prepared for production. A large number of the new stopes are located on relatively short ore shoots in auxiliary veins, such as the Grouse, Intermediate, Sprute Split and Motor Barn veins.

Approximately 70% of the lateral excavation on the 7700' level was completed during the year. Crosscutting to the vein and stope preparation has just been started and will continue throughout 1976. Sinking of the main No. 4 shaft was resumed late in the year and the shaft was deepened 104 feet to a point 120 feet below the 7900' level turnsheet. In addition to shaft sinking, the excavation for the 7900' level pockets was completed.

A new underground pumping system was completed during 1975, and will alleviate troublesome water problems during seasonal water runoffs. A new waste handling facility was also erected at the surface plant in Burke,

which eliminated a long haulage of waste through the mountain to Mullan. A new rockburst monitoring system, similar to the one previously developed at the Lucky Friday mine, was installed and is an extremely useful tool in countering rockbursting problems.

Ace Concrete Co.

Spokane, Washington

Ace Concrete Co., a wholly-owned subsidiary acquired by Hecla in 1959, is one of three major ready-mix concrete and sand and gravel producers in the Spokane, Washington area.

The prestressed concrete division, which markets a wide range of prestress and precast concrete products, was expanded during the year to enable the company to be more competitive and to offer a broader range of products.

Ace also owns and operates a portable aggregate division which produced concrete aggregates for the Lost Creek and Elk Creek Dams on the Rogue River in Oregon and was then moved to Washington to produce aggregates for the Chief Joseph Dam..

Profits in 1975 were reduced from the excellent results achieved in 1974 reflecting lessened construction activity.

Lakeshore Project

Pinal County, Arizona

Hecla and the El Paso Natural Gas Company are equal partners in this large copper mining project, with Hecla as the operator. The mine is leased from the Papago Indian Tribe on a royalty basis. A completely integrated mining and metallurgical operation has been under development since 1969.

At year end preproduction mine development and plant construction were 95% completed. Start-up of the operation began in January, 1976, with mine production beginning at a low rate which will gradually increase over the next several months.

The Lakeshore ore body consists essentially of three parts. The central core is a thick sulfide zone of typical porphyry-type mineralization. Tactite sulfide ore occurs at the base and marginal to the thick sulfide zone, and an oxide ore zone, formed by oxidation of a secondarily enriched chalcocite blanket, overlies the thick sulfide zone and is marginal to it on the northwest. In the early stages of the operation the thinner tactite sulfide ore is being mined, while the thick sulfide ore will be developed for mining in later stages. The oxidized ore will be mined concurrently with the tactite sulfide ore and later with the thick disseminated porphyry ore. The mine is being developed to produce 11,000 tons per day of sulfide ore and 6,450 tons per day of oxide ore.

The integrated mining and processing facilities are shown pictorially on pp.14 and 15 of this report. As shown, sulfide and oxide ore are being mined concurrently from two distinct but related underground operations. Sulfide ore is mined by a continuous panel-caving method and transported to an underground primary crusher. After coarse crushing, the sulfide ore is moved to the surface coarse ore stockpile on a 42-inch, 7,200-ft. belt conveyor installed in one of two parallel 15-degree declines. The other decline is equipped with a hoist and is used to transport men and supplies into the mine. Oxide ore is also being mined by a panel-caving method, but is hoisted to the surface through a 14-ft. circular shaft. On the surface the ore is passed through a primary crusher, then hauled by truck to the coarse ore stockpile area.

The oxide ore and the sulfide ore are alternately reclaimed from the coarse ore storage stockpiles and are then further reduced in particle size in a 17,500-TPD fine crushing plant.

Consolidated Balance Sheets

December 31, 1975 and 1974

Liabilities

	1975	1974
Current Liabilities:		
Notes payable to Banks (Note 3)	$ 4,320,000	$
Accounts payable and accrued expenses	5,023,403	2,755,594
Accrued taxes	1,509,015	2,501,942
Total current liabilities	10,852,418	5,257,536
Notes payable to Banks (Note 3)	38,880,000	20,640,000
Deferred income taxes	16,719,974	12,940,200
Pension plan reserves	2,387,866	1,497,697
Total liabilities and deferred income taxes	68,840,258	40,335,433

Shareholders' Equity

(Statement annexed)

Capital stock, 25¢ par value:		
Authorized 12,000,000 shares: issued 1975, 6,717,578 shares 1974, 6,585,865 shares (Note 8)	1,679,394	1,646,466
Capital surplus	24,471,527	22,309,238
Earnings retained in the business	42,378,672	38,620,190
Net unrealized loss on marketable equity securities (Note 4)	(252,355)	
	68,277,238	62,575,894
Less, Capital stock reacquired, at cost:		
1975, 244 shares; 1974, 244 shares	2,715	2,715
Total shareholders' equity	68,274,523	62,573,179
	$137,114,781	$102,908,612

The accompanying notes are an integral part of the financial statements.

Consolidated Balance Sheets

December 31, 1975 and 1974

Assets

	1975	1974
Current Assets:		
Cash (Note 3)	$ 9,888,287	$ 6,210,275
Due from sales of products	4,941,673	3,697,879
Due from Lakeshore Project partner (Note 2)	1,990,335	2,219,718
Accounts and notes receivable	924,854	1,004,810
Inventories, at lower of average cost or market	4,157,733	1,060,607
Prepaid expenses	248,157	170,565
Total current assets	22,151,039	14,363,854
Investments and interests in mining properties:		
Granduc Mines, Limited (N.P.L.) (Note 6)	6,769,683	7,830,261
Marketable equity securities, carried at market in 1975 and at cost in 1974 (Note 4)	2,525,622	2,944,611
Other, at cost	564,001	563,135
Properties, plants and equipment, at cost, less accumulated depreciation, depletion and amortization (Notes 2 and 7)	104,828,701	76,981,177
Other assets	275,735	225,574
	$137,114,781	$102,908,612

The accompanying notes are an integral part of the financial statements.

The oxide ore is treated in a 6,450-TPD vat leaching plant, in which it is leached with sulfuric acid followed by precipitation with sponge iron. The 55,000 tons of copper precipitate which will be produced each year at full production rates, containing 35,000 tons of copper, is pelletized and shipped to smelters of ASARCO, Inc., for further processing and sale. Sixty percent of this copper will be sold to ASARCO under a long-term agreement, and forty percent will be returned on toll and marketed through Brandeis, Goldschmidt & Co., Inc., metal merchants.

The sulfide ore is treated in an 11,000-TPD flotation concentrator, producing approximately 430-TPD of copper sulfide flotation concentrate. This concentrate is treated in a roasting, leaching, and electrowinning plant to produce 30,000 tons per year of electrowon cathode copper at full production rates. This product is shipped to plants of the Southwire Company, where it is used in the manufacture of copper rod and wire. The sulfide roasting operation also produces 200 TPD of by-product sulfuric acid, which is all consumed in leaching operations. The 250 TPD of iron-bearing leach residue from sulfide concentrate treatment is filtered and converted into sponge iron for use in precipitating copper from vat leaching solutions.

The crushing facilities, flotation concentrator, and vat-leach-cementation plants have all been through production trials with development ore. The roast-leach-electrowinning facilities and associated acid plant have been through initial production trials with a mixture of Lakeshore and purchased flotation concentrate. The reduction side of the sponge iron plant has been operated on purchased iron ore pellets, and the pelletizing facilities for Lakeshore leach residues are currently being tested. These tests have failed to reveal any serious operational deficiencies and the metallurgical facilities are now in operation at a reduced rate matching that of mine production. It is anticipated that the operation will achieve the full production rate of 65,000 tons of copper per year during 1976. No problem in meeting current environmental protection regulations is anticipated at the Lakeshore operation.

The first shipment of copper cathodes from the Lakeshore property was made on January 26, 1976.

At the present copper price the Lakeshore mine operation will not realize a profit, and is expected to generate only a nominal cash flow at full production rates. Copper price increases cannot be expected until demand by consumers improves and the large excess producers' stocks are reduced.

Total expenditures on the Lakeshore project to December 31, 1975 were $177,771,000, including working capital and start-up costs. The total Project costs to April 1, 1976, at which time the Project will be placed on operational status, are presently estimated at approximately $195,000,000, including start-up costs and $8,300,000 of working capital. It is estimated that additional working capital of approximately $10,000,000 will be required to finance in-process and in-transit materials and accounts receivable.

Costs at Lakeshore are being shared equally by Hecla and El Paso Natural Gas Company. Hecla borrowings for this purpose, under revolving credit agreements with participating banks, amounted to $43,200,000 at year end, the remainder of our share of the costs have been financed out of current earnings.

Please refer to the footnotes to the Hecla Financial Statements for further detail as to Lakeshore financing, specifically footnote 3, Notes Payable to Banks, page 24 .

Granduc Mines, Limited (N.P.L.)

British Columbia

Hecla owns 35.4% of the outstanding common stock of Granduc Mines, Limited, and also owns all of the 357,000 remaining outstanding shares of redeemable preferred stock. Granduc Mines, Limited, owns the Granduc mine, located north of Stewart, British Columbia, which it leases to Granduc Operating Company (GOC), a wholly-owned subsidiary of Newmont Mining Corporation and ASARCO, Incorporated. Under the terms of the lease, Granduc Mines, Limited, is to receive from Granduc Operating Company 22-½% of defined net proceeds from the Granduc mine. After 32,500,000 short tons of ore have been milled the percentage is increased from 22-½% to 25%.

Mining and milling operations of the Granduc mine were begun in late 1970, and in 1973 and 1974 production was at the rate of 7500 tons per calendar day. In its report of operations for 1975, Granduc Operating Company stated: "During the year January 1 to December 31, 1975, 37,335,782 pounds of copper were produced from milling 1,653,018 tons of ore with an average grade of 1.20% copper. Nine shipments of copper concentrate totaling 61,500 dry short tons were made from the Company's port facilities at Stewart. Operations were conducted on a reduced scale from February onward after the December, 1974, decision to cut production by approximately 50 percent. Operating performance objectives set for this program to minimize cash losses were met, and in certain cases exceeded. The tonnage milled during the year averaged 4,529 tons per calendar day, well over the planned rate."

The decrease in production rate was stated by GOC in late 1974 to be necessary because of "the unusually rapid increase in costs during the preceding year, the drastic drop in the price of copper over the last six months of 1974, and the mining royalty imposed by the British Columbia Mineral Land Tax Act, the royalty being payable even when the mine operates at a loss."

By the end of 1975 a total of 10,604,000 tons of ore had been milled, and ore reserves at the end of 1975 were estimated as 19,606,000 tons of ore averaging 1.69% copper before dilution, compared with 22,322,000 tons of ore averaging 1.71% copper before dilution at the end of 1974. These reserves include the ore blocks below the 2600 level. Granduc Operating Company is presently reviewing the advisability of making the additional expenditures necessary to mine the ore zones below the 2600 ft. main tunnel haulage level.

Results from 1975 operations were unsatisfactory because of the low copper price, and Granduc Operating Company reports that there is a deficiency in defined net proceeds as of December 31, 1975, of which Granduc Mines, Limited's 22-½% share is $921,542. This deficiency must be made up by Granduc Operating Company from future mine operating profits before any further payments are due Granduc Mines, Limited. Under the equity method of accounting, Hecla is required to record its 35.4% share in the allocable losses of Granduc Mines, Limited, which amounted to $782,200 in 1975, as compared with $36,000 in 1974.

It is uncertain at this time when and to what extent further royalty will be realized by Granduc Mines, Limited.

Further details of pertinent provisions of the lease and financial results are set forth in Note 6 to the Financial Statements.

Consolidated Statements of Changes in Financial Position

For the years ended December 31, 1975 and 1974

	1975	1974
Source of Working Capital:		
Net income	$ 5,953,699	$ 8,441,340
Add—Expenses not requiring outlay of working capital:		
Depreciation, depletion and amortization	357,573	354,300
Increase in deferred income taxes	3,779,774	3,545,200
Equity in net loss of Granduc Mines, Limited	782,200	36,000
Other, net		(113,216)
Less: Gain on sale of securities included in proceeds, below	(348,541)	(713,267)
Working capital provided by operations	10,524,705	11,550,357
Proceeds from sales of securities	515,175	5,419,114
Proceeds from sales of equipment		149,253
Proceeds from partial liquidation of investment in Granduc Mines Limited (Note 6)	278,378	1,638,558
Borrowings from banks	22,560,000	9,300,000
Increase in pension plan reserve	890,169	711,849
	34,768,427	28,769,131
Use of Working Capital:		
Current portion of notes payable to banks	4,320,000	
Property additions:		
Lakeshore copper property	27,871,172	28,178,018
Other	333,925	512,704
Increase (decrease) in other assets	51,027	(209,173)
	32,576,124	28,481,549
Increase in working capital	$ 2,192,303	$ 287,582
Changes in Components which Increased (Decreased) Working Capital:		
Cash	$ 3,678,012	$ 408,370
Receivables	934,455	(1,025,772)
Inventories	3,097,126	213,248
Prepaid expenses	77,592	49,801
Accounts payable and accrued expenses	(2,267,809)	1,265,032
Current portion of notes payable to banks	(4,320,000)	
Accrued taxes	992,927	(623,097)
Increase in working capital	$ 2,192,303	$ 287,582

The accompanying notes are an integral part of the financial statements.

Consolidated Statements of Income

For the years ended December 31, 1975 and 1974

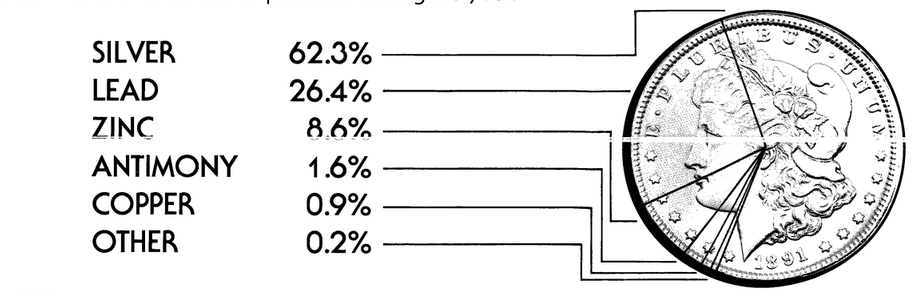
	1975	1974
Income:		
Sale of concentrate and products	$ 29,282,055	$ 28,917,379
Gain on sale of securities	348,541	713,267
Dividend income	89,103	147,934
Interest and other income	65,795	192,057
Equity in net (loss) of Granduc Mines Limited (Note 6)	(782,200)	(36,000)
	29,003,294	29,934,637
Cost and Expenses:		
Cost of sales and other expenses not shown separately	17,573,988	15,605,622
Exploration	1,106,130	807,894
Property and excise taxes	944,477	932,581
Interest on bank loans	2,848,201	1,676,503
Less, Interest capitalized (Note 1)	(2,848,201)	(1,676,503)
	19,624,595	17,346,097
	9,378,699	12,588,540
Provision for income taxes:		
Including federal income taxes of $3,111,800 and $3,675,200 (Note 5)		
Current	132,000	602,000
Deferred	3,293,000	3,545,200
	3,425,000	4,147,200
Net income	$ 5,953,699	$ 8,441,340
Per share of capital stock	$0.89	$1.26*
Dividends paid—Stock	2%	2%

*Adjusted for 1975 stock dividend.

The accompanying notes are an integral part of the financial statements.

Production Analysis

The sketch graphically illustrates Hecla's sales income from metallic concentrates produced during the year.



1975 production by mines and metals contained in metallic concentrates produced was as follows:

	Tons of Ore Milled	Ounces Gold	Ounces Silver	Tons Lead	Tons Zinc	Tons Copper
Lucky Friday Mine	173,245	1,245	2,540,832	18,282	2,068	257
Sunshine Unit Area (1)	62,034		1,435,502			278
Star-Morning Unit Area (1)	84,648		195,703	3,941	4,534	
	319,927	1,245	4,172,037	22,223	6,602	535

(1) Reflects Hecla's share of production from these properties.

The following table represents total production of metals contained in metallic concentrates produced by Hecla Mining Company for the past five years:

	Tons of Ore Milled	Ounces Gold	Ounces Silver	Tons Lead	Tons Zinc	Tons Copper
1971	495,776	59,974	6,369,914	32,170	10,323	2,214
1972	419,441	48,037	4,468,989	26,970	10,034	1,939
1973 (1)	295,462	1,271	3,853,939	23,202	7,074	438
1974	300,236	1,026	3,579,872	19,791	6,638	454
1975	**319,927**	**1,245**	**4,172,037**	**22,223**	**6,602**	**535**

(1) The Mayflower Mine was closed December 31, 1972. The Sunshine Unit Area was closed because of a labor strike from March 11, 1973 to July 15, 1973.

Average Metal Prices

		1974	1975 First Quarter	1975 Second Quarter	1975 Third Quarter	1975 Fourth Quarter	1975 Year
Silver	—$ per oz. (Handy & Harman)	4.71	4.30	4.41	4.72	4.25	**4.42**
Lead	—¢ per lb. M.W. U.S. Producer	22.53	24.50	22.28	19.52	19.82	**21.53**
Zinc	—¢ per lb. M.W. U.S. P.W.	35.94	39.07	38.94	38.90	38.93	**38.96**
Copper	—¢ per lb. Metals Week Refined	76.65	65.17	63.07	63.38	63.16	**63.53**
Copper	—¢ per lb. L.M.E. Wirebar Cash	93.13	57.73	57.04	56.07	53.02	**56.08**
Gold	—$ per oz. (London Final)	159.26	178.00	167.16	157.42	141.49	**161.02**

Metal Markets and Prices

Silver

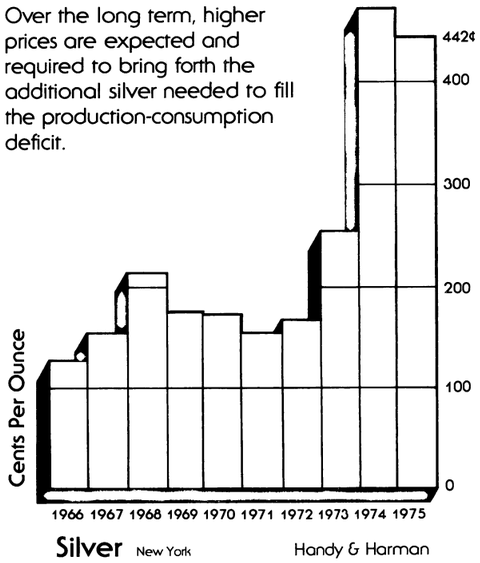
The average Handy & Harman price was $4.42 per ounce in 1975 compared to $4.71 per ounce in 1974. The low was $3.945 on January 22, the high $5.225 on August 7, and at December 31 the Handy & Harman price was $4.165 per ounce.

Speculative interest continued high in reaction to a rising tide of fiat money and inflation, and silver was the most heavily traded commodity on the world's futures markets in 1975.

In 1975 U.S. mine production is estimated at 35 million ounces with industrial consumption of 155 million ounces, compared to 33.8 million ounces of mine production and 177 million ounces of consumption in 1974. Domestic Commodity Exchange inventories increased from 87.4 million ounces to 124.2 million ounces during the year.

Preliminary figures for 1975 indicate free world consumption was 390 million ounces and new mine production was 235 million ounces. The resulting 155-million-ounce primary deficit was filled by salvage and above-ground inventories. Comparable revised figures for 1974 were free world consumption of 464 million ounces and new mine production of 241.5 million ounces giving a 233-million-ounce primary deficit.

Over the long term, higher prices are expected and required to bring forth the additional silver needed to fill the production-consumption deficit.



Silver New York Handy & Harman

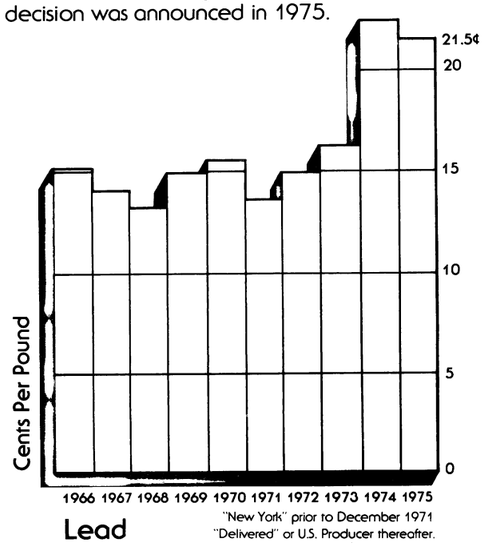
Lead

The domestic lead price was 24.5¢ at the beginning of the year, decreased to 22.75¢ in early May, and to 19¢ on June 2, increased to 20¢ on August 13, and then again decreased to 19¢ on December 15, which was the year-end price. The average 1975 price was 21.53¢ compared to 22.53¢ in 1974.

Estimated 1975 U.S. lead consumption in all forms fell to 1,230,000 tons as compared to 1,600,000 tons in 1974. U.S. 1975 supply was about 1,336,000 tons which included 614,000 tons of mine production, 609,000 tons recovered from secondary production, and 113,000 tons of net imports. This compares with 1,454,000 tons in 1974, which included 664,000 tons of mine production, 697,000 tons of secondary production, and 93,000 tons of net imports.

Lead stocks at U.S. primary smelters and refineries increased about 44,000 tons to 82,000 tons at year-end. The U.S. government stockpile, which was authorized for sale in previous years, decreased only 7,000 tons to 602,000 tons. About 72,000 tons will be available for disposal when refiners' stocks are reduced.

In March, the Environmental Protection Agency (EPA) requested a rehearing of a 1974 decision (by the U.S. Circuit Court of Appeals for the District of Columbia) which set aside the EPA regulations for a gradual reduction of lead additives in gasoline, but no new decision was announced in 1975.



Lead "New York" prior to December 1971 "Delivered" or U.S. Producer thereafter.

Summary of Operations

	Years Ended December 31				
	1975	1974	1973	1972	1971
	(in thousands except for per share amounts)				
Sales of concentrates and products (1)	**$29,282**	$28,917	$19,956	$20,313	$23,748
Income before income taxes	**9,378**	12,588	5,722	3,550	5,386
Provision for income taxes	**3,425**	4,147	1,487	1,050	1,769
Net income	**5,953**	8,441	4,235	2,500(2)	3,617
Average number of shares outstanding (3)	**6,717**	6,717	6,717	6,717	6,716
Net income per share	**$0.89**	$1.26	$0.63	$0.37(2)	$0.54
Stock dividends	**2%**	2%	2%	2%	2%

NOTES:

(1) Hecla and its wholly owned subsidiaries are engaged in three lines of business: Mining and concentrating of non-ferrous ores, production and sale of sand and gravel products and fabrication of prestressed concrete structures. During the past five years the percentage of total sales and revenues contributed by products were as follows:

	1975	1974	1973	1972	1971
Silver	**55.6%**	53.6%	43.9%	32.5%	37.3%
Lead	**23.5**	23.9	28.5	29.9	28.1
All others*	**20.9**	22.5	27.6	37.6	34.6
	100.0%	100.0%	100.0%	100.0%	100.0%

*No single product listed in the column contributed in excess of 15% of total sales.

(2) After deducting extraordinary charge (net of applicable income tax) of $545,000 or 8¢ per share resulting from the Sunshine mine fire disaster.

(3) Adjusted to reflect the 2% stock dividends in August of each year.

Management's Discussion and Analysis of The Summary of Operations

The decrease in net income for 1975 from 1974 was primarily attributable to lower average silver prices, substantially increased operating and smelter treatment costs, a reduction in net gain from sale of securities, and a significant increase in the Company's share in equity in net losses of 35.4% owned Granduc Mines, Limited. Granduc results reflect continuing increased operating costs and sharply lower world copper prices when compared to those that existed in early 1974.

The increase in net income in 1974 over 1973 was primarily attributable to significantly improved metal prices which more than offset increased operating and smelter treatment costs. In addition, net income was significantly increased in 1974 due to larger net gains from the sale of securities, this increase more than offsetting the decrease in the Company's share in equity in reported results of Granduc Mines, Limited. Granduc results were sharply lower as the result of a substantial writedown of ore reserves at the Granduc Mine, increased operating costs and sharply lower world copper prices in the last half of 1974.

Price Range of Hecla's Capital Stock

	Capital Stock	
1974	High	Low
First Quarter	$ 36⅝	$ 20⅛
Second Quarter	31⅜	19⅜
Third Quarter	26⅛	10⅝
Fourth Quarter	21⅝	13⅛
1975		
First Quarter	$ 20¾	$ 13½
Second Quarter	23¾	15½
Third Quarter	23⅞	16¼
Fourth Quarter	17⅞	13

Above prices are based on the quotations of the New York Stock Exchange, the exchange upon which the Company's stock is most actively traded.

Hecla Mining Company

Incorporated under the laws of the State of Washington, July, 1898.

Capitalization—12,000,000 shares of a par value of 25¢ each ($3,000,000) of which 6,717,334 shares were issued and outstanding on December 31, 1975.

Main Office, Hecla Building, Wallace, Idaho 83873

Eastern Transfer Agent
Registrar and Transfer Company, 140 Cedar Street, New York, NY 10006

Eastern Registrar
Manufacturers Hanover Trust Company, 40 Wall Street, New York, NY 10015

Western Transfer Agent
Spokane and Eastern Branch, Seattle-First National Bank, Spokane, WA 99210

Western Registrar
Pacific National Bank of Washington, Spokane, WA 99210

Shares of the Corporation are traded on the New York Stock Exchange, New York, NY, the Spokane Stock Exchange, Spokane, WA, and the Pacific Coast Stock Exchange, San Francisco, CA.

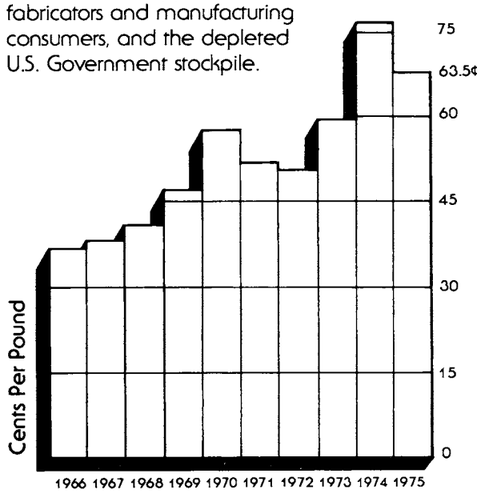
Copper

The domestic producer price for cathode copper was reduced 4¢ to 68¢ per pound on January 2 and to 63¢ on January 28, where it remained throughout 1975, except for a brief period from June 17 to July 28 when two producers quoted a 60¢ price. The average 1975 producer price was 63.54¢ as compared to 76.65¢ in 1974.

New York Commodity Exchange (COMEX) dealer spot copper reached a 51¢ low in January, a 61.5¢ high in March and averaged 55.54¢ in 1975 compared to 90.16¢ in 1974.

It has been estimated that both mine production and refined copper output in the world declined by about 7% in 1975 as compared to 1974, and that world consumption of refined copper fell by 13% in 1975. The excess of production to consumption was reflected in a substantial increase in producer stocks, now estimated to be nearly 1.5 million tons. This large inventory is about a 2-½ month supply of copper, more than twice the "normal" supply.

Until demand by consumers increases materially, the excess inventory held by producers will have a depressing effect on the price. Some encouragement for improvement in the market is provided by a generally improving economy, increases in consumption since the first quarter of 1975, low copper inventory levels of fabricators and manufacturing consumers, and the depleted U.S. Government stockpile.



Copper Wirebars F.O.B. Domestic Refinery

Zinc

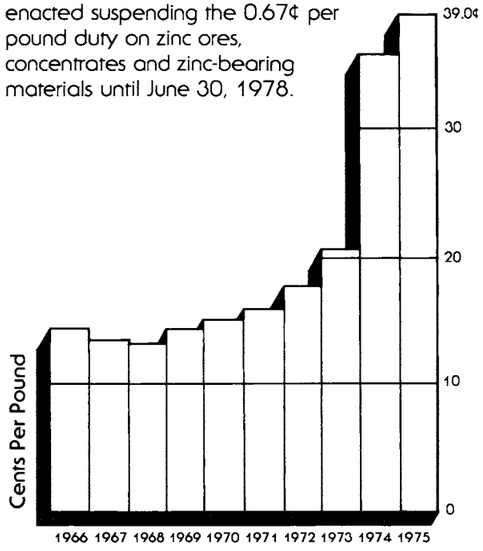
The domestic Metals Week prime western delivered zinc price was 39.33¢ at the beginning of the year, moved to a low of 38.70¢ on September 29 and closed the period at 39.00¢. On January 5, 1976, the price was reduced 1-½¢ and all producers were quoting 37¢ by January 7, 1976. The average price for 1975 was 38.96¢ compared to 35.94¢ in 1974.

U.S. estimated 1975 zinc consumption in all forms was 1,211,000 tons which was 30% less than the 1,719,000 tons consumed in 1974. U.S. slab zinc consumption decreased 29% to 919,000 tons, of which 470,000 tons were from newly-mined U.S. production and the balance from secondary production, imports and inventory change. This compares to 1,288,000 tons of slab zinc consumed in 1974 and newly-mined domestic production of 500,000 tons.

In 1975, net imports of zinc in all forms were 512,000 tons compared to 708,000 tons in 1974.

Zinc smelter stocks increased from 46,000 tons to 90,000 tons during 1975. Consumer stocks were reduced from 211,000 tons to 92,000 tons during the first eleven months of 1975. G. S. A. stockpile sales of 5,900 tons in 1975 reduced the Strategic Reserve to 385,700 tons.

Effective August 9, 1975, a law was enacted suspending the 0.67¢ per pound duty on zinc ores, concentrates and zinc-bearing materials until June 30, 1978.



Zinc Prime Western East St. Louis through January 1971; U.S. Prime Western thereafter.

OXIDE MINE
(UNDERGROUND)

OXIDE MINE
SHAFT & CRUSHER

RADIAL
STACKER AREA

DECLINE
PORTALS

FINE CRUSHER

SULFIDE MINE
(UNDERGROUND)

DECLINES

CRUSHER
(UNDERGROUND)

SULFIDE ORE

SULFIDE CRUSHED
ORE STORAGE

SULFIDE ORE
CONCENTRATOR

OXIDE ORE

OXIDE ORE
VAT LEACH
TANKS

LEACH RESIDUE

CuSO4

Fe PELLETS

TAILINGS

WASTE
TO
TAILINGS POND

CEMENTATION
PLANT

FILTER
PLANT

SULFIDE
CONCENTRATE

LEACH
RESIDUE

SPONGE IRON PLANT

CuSO4

H2SO4

ROASTER

COPPER PRECIPITATE
PELLETS

ELECTROWIN
TANK HOUSE

H2SO4
ACID PLANT

65% COPPER PRECIPITATES
TO ASARCO SMELTER

99.95% COPPER CATHODES
TO MARKET

TAILINGS SETTLING
POND

This pictorial drawing of the Lakeshore Copper Operation is designed to give a simplified representation of the extraction of the copper ore from underground and its flow through the metallurgical processing plants.

From the oxide mine the ore is hoisted to the surface through a vertical shaft and the ore from the sulfide mine is transported by a conveyor in the south decline. All of the ore is deposited in the radial stacker area from which it is conveyed to the fine crusher. After being crushed the oxide ore is treated in the vat leaching facilities to produce copper precipitate pellets. The crushed sulfide ore is conveyed to the sulfide ore concentrator where sulfide concentrates are produced for the roasting-leaching-electrowinning process, which produces copper cathodes. Sponge iron and sulfuric acid are recovered as by-products from the roast-leach-electrowin plant and used in the treatment of the oxide ores.

Lehman Brothers Kuhn Loeb
Incorporated

40 Wall Street
New York, N. Y. 10005

February 1, 1978

E. L. HENNESSY, JR.
FEB 14 1978

Mr. Harry J. Gray
Chairman
United Technologies
United Technologies Bldg.
Hartford, Connecticut 06101

Dear Mr. Gray

Bill Love, President of Hecla Mining Company, and I would like to bring to your attention an opportunity to acquire an interest in a domestic copper property on an attractive basis. The property, the Lakeshore Mine, near Casa Grande, Arizona, is owned jointly by Hecla Mining Company and El Paso Natural Gas Company.

The management of Hecla is of the opinion that the Lakeshore Mine is a viable property, but based on Hecla's current financial situation and the need for additional expenditures which should be undertaken for optimization of the long-range future of the Lakeshore Mine, Hecla's Management has concluded that it is in the best interest of Hecla shareholders to dispose of all or part of its 50% interest in the Lakeshore Mine.

It may be that this matter has already been brought to the attention of someone else in your organization. However, we felt the situation interesting enough to take this means of making sure it had come to your attention.

I am attaching herewith a brief memorandum describing the property and would appreciate hearing from you as to whether you would like to examine the situation more closely. If so, the next step could be a meeting which we will be happy to arrange between you or your representatives and Hecla Mining Company executives.

Sincerely yours,

Morris H. Wright
Managing Director

MHW:jmr
Att.

The Lakeshore Mine

The Lakeshore Mine consists of a Mineral Lease from the Papago Indian Tribe, a related Business Lease for plant sites, and Water Permit. The mine is an underground copper mining complex which consists of an oxide mine, a sulfide mine, and a surface plant for the processing of sulfide and oxide ores to produce cathode copper and copper precipitates. The plant is the only metallurgical complex for the production of metal from sulfide ore in Arizona which has been issued an unconditional operating permit by the Arizona environmental regulatory agency. The company does not anticipate any difficulty or unusual expenditures to meet environmental standards now or in the foreseeable future. The total investment in the mine is in excess of $200,000,000, one-half of which was financed by Hecla, partly under a credit agreement pursuant to which Hecla has borrowed $55 million.

The Lakeshore mine became operational April 1, 1976 and, because of the depressed condition of the copper market and high start-up costs, incurred substantial operating losses which caused a serious drain on Hecla's financial resources. Operations were suspended in September, 1977. The mine and plant are being maintained in good condition for reactivation and 130 key employees have been retained.

Recently, Hecla has completed a plan which contemplates

maintaining the mine and plant on stand-by basis until late 1979, when production would be resumed. During 1978 and 1979 certain mine development work would be completed, the crushing plant and concentrator would be enlarged, and a solvent extraction-electrowinning circuit for oxide leach solutions would be added. The operation would then be capable of annual production of 124 million pounds of copper cathode, saleable directly to consumers and of quality suitable for continuous rod-drawing applications.

For a 12-year period beginning January 1978 and ending December 1989 (10 years of production staring December 1979) the estimated cash flows attributable to Hecla's 50% share at various copper prices, all stated in 1977 dollars, would be as follows:

($000)	Copper Price/Lb. 85¢	95¢	105¢	115¢
1978 & 1979 investment (including 10% interest)(1)	$ 47,864	$ 47,123	$ 46,367	$ 45,621
Less taxes saved (2)	16,637	16,267	15,889	15,516
1978 & 1979 net investment	$ 31,227	$ 30,856	$ 30,478	$ 30,105
1980-1989 operating income	$ 84,051	$137,396	$192,400	$246,592
Less taxes paid	17,457	35,553	54,311	76,069
Net 10-year operating income	66,594	101,843	138,089	170,523
Less capital expenditures (1980-1989)	8,465	8,465	8,465	8,465
10 year net after-tax cash flow	$ 58,129	$ 93,378	$129,624	$162,058
After-tax DCF rate of return	10.9	23.1	35.1	46.2

NOTES:
(1) Does not include working capital requirements.
(2) Assumes sufficient US taxable income and 50% rate.

Although Hecla will consider any reasonable terms for its interest in Lakeshore, we believe the following approach offers an attractive basis for discussion. It can, of course, be modified to take into account tax and other considerations.

(1) Hecla would assign its 50% of the Lakeshore mineral interest to your company in exchange for an advance royalty payment in an amount to be negotiated.

(2) Your company would lease from Hecla its 50% of the surface and metallurgical plant - with annual rental payments to be negotiated.

(3) Your company would replace Hecla as operator, and at your option, Hecla would continue to manage the operation for payment of a nominal management fee.

(4) Your company would receive 100% of computed defined after-tax cash flow up to an estimated $5 million per year.

(5) Hecla would receive in the form of royalties one-half of the excess computed after-tax cash flow over $5 million per year; for purpose of determination of Hecla's share, these after-tax computed cash flows would be on a cumulative basis.

(6) As a possible alternate to (5) above, Hecla would

receive royalties equal to 50% of any increase in the price of copper over ¢ per pound (1977 dollars).

(7) Any royalties paid to Hecla under (5) or (6) above would be offset by the amount of advance royalty paid to Hecla under (1) above.

(8) At the end of 10-year period of Lakeshore operations Hecla would have the option of discontinuing lease rental payments in exchange for a 50-50 joint venture participation with your company.

We do believe that Hecla's need to dispose of its interest in this property offers an uncommon opportunity for a company such as yours to acquire an interest in a major copper facility at a capital cost per ton of annual capacity substantially below the $6,000-$7,000 estimated for a "green field" operation.

AC-016

avoid verbal orders

avo

TO Paul W. O'Malley LOCATION Ft. Wayne, Indiana

FROM E. Grover Heinrichs LOCATION Tucson, Arizona

SUBJ. Hecla Mng. Co. Lakeshore Mine DATE March 10, 1978
RE: Letter to Harry J. Gray from
Lehman Bros. Kuhn Loeb (copy enclosed)

COPY TO

The Lakeshore Mine as it now sits is not an economically viable operation and there is some reason to believe that it will take from 3 to 5 years before the price is such that it could be a paying proposition. It is one of the higher cost copper operations in Arizona and was the first mine to close during the current economic crisis.

I have heard that many experts believe the mining phase was not well thought out and some basic conceptual errors were made in the initial mine design. The present system simply does not work. It has been said that the major question now is can the mine and mill be resurrected at some reasonable cost in order to produce ore at a profit.

To determine what could be done and how would be a very expensive study and might require from six months to a year to complete by a team of experts.

The milling and metallurgical phase was studied in some detail by a former Essex employee, Lyle Lichty, and I have included his report as part of the current study.

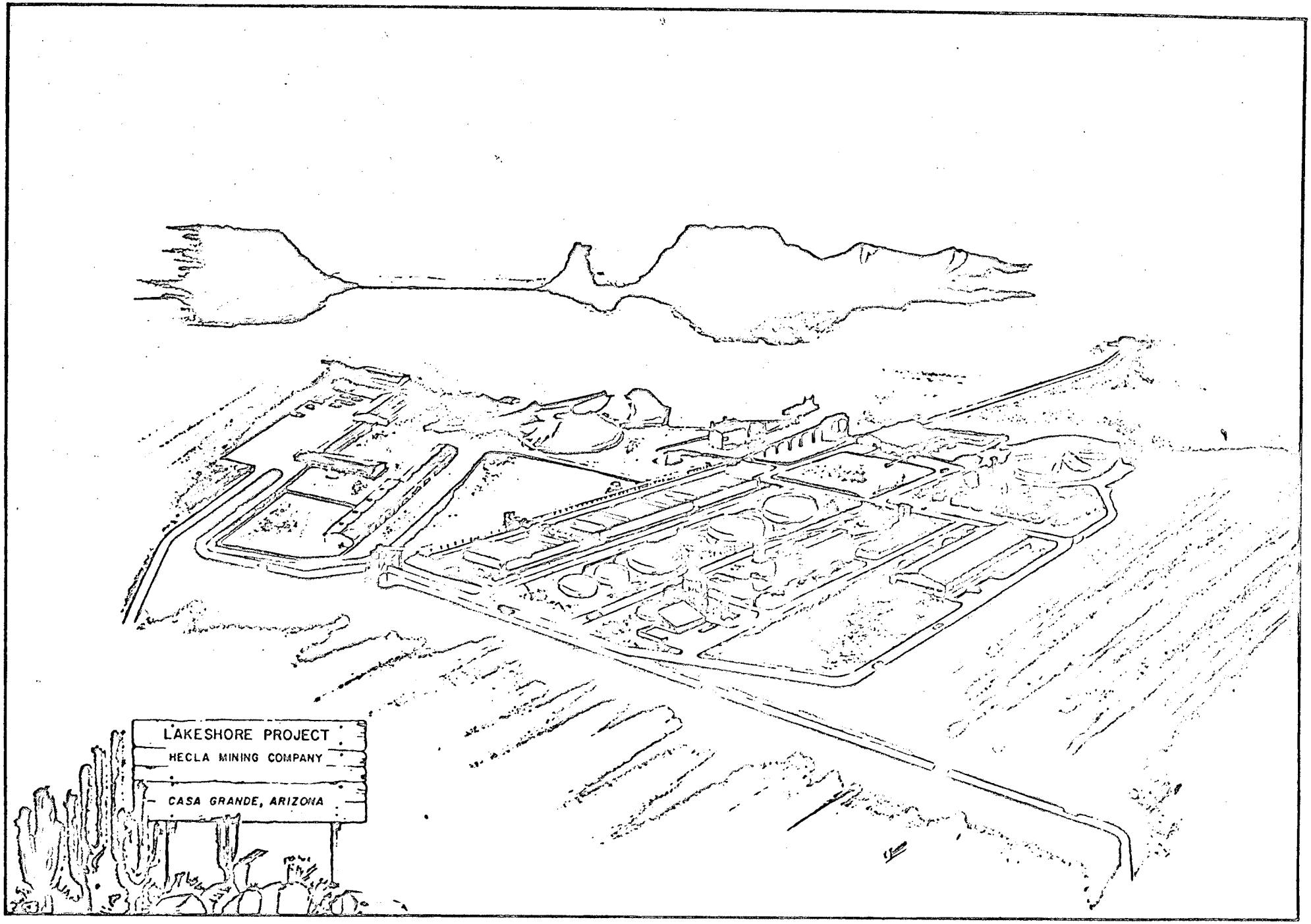
In summary, I would have to recommend that Essex shy away from the Lakeshore property because of the apparent technical problems that may or may not be solvable and the massive amounts of money that will be required to determine this.

The orebody contains a very large amount of copper and it will be mined one day but a major mining company with the expertise readily available would be a logical candidate to take on the project.

One possible opportunity to this that might be worth investigating would be an approach to Newmont on a suggested joint venture basis in which Essex put up some limited cash for a limited feasibility study and Newmont agrees to throw in its Vekol Mine as part of the package. The Vekol is 12 miles from Lakeshore and is not developed; together they might make an economic unit.

A joint study with Newmont would also have some beneficial side effects in getting Essex and United people acquainted with Newmont people in the event a merger is contemplated at some future date. See attached report by R. A. Kelly dated April 26, 1973.

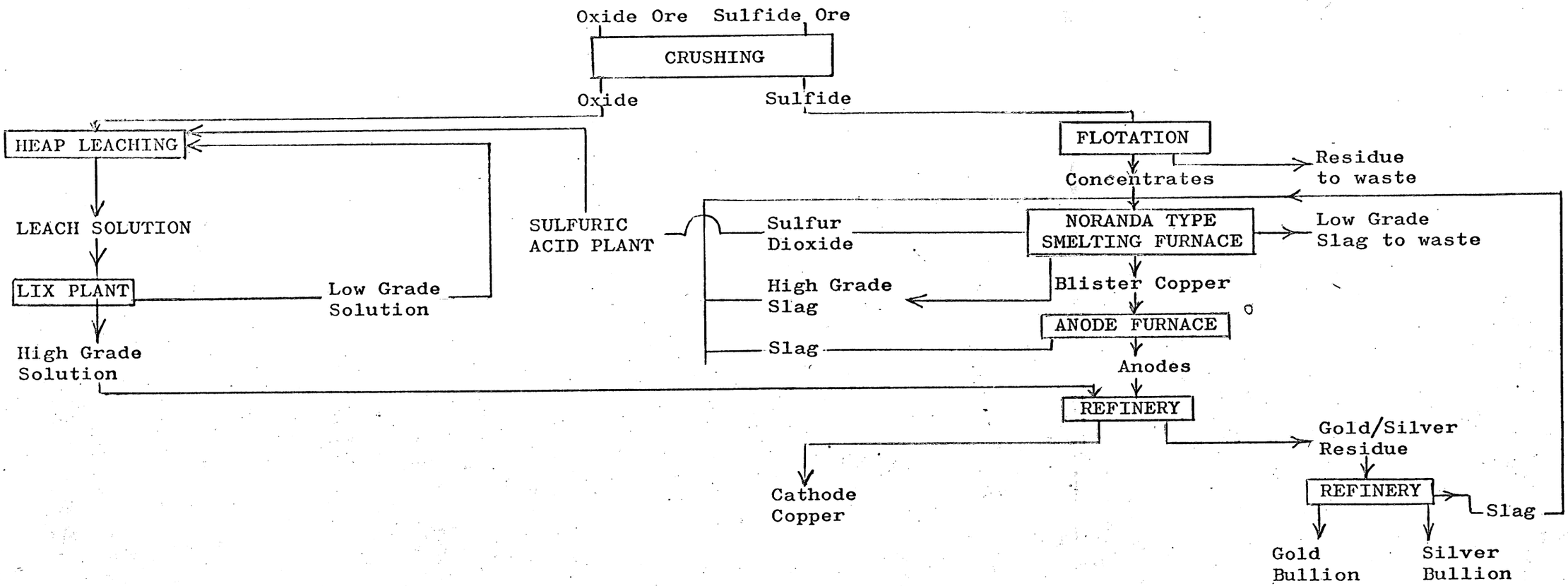
One other approach to consider in all this would be a tender offer for Hecla Mining Co. In my opinion 100% of Hecla at the moment would be easier and cheaper to buy via a tender offer than Hecla's 50% of the Lakeshore Mine.


LAKESHORE PROJECT
HECLA MINING COMPANY
CASA GRANDE, ARIZONA

SUGGESTED LAKESHORE FLOWSHEET

To Improve The End Product

11/13/75



LJL/rpj

Comments on Lakeshore Metallurgy

Summary of Current Proposed Plan

1. There are two main classes of ore at the Lakeshore property, namely (1) oxide largely in a high lime gangue and (2) sulfide largely chalcopyrite and these will be treated separately.
2. It is proposed to float a sulfide concentrate and to roast the concentrate forming sulfur dioxide gas which will be converted to sulfuric acid.
3. The sulfuric acid will be used to leach copper from the oxide zone in vats to produce a copper solution.
4. The roasted sulfide concentrate will be leached with water and the copper solution will be sent to an electrolytic copper recovery system to produce cathode copper.
5. The residue from the leaching operation containing some unleached copper iron oxides and whatever gold and silver is present will be reduced to metallic iron in a Lurgi reduction unit using natural gas or oil.
6. The leach copper solution (3 above) is treated with the metallic iron to precipitate copper mud. Any gangue minerals and the gold and silver of the flotation concentrate will report with the copper mud. This produce will be sold to a conventional smelter.
7. In my estimation, overall copper recovery from oxide and sulfide ores will be about 75%.

Criticism of Metallurgical Plan and Recommendations

1. The copper mud production could be low grade compared to other properties and will command a higher smelting charge.

2. The cathode copper may be high in iron and other inclusions, such as silica, since the solutions are not purified after leaching. A similar installation at Ray Mines of Kennecott produces cathodes which require melting and fire refining before being acceptable for sale.

3. The reduction of the iron oxide residue to metallic iron is costly and is not done without difficulties (see 5 above).

4. It is questioned why Hecla did not spend some 25% more capital to produce a product of superior copper grade with a higher overall recovery and no more difficulty with E.P.A. regulations. To accomplish this would entail several radical changes in the overall flow sheet with a LIX plant to treat the leach solutions from the oxide ore and direct electrolytic recovery for the oxide copper in the present electrolytic tank house.

5. In place of the roasting and leaching procedure, it probably would have been better to treat the flotation concentrates in a Noranda type furnace with the sulfur providing most of the energy for the smelting operation. The products of this more conventional operation would be copper anodes containing the gold and silver which would provide good feed for the electrolytic plant and a sure method to recover gold and silver which in the present plan is lost. All the cathode copper thus produced would command a top price or would be suitable for wire bars or rod directly.

6. Overall copper recovery from oxide and sulfide ores would approximate 85% by these suggestions.

Prepared by: Lyle Lichty, May 1975

HECLA MINING COMPANY
P. O. BOX 320
WALLACE, IDAHO 83873
(208) 752-1251

HARRY J. GRAY

JUL 28 1978

AM 7 8 9 10 11 12 1 2 3 4 5 6 PM

July 25, 1978

Mr. Harry J. Gray
Chairman and President
United Technologies Corporation
Hartford, CT 06101

Dear Mr. Gray:

Please note the attached pages.

Any or all bids which will equal or exceed what Hecla might expect from salvage of plant and equipment will be considered.

Sincerely yours,

W. H. Love
President

WHL/amh

Enclosures

In LAKESHORE File
1. Letter Hecla to H. Gray
2. Lakeshore at a glance
3.

ESSEX GROUP

Internal Correspondence

To: Paul O'Malley

Date: September 5, 1978

c.c. Ben Bowdon

From: E. Grover Heinrichs

Subject: Letter of July 20, 1978 from Hecla Mining Co. Pres., Bill Love, to Harry Gray

The Lakeshore Mine, though it does represent 600,000,000 tons of copper ore or 8 billion lbs. of copper, which is being put on the auction block by Hecla as described in the subject letter is not in my opinion a good Essex opportunity; and not too much has changed since my memo to you of 3/10/78 (copy enclosed). The known problems at Lakeshore are itemized below:

1. The underground mine would require extensive redesign at an estimated cost of $50,000,000.

2. The royalty payment to the Papago Indians of 10% NSR is considered too high and would have to be renegotiated.

3. The metallurgical reduction plant is not ideal (see attached report by Lyle Lichty, May 1975). What value could be placed and of what use the present plant facility could be, would depend on the ultimate final design modifications. If Lichty's modifications were utilized the cost would likely be in the area of $20,000,000 with some cost reductions in this figure by using the existing facilities.

The statement by Hecla's staff in their report of July 7, 1978 (copy attached) is certainly true: "It is Hecla's belief that this opportunity (Lakeshore Mine) affords the purchasing company the ability to acquire substantial mineral reserves and an operating plant at a cost which would be very substantially less than that which would be necessary to explore for, develop, and bring into production a copper property of similar potential".

The Lakeshore is unquestionably one of the more significant copper ore deposits in the U.S., but its economic viability can only be realized if some of the mine design problems can be corrected and the debt load deferred.

However, it is my opinion that the logical buyer would be Newmont because of their vast reservoir of underground mining experience and their 51% interest in an adjacent property known as the Vekol deposit, which perhaps could be developed and mined simultaneously with the cost of one concentrator to handle both ores.

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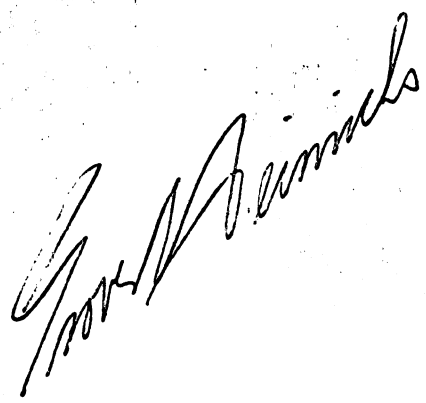
The banks (Chase Manhattan and others) have a big stake in Lakeshore and would certainly like to have the property put back on track. Newmont, though cash poor, has the expertize; Essex has the market.

If Hecla and El Paso and the banks would accept 10¢ or 20¢ on the dollar paid out of production profits at some future date and the Papagos would modify their royalty; then perhaps the gamble would be worth the investment and only after an extensive examination of all the available data from a mining and metallurgical, engineering and financial viewpoint.

Estimated total expenditures on the Lakeshore Mine and Plant approximate $200,000,000 and the current carrying costs are estimated to be approximately $700,000/month as an inactive property.



P.S. In summary therefore, it is my recommendation that the request for bid by Sept. 16, 1978 not be acted upon. Instead, with your permission, I will maintain surveillance of the property and informally inquire of Newmont as to any possible interest on their part in such a venture.

EGH

AC-016

avoid verbal orders

TO Paul W. O'Malley LOCATION Ft. Wayne, Indiana

FROM E. Grover Heinrichs LOCATION Tucson, Arizona

SUBJ. Hecla Mng. Co. Lakeshore Mine DATE March 10, 1978
RE: Letter to Harry J. Gray from
Lehman Bros. Kuhn Loeb (copy enclosed)

COPY TO

The Lakeshore Mine as it now sits is not an economically viable operation and there is some reason to believe that it will take from 3 to 5 years before the price is such that it could be a paying proposition. It is one of the higher cost copper operations in Arizona and was the first mine to close during the current economic crisis.

I have heard that many experts believe the mining phase was not well thought out and some basic conceptual errors were made in the initial mine design. The present system simply does not work. It has been said that the major question now is can the mine and mill be resurrected at some reasonable cost in order to produce ore at a profit.

To determine what could be done and how would be a very expensive study and might require from six months to a year to complete by a team of experts.

The milling and metallurgical phase was studied in some detail by a former Essex employee, Lyle Lichty, and I have included his report as part of the current study.

In summary, I would have to recommend that Essex shy away from the Lakeshore property because of the apparent technical problems that may or may not be solvable and the massive amounts of money that will be required to determine this.

The orebody contains a very large amount of copper and it will be mined one day but a major mining company with the expertise readily available would be a logical candidate to take on the project.

One possible opportunity to this that might be worth investigating would be an approach to Newmont on a suggested joint venture basis in which Essex put up some limited cash for a limited feasibility study and Newmont agrees to throw in its Vekol Mine as part of the package. The Vekol is 12 miles from Lakeshore and is not developed; together they might make an economic unit.

A joint study with Newmont would also have some beneficial side effects in getting Essex and United people acquainted with Newmont people in the event a merger is contemplated at some future date. See attached report by R. A. Kelly dated April 26, 1973.

One other approach to consider in all this would be a tender offer for Hecla Mining Co. In my opinion 100% of Hecla at the moment would be easier and cheaper to buy via a tender offer than Hecla's 50% of the Lakeshore Mine.

FILE COPY

A Proposal to Consider the Acquisition of

100% of Hecla Mining Company
(owner of half of the Lake Shore,
Arizona, Copper Deposit)

and

51% of Vekol Hills Mining Company
(owner of the Vekol,
Arizona, Copper Deposit)

April 26, 1973

R. A. Kelly

A PROPOSAL to CONSIDER the ACQUISITION of HECLA MINING CO. (100%) and VEKOL HILLS MINING CO. (51%)

SUMMARY

Although complete data on the size and grade of the Lake Shore and Vekol ore deposits are not available at this time, sufficient information has been obtained to conclude that these deposits would be desireable to Essex. The principle questions are if the owners would sell and, if so, at what price and basis.

The following paragraphs describe the data relating to reserves and possible methods and prices of acquisition.

Attached are sections covering descriptions of the ore bodies and the available operating and financial data on Hecla and Vekol.

ADVANTAGES FOR ESSEX

The Lake Shore deposit contains ore reserves totalling about 400 million tons of 0.8% copper (about 6 billion pounds of copper). It will be mined as an underground operation. The tactite ores with grade averaging 1.69% copper is proposed to be mined first. The sulfur from this will justify an acid plant. The acid would be used to leach the copper from some 200 million tons of 0.7% oxide ore.

The Vekol deposit is about 12 miles northwest of Lake Shore and contains more than 100 million tons of 0.55% to 0.60% copper (about one billion pounds of copper). This ore would be open-pit mined.

It could be much more economical to mine both ore bodies together. The economies would come from a single town site, a combined labor force, improved utilization of equipment, one concentrator, one acid plant, one electro-winning plant and/or smelter, combined water and power plants, etc. Perhaps agreements with the Papago Indians could be improved.

This proposal contemplates that Essex would acquire half interest in the Lake Shore by acquiring 100% of Hecla's common stock. The remaining half would continue tc be owned by El Paso Natural Gas Co. (who owns the Narragansett Wire Co., a producer of electric copper wire).

It is also proposed that Essex would acquire Newmont's 51% ownership of Vekol Hills Mining Co. The remaining principle stockholder would be Superior Oil Co.

It is assumed that El Paso and Superior would be pleased to join with Essex who, as a market for all the production, could save selling expenses of $35 million over the life of the reserves, assuming 1/2¢ per pound selling cost. Also, if at a later time, it was desireable to expand, both El Paso and Superior are financially able to assume their share of a joint venture.

POSSIBLE METHODS of ACQUISITION and COST

a) Hecla has 6,330,137 shares of stock outstanding of which El Paso owns 1,061,208 shares, or 16.8%. (Hecla

paid one million shares to El Paso for half interest in the Lake Shore deposit; the balance represents stock dividends). Hecla's stock is traded on the NYSE at a price about $15-16.

Essex would attempt to buy El Paso's shares for cash contingent upon Essex being able to acquire the remaining Hecla shares on a stock exchange basis.

The following cost to Essex assumes Hecla stock values at $16, $18, and $20 per share and Essex stock at $20 per share:

	OFFER for HECLA'S STOCK ("000")		
	$16	$18	$20
Cash to El Paso	$ 16,979	$ 19,102	$ 21,224
SX Stock to Hecla ($20)	84,303	94,841	105,379
Total Value	$101,282	$113,943	$126,603
SX Shares Required	4,215	4,742	5,269
% of SX Stock (After Merger)	19.2%	21.1%	22.9%

The cash paid to El Paso might be available after merger by liquidating Hecla's "Investments" valued at $18 million.

b) Vekol partners have reportedly invested about $6 million to date in the development of this deposit. It would be most desireable to buy Newmont's 51% for $5 million cash. They also own about 1% of Hecla's stock that might be purchased for cash at the same time. It is rumored Newmont could use cash for needs at Magma.

c) Total Essex cost might be summarized as follows:

Cost to Acquire	Cash (in "000")	Stock
Cash to El Paso	$20,000	
Stock Value to Hecla		$100,000
Cash to Newmont	5,000	
sub-total	$25,000	$100,000
less: Hecla Investments	(18,000)	----
Net to Acquire	$ 7,000	$100,000
Cost to Develop to Production		
Lake Shore (Essex Share)	$30,000 ← *	
Vekol (Essex Share)	13,000	
Grand Total Cost	$50,000	$100,000

The total investment to develop both deposits to production is estimated to be $175 million (Lake Shore $150 million and Vekol $25 million). Assuming Essex owned 50% of each deposit with a return on investment of 10% or 15% after taxes, Essex return would appear:

	10% R.O.I.	15% R.O.I.
Profit (1/2 on $175 million Investment)	$8,750,000	$13,125,000
Earnings per share on 5,200,000 SX shares issued to acquire Hecla	$1.68	$2.52

d) Bagdad as a comparison, was estimated to have a reserve of 300 million tons of ore at 0.5% grade (3 billion pounds of copper). Cypress paid $60 million in stock and would need $100 million in cash to develop.

LAKE SHORE (ARIZONA) COPPER DEPOSIT

(Underground Mining)

Location

The Lake Shore deposit lies approximately 60 miles due south of Phoenix and 50 air miles west-northwest of Tucson on the Papago Indian Reservation. It is two miles east of the paved highway connecting Casa Grande, 23 miles to the north, with Sells, the Papago Council headquarters, some 55 miles to the south. It is a flat desert on the south westerly side of the Slate Mountain.

The property consists of (1) three patented lode mining claims covering 62 acres known as the Treasure State Claims; (2) three patented and 19 unpatented lode mining claims covering 400 acres known as the Drake Claims; (3) 3,717 acres held under mining leases; and (4) 6,325 acres held under a business lease from the Papago tribe.

Ownership

Mining claims were first located on this property in the 1880's and a few tons of ore were shipped. Again between 1914 and 1919, it was actively explored and some additional ore was shipped. Transarizona operated and explored it until they were forced into receivership in 1962. They tried to interest several companies in the

properties. El Paso Natural Gas conducted modest drilling in 1963; and finally in 1966, acquired 100% interest in all the properties of Transarizona Resources, Inc. El Paso processed some of the oxide ores by the segregation process from a small open pit ore body while doing extensive drilling.

By February, 1969, seventy-seven (77) drill holes delineated a major ore discovery estimated to contain 472 million tons averaging 0.75 percent copper, also averaging 700 to 3,200 feet deep. This figure included 241 million tons of dissiminated sulfide averaging 0.7 percent copper, 207 million tons of dissiminated oxide averaging 0.71 percent copper, and 23.6 million tons of tactite sulfide ore averaging 1.69 percent copper. A second management report, dated about the same time, indicates the deposit to be 322 million tons of 0.81 percent ore. 22 holes

In 1969, agreements were reached by El Paso and Hecla Mining Company (Wallace, Idaho) whereby Hecla would obtain half interest in the property and become the operator of this underground mine. The 1972 Hecla Annual Report states the estimated cost to develop this project, including start up costs, will be $140 million divided equally between Hecla and El Paso. Production is scheduled for early 1975. @ 16,000 TPD

Plant

The concentrator, roast-leach-electrowinning and vat leach pilot plants operated successfully during the year and provided the data necessary for design engineering of the commercial plants. Some additional pilot testwork in the vat leach-cementation and sponge iron processes will be continued in 1973.

Design engineering of the ore storage facilities, fine crushing plant, and concentrator was completed by Mountain States Engineering. Construction of these facilities is now underway, with the concrete work essentially complete. Design engineering of the other metallurgical plants has been assigned to Parsons-Jurden Corporation and this work is now in progress.

No mention is made of smelter and refining facilities, nor was data available regarding concentrator size.

Hecla has spent $45,280,918 through 1972 on the Lake Shore property. This has been financed through working capital and a $9 million 90-day bank credit agreement. An agreement has been made with banks to increase this loan to $42 million which will later be converted to a 5-year note. A recent agreement has also been reached whereby El Paso will make future development payments until El Paso's share equals Hecla's. After that, further expenditures will be on a 50-50 basis.

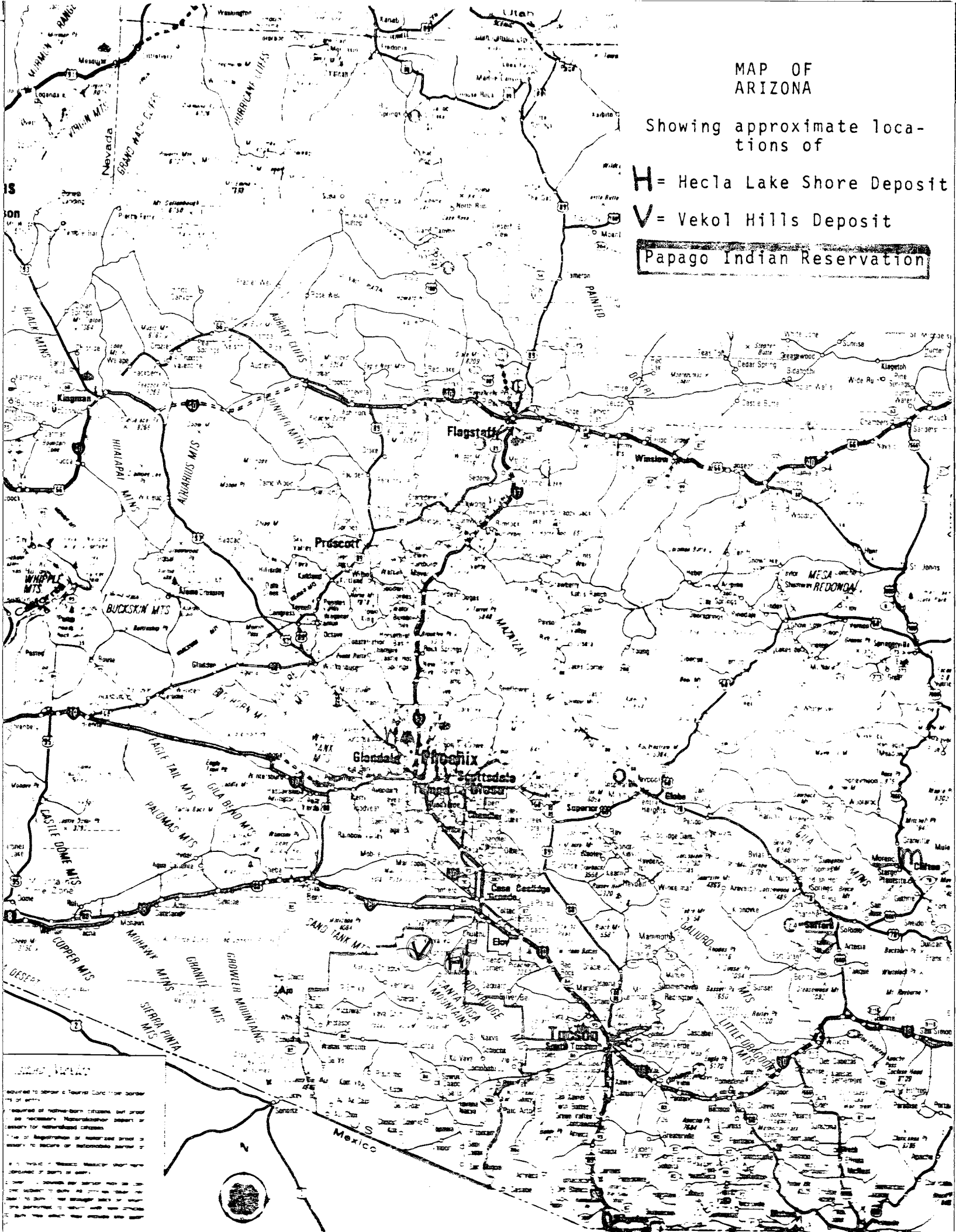
CONTENTS

Arizona Map

Lake Shore Deposit

Vekol Hills Deposit

Hecla Mining Company


MAP OF
ARIZONA
Showing approximate locations of
H = Hecla Lake Shore Deposit
V = Vekol Hills Deposit
Papago Indian Reservation
Flagstaff
Winslow
Kingman
Prescott
Glendale
Phoenix
Scottsdale
Tucson
Casa Grande
Eloy
Superior
Globe
Clifton
Safford
Nevada
Utah
Mexico
BLACK MTS
HUALAPAI MTS
AQUARIUS MTS
BUCKSKIN MTS
WHIPPLE MTS
EAGLE TAIL MTS
GILA BEND MTS
PALOMAS MTS
CASTLE DOME MTS
COPPER MTS
MOHAWK MTS
GRANITE MTS
GROWLER MOUNTAINS
SIERRA PINTA MTS
SANTA ROSA MOUNTAINS
ROCKDUDGE
SAND TANK MTS
GALIURO MTS
LITTLE DRAGOON MTS
MESA REDONDA
PAINTED DESERT
AUBREY CLIFFS
HURRICANE CLIFFS
GRAND WASH CLIFFS
VIRGIN MTS
MURMON RANGE

VEKOL HILLS (ARIZONA) COPPER DEPOSIT

(Open Pit Mining)

Location

The Vekol area lies 10-15 miles northwest of the Lake Shore deposit in the Arizona desert about 60 miles south of Phoenix. The property is leased from the Papago Indian tribe by the Vekol Hill Mining Company.

History and Ownership

Hunting Geophysical Surveys of Canada obtained a prospecting permit from the Papago Indians and after two or three years found two significant magnetic and I.P. targets of which Vekol was one.

Hunting and Hamms Brewery interests formed the Deniza Mining Company for exploration of the area. Getting encouragment from drilling the anomalous zones on the Vekols, Deniza sold an estimated two-thirds (2/3) to a Newmont-New Jersey Zinc joint venture.

Upon further drilling, Newmont increased their interests and New Jersey sold their interest to Superior Oil. Eventually, all Deniza interest was purchased and the Vekol Hill Mining Company was formed. Ownership is reported as follows:

Newmont Mining	51%
Superior Oil	48%
A Milwaukee/Minneapolis beer interest	1%

The Papago Indians have a sliding scale royalty of 5% N.R.S. based on planned production grades of approximately 0.67 percent copper.

Reserves

The following data are approximates obtained in February, 1973, by Grover Heinrichs from Ben Dickerson, Manager of Superior's Mineral Division:

Reserves: 100 million tons of ore

Grade: 0.55 to 0.60 percent copper with Moly and precious metal benefits

Stripping Ratio (after removal of overburden); 2:1 to 3:1

Stripping overburden on a daylight basis takes 18 months, or 9 months on a 24-hour basis

Property life at 20,000 TPD estimated 14 years

Development

The property is reportedly drilled out and all engineering feasibility studies are completed. Total costs expended to date are estimated at $6-7 million. The contract with the Papago's comes up for renewal in 1975. Meanwhile, until the property is put into production, the advance royalties on the 2,800 acres comprising this lease ~~if~~ are $50,000 a year.

HECLA MINING COMPANY

Ownership

Hecla's Balance Sheet as of December 31, 1972, showed:

Assets	$72,543,000
Liabilities	22,643,000
Net Worth	49,900,000

The common stock is listed on the New York Exchange. The current price is $15-16 with a high-low for the year of $20 and $15. Outstanding shares total 6,330,137. El Paso Natural Gas Co. holds 1,061,208 shares or 16.8%. El Paso received one million shares in 1969 for half interest in the Lake Shore deposit. The transaction at the time was reported to be valued at $28 million. For the years 1970, -71, and -72, Hecla has paid 2% stock dividends in order to conserve cash for developing the Lake Shore deposit.

Hecla's corporate office is in Wallace, Idaho.

Sales and Earnings

Sales for 1972 were $20 million. By product, silver accounted for $7.6 million (38%), lead for $7 million (35%), gold for $2.3 million (11.5%), zinc for $1.7 million (8.5%), and copper for $1.2 million (6%). By mine, the Lucky Friday Mine near Wallace accounted for $10.7 million of silver, lead and zinc; Mayflower Mine east of Salt Lake City accounted for $5.7 million in gold, silver, lead, and zinc; the Sunshine and Star-Morning units at Wallace accounted for another $3.6 primarily of silver and zinc.

no longer in production

Earnings for the past ten years have averaged $4,543,000 a year, between 10-15% on Net Worth a year. The best year was $6,843,000 in 1966, and the worst recent year was 1972 with $2,500,000. The reduction in 1972 profits was caused by the fire disaster in the Sunshine Mine including the non-insurable after-tax loss of $545,000 plus the loss from not operating for eight months while during rehabilitation of the mine. Hecla's share of the start up loss in the Granduc (Copper) Mine in British Columbia (35.4% owned) was an additional $560,000 for 1972.

Investments and Mining Properties

Hecla shows investments in mining properties as of December 31, 1972, of $18 million (see attached). These investment properties are operated by others. The largest is a 35.4% ownership in the Granduc Mine being operated by Newmont and Asarco. In 1972, the second year of operation, the Granduc produced 54 million pounds of copper.

Properties owned and operated by Hecla include the Lake Shore deposit on which they have spent $45,281,000 through 1972. Hecla has recently revised their agreement with El Paso whereby El Paso will pay future development costs until El Paso's contribution equals Hecla's. After that, each contributes equally. The total cost to production is estimated at about $150 million.

Hecla has borrowed $9 million from banks who have agreed to lend up to $42 million on 90-day notes, and later convert to a 5-year note.

Hecla's other mining properties show a cost of $10.4 million. Against these and the Lake Shore, Hecla has a depreciation reserve of $10 million.

ESSEX AND HECLA
COMBINED BALANCE SHEETS
DECEMBER 31, 1972
(in "000")

	ESSEX	HECLA	TOTAL	%
ASSETS				
Current Assets	$321,877	$ 6,319	$328,196	63%
Investments and Other Assets	8,438	20,497	28,935	6
Goodwill	5,117	----	5,117	1
Fixed Assets - Net	110,838	45,727	156,565	30
Total Assets	$446,270	$72,543	$518,813	100%
LIABILITIES AND NET WORTH				
Current Liabilities	$ 75,870	$ 5,428	$ 81,298	16%
Long-Term Debt	112,119	9,000	121,119	23
Other Liabilities and Taxes	8,600	8,215	16,815	3
Sub-Liabilities	$196,589	$22,643	$219,232	42%
Preferred Stock	$ 533	$----	$ 533	---
Common Stock	8,848	1,583	10,431	2
Surplus	240,280	48,317	288,597	56
Sub-Net Worth	$249,681	$49,900	$299,581	58%
Total Liabilities	$446,270	$72,543	$518,813	100%

HECLA MINING COMPANY
Analysis of Investments and Properties
As of December 31, 1972

Investments and Interests in Mining Operations

Day Mines, Inc., at cost (13.5% owned-Market $3,302,338)	$ 3,628,798
Sunshine Mining Co., at cost (3.7% owned-Market $1,994,750)	2,754,087
Granduc Mines, Ltd., at equity (35.4% owned-Common Stock $4,233,812, Preferred Stock $4,855,430)	9,089,242
Other listed capital stocks, at cost (Market $1,443,240)	2,200,373
Other, at cost	516,661
Hecla (243 shares of treasury stock)	2,710
Total Investments (Market Value $16,348,941)	$18,011,871

Properties, Plants, and Other Assets

Lake Shore	- Mining Properties	$ 3,172,989	
	- Deferred Development Costs*	26,221,162	
	- Plants and Equipment	15,886,767	$45,280,918
Other	- Mining Properties	$ 1,701,143	
	- Deferred Development Costs	3,086,736	
	- Plants and Equipment	5,482,377	
	- Land	133,547	10,403,803
			$55,684,721
less: Reserve for Depreciation			(9,957,734)
Properties, Plants - Net			$45,726,987
Advance Royalties - Lake Shore			2,000,000
Other Assets			484,286
Properties, Plants and Other Assets			$48,211,273

*Includes capitalized depreciation of $4,225,654.

HECLA MINING COMPANY

EARNINGS AND DIVIDENDS OF PRIOR YEARS

The following is a 10-year summary of earnings and dividends per share. Shares outstanding are based upon the weighted average number of shares outstanding for each year where such average differs significantly from shares outstanding at the end of the year.

	Total Earnings	Average Number Shares Outstanding*	Net Income Per Share*	Dividends Paid Per Share	
				*	**
1963	$1,846,227	3,462,144	$ .53(1)	$ .22	$ .3375
1964	5,198,379	6,038,620(2)	.86	.48	.615(3)
1965	5,825,845	6,052,698	.96(1)	.47	.60(4)
1966	6,843,424	6,212,063	1.10(1)	.45	.575
1967	5,572,206	6,295,492	.85	.47	.60
1968	4,648,465(5)	6,315,816	.74(5)	.51	.65
1969	4,874,154	6,322,468	.77	.58	.70
1970	4,715,058	6,326,464	.75	.16	.175
1971	3,616,772(6)	6,328,952	.57(6)		
1972	2,500,421(6)(7)	6,329,894	.40(6)(7)		

*Adjusted to reflect the 1 for 1 stock distribution in 1968, the 1,000,000 shares issued in 1969 to acquire net assets of Transarizona Resources, Inc. on a pooling of interests basis and the 2% stock dividends in 1970, 1971 and 1972.

**Adjusted to reflect 1 for 1 stock distribution in June 1968.

(1) Net income per share includes extraordinary net capital gains on sales of capital stock of other companies as follows: 1963 — $.08; 1965 — $.02; 1966 — $.13.

(2) In 1964, 2,572,675 shares were issued when Lucky Friday Silver-Lead Mines Company was merged into Hecla.

(3) $.35 per share in cash plus two shares of The Bunker Hill Company (market value 26.5¢ per share of Hecla) for each 100 shares of Hecla.

(4) $.375 per share in cash plus two shares of The Bunker Hill Company (market value 22.5¢ per share of Hecla) for each 100 shares of Hecla.

(5) Restated to reflect results of operations of Transarizona Resources, Inc. acquired during 1969 on a pooling of interests basis. Years prior to 1968 were not adjusted to reflect Transarizona operations as such results were not material for those years.

(6) Restated for 1971 to include equity in net loss of Granduc Mines, Limited (NPL) in which Hecla owns 35.4% of the Common Stock. Amounts deducted include $359,911 for 1971 and $330,247 for 1972. Effect on per share earnings is $(.06) in 1971 and $(.09) in 1972.

(7) Net income per share includes deduction for an extraordinary loss from the Sunshine Mine fire disaster of $(.05) per share.

ESSEX GROUP

Internal Correspondence

To: Paul O'Malley

Date: September 5, 1978

From: E. Grover Heinrichs

cc: Ben Bowdon

Subject: Letter of July 20, 1978 from Hecla Mining Co. Pres., Bill Love, to Harry Gray

The Lakeshore Mine, though it does represent 600,000,000 tons of copper ore or 8 billion lbs. of copper, which is being put on the auction block by Hecla as described in the subject letter is not in my opinion a good Essex opportunity; and not too much has changed since my memo to you of 3/10/78 (copy enclosed). The known problems at Lakeshore are itemized below:

1. The underground mine would require extensive redesign at an estimated cost of $50,000,000.

2. The royalty payment to the Papago Indians of 10% NSR is considered too high and would have to be renegotiated.

3. The metallurgical reduction plant is not ideal (see attached report by Lyle Lichty, May 1975). What value could be placed and of what use the present plant facility could be, would depend on the ultimate final design modifications. If Lichty's modifications were utilized the cost would likely be in the area of $20,000,000 with some cost reductions in this figure by using the existing facilities.

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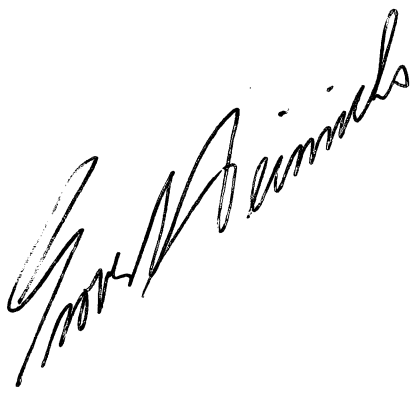


P.S. In summary therefore, it is my recommendation that the request for bid by Sept. 16, 1978 not be acted upon. Instead, with your permission, I will maintain surveillance of the property and informally inquire of Newmont as to any possible interest on their part in such a venture.

EGH

G 4/Phillips

HECLA MINING COMPANY
P. O. Box 320
WALLACE, IDAHO 83873
(208) 752-1221

HARRY J. GRAY

JUL 28 1978

7 8 9 10 11 12 1 2 3 4 5 6 PM

July 25, 1978

Mr. Harry J. Gray
Chairman and President
United Technologies Corporation
Hartford, CT 06101

Dear Mr. Gray:

Please note the attached pages.

Any or all bids which will equal or exceed what Hecla might expect from salvage of plant and equipment will be considered.

Sincerely yours,

W. H. Love
President

WHL/amh

Enclosures

July 7, 1978

DOMESTIC COPPER MINE

and

INTEGRATED METALLURGICAL PLANT

FOR SALE

Hecla Mining Company's undivided one-half interest in the Lakeshore Mine and Metallurgical plant located on the Papago Indian Reservation, 30 miles south of Casa Grande, Arizona.

Sealed bids must be submitted prior to September 16, 1978.

Qualified parties may obtain detailed information regarding this facility and its production history by writing or calling:

W. H. Love
or
William A. Griffith
Hecla Mining Company
P. O. Box 320
Wallace, Idaho 83873

Phone: (208) 752-1251

Telex: 326476
Hecla Co Walc

There are no prestablished terms of any offer, but the Company reserves the right to refuse any and all bids for any reason. All proposals will be kept in the strictest confidence.

Principals only

July 7, 1978

DOMESTIC COPPER MINE

and

INTEGRATED METALLURGICAL PLANT

FOR SALE

Hecla Mining Company is offering for sale its undivided one-half (1/2) interest in the Lakeshore copper mine and integrated metallurgical plant near Casa Grande, Arizona, to a buyer who has the financial capability to assume Hecla's position at this property. It is Hecla's belief that this opportunity affords the purchasing company the ability to acquire substantial mineral reserves and an operating plant at a cost which would be very substantially less than that which would be necessary to explore for, develop, and bring into production a copper property of similar potential.

The Lakeshore mine has been developed under a joint venture agreement between Hecla and the El Paso Natural Gas Company since early 1970. The plant commenced operations in early 1976 but, because of the present state of copper prices, has been idle since September 1977.

The joint venture leased 10,505 acres from the Papago Tribe of Indians pursuant to two leases; a Mining Lease covering the ore mineral deposit, and a Business Lease. The Mining Lease, dated August 17, 1976, runs for a period of ten years and as long thereafter as minerals are produced from the properties in paying quantities. Under the Mining Lease the present royalty is equivalent to 10% of net smelter returns. There are also provisions for minimum advance royalties, currently $160,000 per month. Lessee is able to recoup previously paid but unrecouped advance royalties out of not less than 75% of earned royalties.

The Business Lease provides lands necessary for plant facilities, waste dumps, tailings disposal, and other functions related to the mining operation. The Business Lease is for a period of 25 years (from September 1969), with an option to renew for a like period. The rental has been paid in full for the initial 25-year period.

In addition the Hecla-El Paso joint venture has rights of way for water and natural gas pipelines, water permits for use of water at no charge and agreements covering the purchase of power. Water for the Lakeshore operation is supplied from a well field constructed about 6 miles west of the plant site, under provisions of a 25-year contract with the Papago Tribe.

A shipping and receiving facility is owned in an industrial park in Casa Grande, Arizona. This installation includes railroad spurs and facilities for loading and unloading railcars and trucks.

The Lakeshore copper deposit is a composite body consisting of an oxide mineral zone and a sulfide mineral zone. There is little known intermixing of oxide and sulfide mineralization.

Based on information from drill holes and underground development, the total amounts of copper mineralization within the deposit have been computed at various grade cutoffs as shown in the following table:

Lakeshore Mineral Inventory, April 1975 (In-situ)

Grade Cutoff	Oxide Mineral Inventory		Sulfide Mineral Inventory	
	Tons	% Acid Soluble Copper	Tons	% Copper
0.10	825,375,000	0.45	808,583,000	0.47
0.30	142,583,000	0.72	523,083,000	0.62
0.40	103,000,000	0.86	401,500,000	0.70
0.50	79,583,000	0.99	293,583,000	0.80
1.00	28,250,000	1.52	50,583,000	1.39

The proportions of these reserves that can be considered mineable ore reserves depend upon metal prices, mining methods, costs of operation, and other considerations.

The Lakeshore mine is an underground copper mining operation. The oxide and tactite sulfide sections of the mine, although interconnected, are essentially separate operations. The principal mining method has been block caving. During the eight months of operation in 1977 sulfide mine production was at a rate of about 152,000 tons per month containing 0.91% total copper. Oxide production during the eight months of operation in 1977 was at an average rate of about 159,000 tons per month containing 0.98% acid soluble copper.

Surface mine support installations include office and dry buildings, heavy equipment shop facilities, power, compressor, and hoist facilities, radial stackers, water supply, and sewage facilities.

The Lakeshore metallurgical plant was designed to produce pelletized copper precipitates from oxide ore, and electrowon cathode copper from sulfide ore, while complying with all present environmental regulations. The operation utilizes by-product sulfuric acid produced in the treatment of sulfide flotation concentrates for the leaching of material from the oxide mine. The pelletized cement copper product is suitable for direct charging into the converters of conventional smelters.

The same fine crushing facilities are used for oxide and sulfide, and a crushing rate in excess of 980 tons per operating hour has been demonstrated.

The oxide material has been treated in a vat leaching operation having a capacity of about 6,500 tons per day, with copper recovered as copper precipitate. Average recovery of acid soluble copper during 1977 was 92%.

The sulfide material is treated in a conventional flotation concentrator, having a capacity of 10,000 tons per day, to produce a concentrate. Copper recovery in concentrate averaged 85% during 1977. The sulfide concentrate is treated by a process of sulfate roasting, leaching, and electrowinning to produce cathode copper. This plant has a demonstrated capacity of about

30,000 tons of electrowon copper annually, a substantial portion of which is in the form of high quality cathode which is suitable for direct charging into continuous copper rod drawing systems. The sulfide concentrate treatment facility has also successfully processed a variety of copper concentrates from other Arizona mines.

The two products, cathode copper and pelletized cement copper, are trucked to a rail-loading facility in Casa Grande, Arizona, 30 miles to the north. From that point, the cathode copper is shipped to fabricators, and the cement copper is shipped to custom smelters.

Hecla has the right to take 50% of the products derived from the Lakeshore mine and has sold 60% of its share of cement copper precipitates to ASARCO Incorporated, who also smelted and refined the remaining 40% under a tolling arrangement.

The copper returned on toll has been marketed by Hecla.

All of the cathode produced has been sold to Southwire Company, Carrollton, Georgia.

Operating results of the Lakeshore mine and related facilities during 1976, and 1977, including the first quarter startup period in 1976, are summarized in the following table. This table reflects the production shutdown during the month of September 1977 which has continued to date.

	Tons of Ore Processed		Average Grade of Ore Processed - Copper %		Production Tons of Copper	
Year	Sulfide Ore	Oxide Ore	Sulfide	Oxide	Lakeshore Production	Purchased Concentrate
1976 (1)	1,231,000	1,460,000	0.76	1.03	19,620	8,758
1977 (2)	1,216,000	1,271,000	0.91	0.98	20,195	15,410

(1) Includes production from January 1 to year-end, including first quarter startup period.

(2) Operations were suspended in September 1977.

While the present relationship between Hecla and El Paso is a joint venture, El Paso has advised Hecla that it intends not to increase its percentage interest in the property. The purchasing party thus can tailor its offer in a manner which will best suit its needs and conditions, and Hecla is willing to review any offer whether it is a cash purchase, purchase for stock, retained carried interest or any other consideration which an offering party might find desirable. In order to be seriously considered, however, the offering party must be ready, willing, and able to assume all of Hecla's future liabilities with respect to the Lakeshore mine, including contractual obligations under the leases with the Papago Tribe of Indians and others.

The El Paso Natural Gas Company presently holds a first right of refusal for sixty (60) days with respect to any sale of Hecla's interest in the Lakeshore properties. As stated above, El Paso has recently stated that it is El Paso's intent not to increase its percentage interest in the Lakeshore mine. An offering party must stand ready to assume Hecla's obligations within thirty (30) days from the date that El Paso has formally rejected the right to purchase on the same terms and conditions the offering party presents.

The agreements with the Papago Tribe of Indians provide for assignment to a purchasing party. Any purchasing party with net worth in excess of $100,000,000 can accept assignment without approval by the Secretary of the Interior. Those with net worth less than that amount would be required to obtain the Secretary's approval.

As full freedom is allowed with respect to consideration for the property, Hecla must also look to the offer which will best serve its shareholders. Therefore Hecla specifically reserves the right to refuse for any reason any and/or all offers which may be presented. Hecla further reserves the right to accept any offer, whether or not such offer came about as a result of advertisement, or otherwise.

A careful and independent investigation should be made prior to submittal of a bid. Each party submitting a bid should rely on its own evaluation and draw its own conclusions with respect to the Lakeshore mine, as the projections and opinions of Hecla are merely that. Qualified parties may obtain detailed information regarding this facility and its production history and may arrange for a physical inspection of the plant by contacting:

William H. Love or
William A. Griffith
Hecla Mining Company
P. O. Box 320
Wallace, Idaho 83873

Phone: (208) 752-1251

Telex: 326476
HECLA CO WALC

As some information is sensitive or subject to confidentiality agreement, Hecla may, in some cases, ask that a confidentiality agreement be executed prior to disclosure.

Sealed bids must be submitted prior to September 16, 1978.

Principals only

L A K E S H O R E

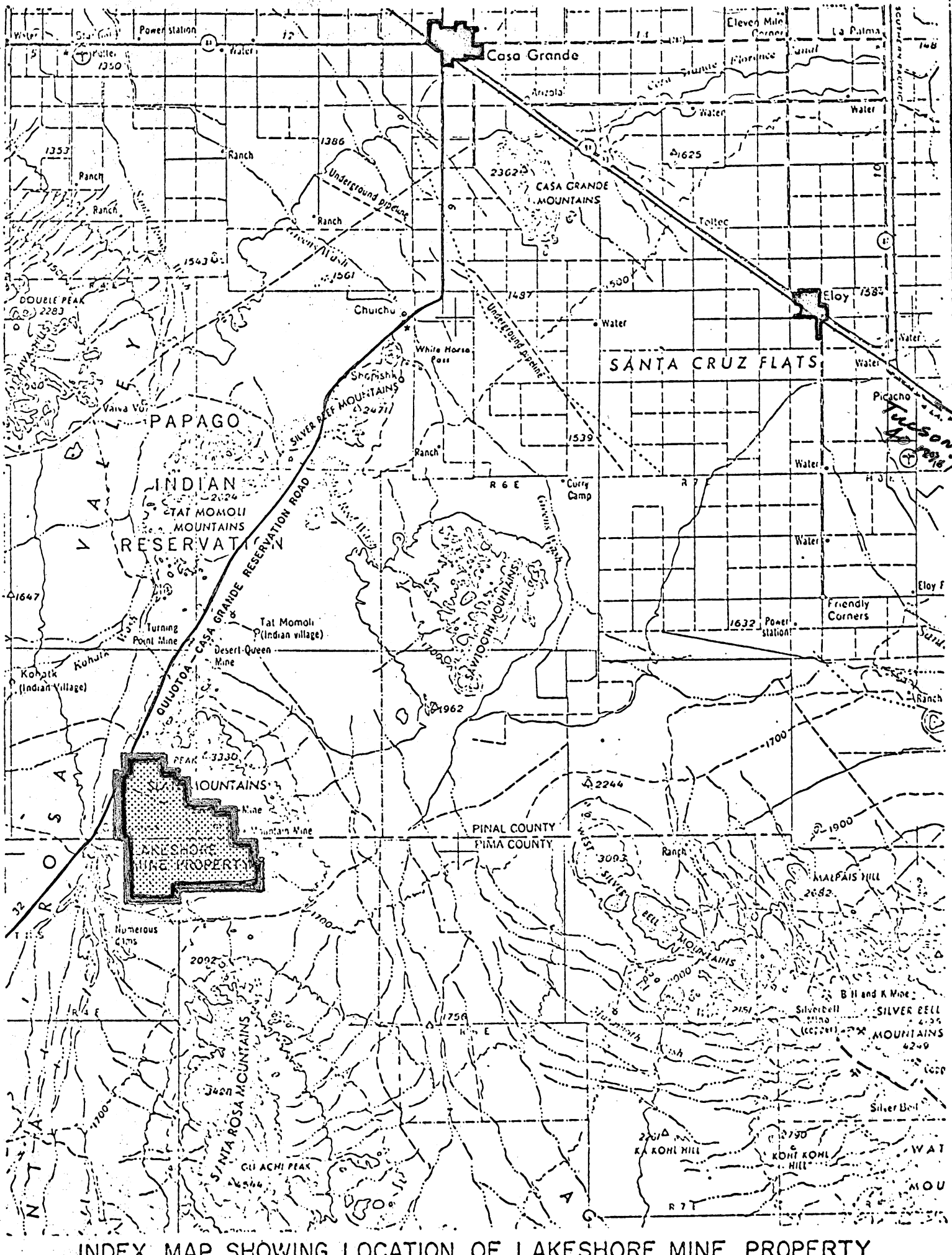
AT A GLANCE

Location:	Slate Mountains 28 miles south-southwest of Casa Grande, Arizona 70 miles south of Phoenix, and 60 miles northwest of Tucson.
Elevation:	1900 feet above sea level
Ecosystem:	Typical Sonoran Desert
Temperature Range: (1970 - 1973 records)	22° F Low 116° F High
Annual Precipitation:	8 inches
Property:	10,500 acres
Ownership:	Leased from The Papago Tribe by El Paso Natural Gas Co. (50%) and Hecla Mining Co. (50%)
Operator:	Hecla Mining Co.
Work Force:	1200 maximum (construction and development phase) 1200 (production)
Mining Method:	Underground
Ore Treatment:	Hydrometallurgical
Planned Production:	9,150 tons/day sulfide ore 6,450 tons/day oxide ore

March 1974

LAKESHORE MINE

HECLA MINING COMPANY

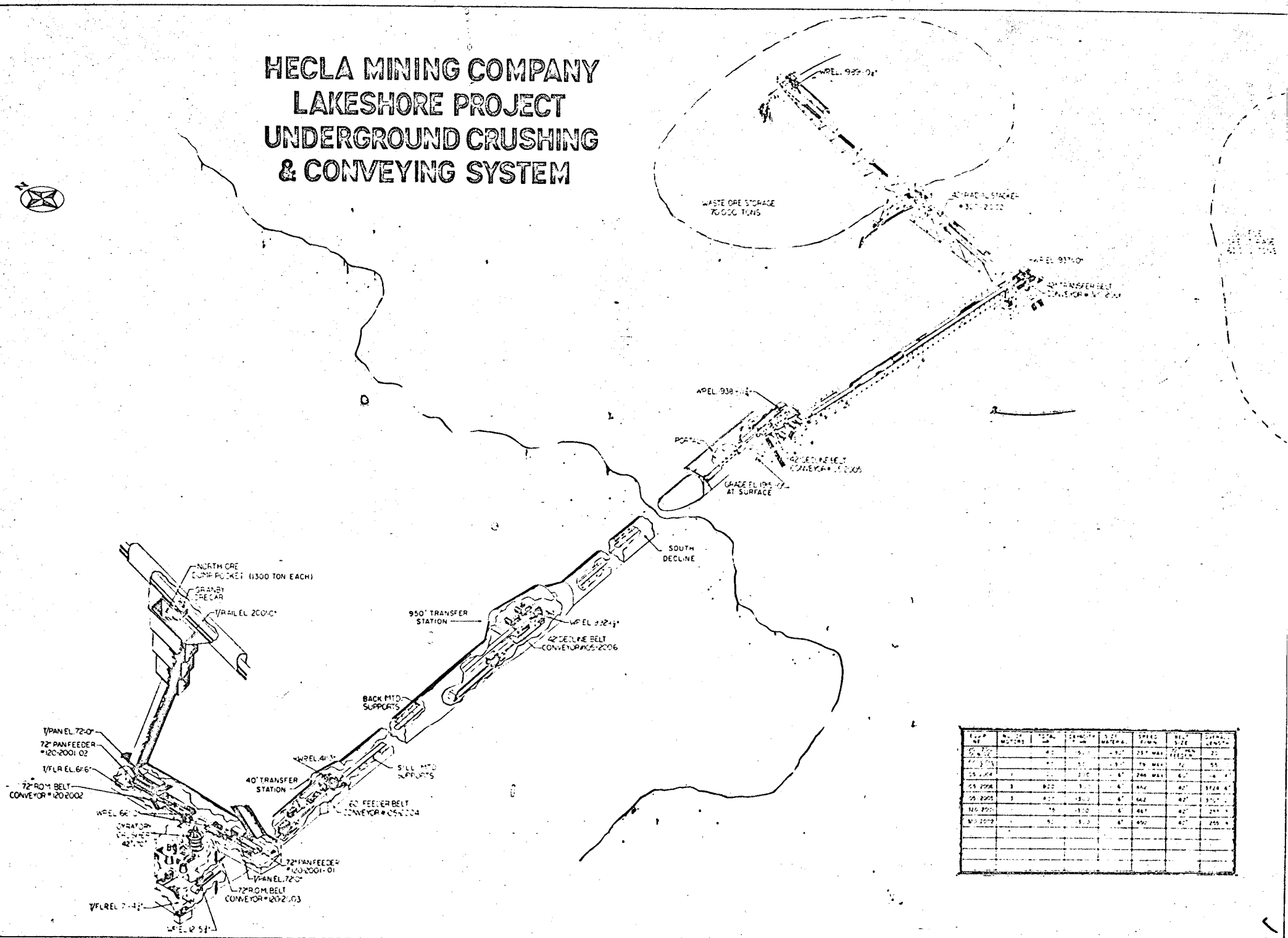


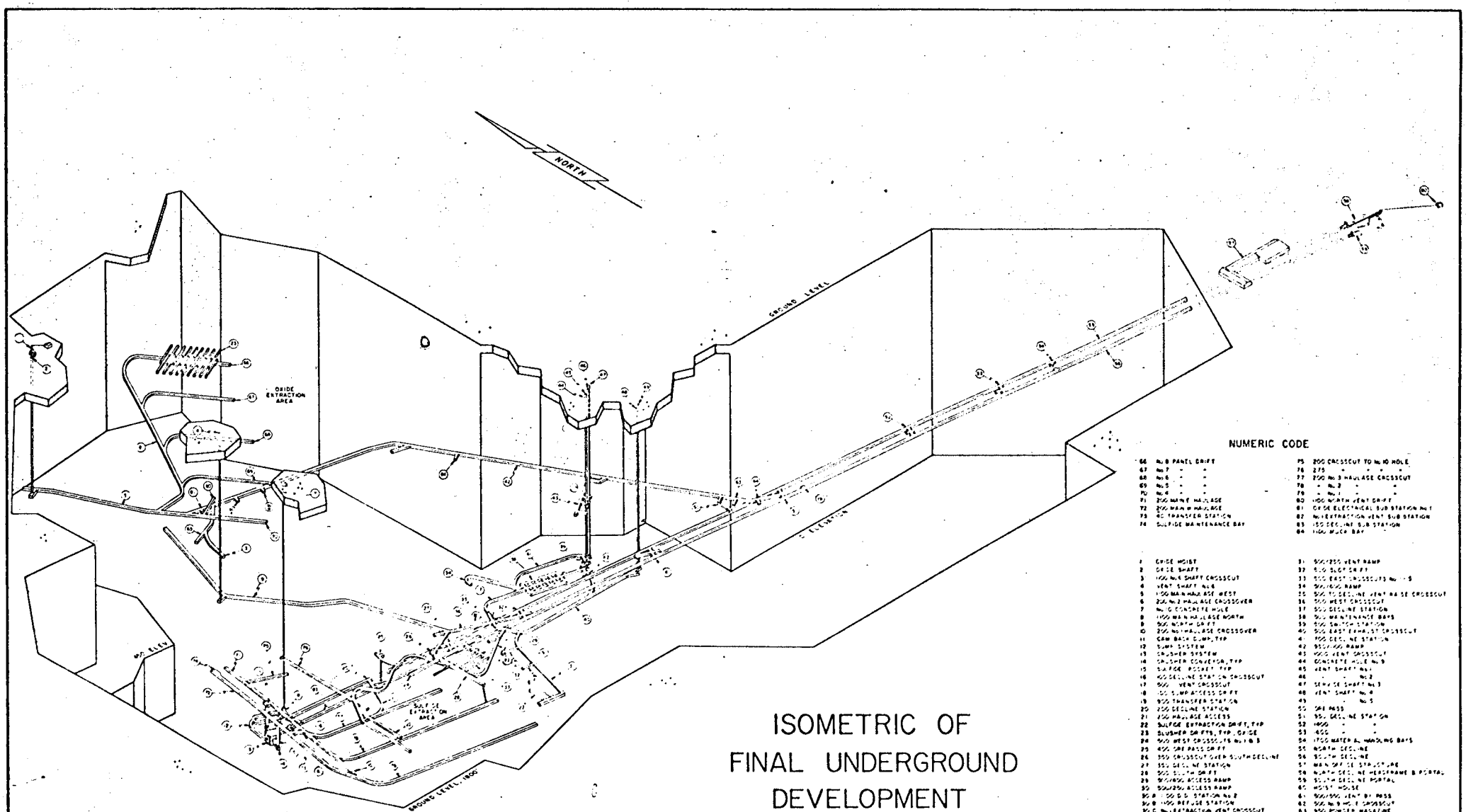
INDEX MAP SHOWING LOCATION OF LAKESHORE MINE PROPERTY

SCALE: 1" = 4 miles

Fig. 1

HECLA MINING COMPANY
LAKESHORE PROJECT
UNDERGROUND CRUSHING & CONVEYING SYSTEM





ISOMETRIC OF FINAL UNDERGROUND DEVELOPMENT

HECLA MINING COMPANY

LAKESHORE MINE

DWG BY [illegible] DATE [illegible]

SCALE [illegible]

NUMERIC CODE

66	No 8 PANEL DRIFT	75	200 CROSSCUT TO No 10 HOLE
67	No 7 " "	76	275 " " " "
68	No 6 " "	77	700 No 3 HAULAGE CROSSCUT
69	No 5 " "	78	" No 2 " "
70	No 4 " "	79	" No 1 " "
71	200 MAIN HAULAGE	80	1100 NORTH VENT DRIFT
72	200 MAIN 8 HAULAGE	81	OXIDE ELECTRICAL SUB STATION No 1
73	4C TRANSFER STATION	82	No 1 EXTRACTION VENT SUB STATION
74	SULFIDE MAINTENANCE BAY	83	1150 DECLINE SUB STATION
		84	1100 MUCK BAY "

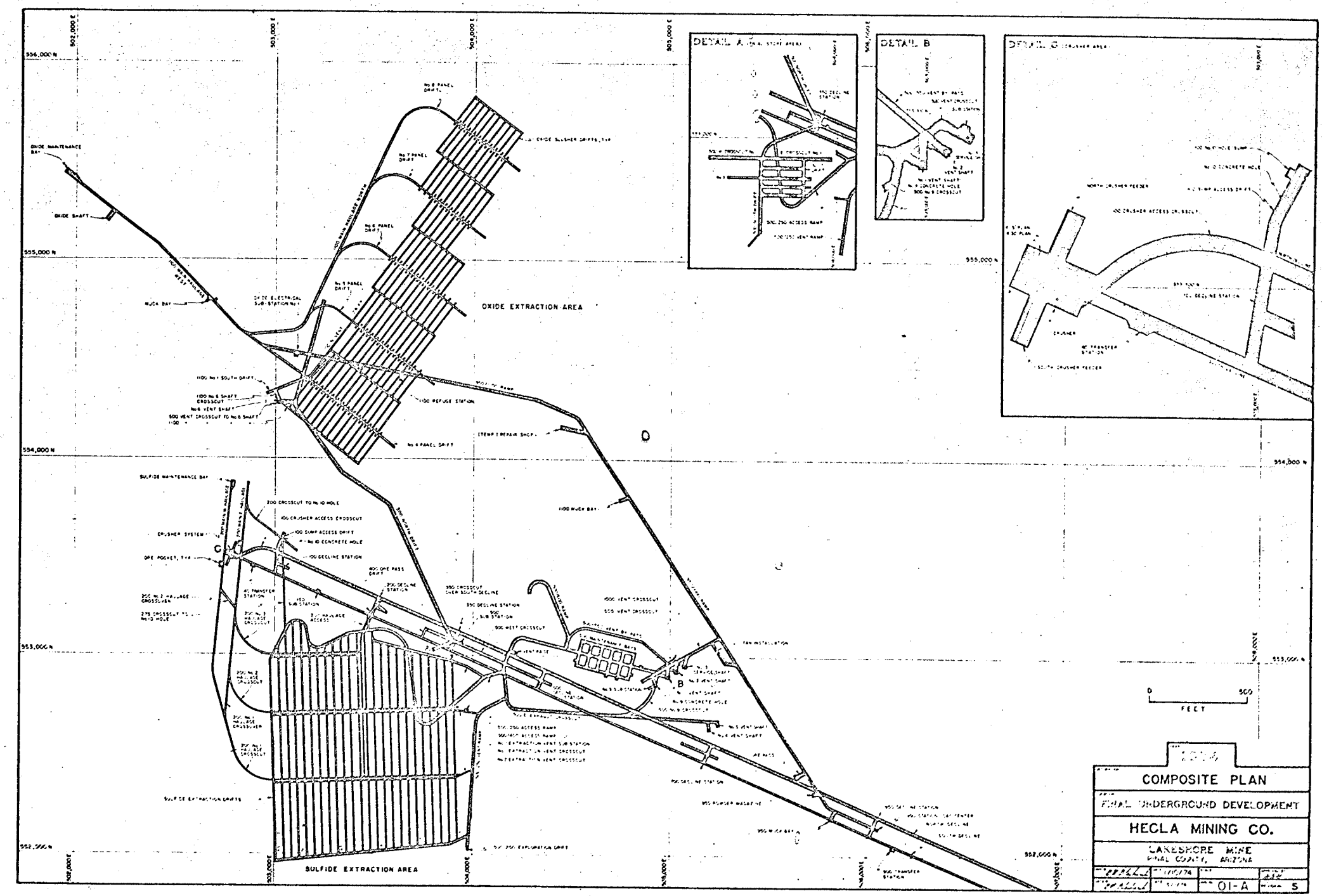
1	OXIDE HOIST	31	900/1250 VENT RAMP
2	OXIDE SHAFT	32	500 SLOT DRIFT
3	1100 No 6 SHAFT CROSSCUT	33	500 EAST CROSSCUTS No 1-5
4	VENT SHAFT No 6	34	900/1100 RAMP
5	1100 MAIN HAULAGE WEST	35	500 TO DECLINE VENT RAISE CROSSCUT
6	200 No 2 HAULAGE CROSSOVER	36	500 WEST CROSSCUT
7	No 6 CONCRETE HOLE	37	500 DECLINE STATION
8	1100 MAIN HAULAGE NORTH	38	500 MAINTENANCE BAYS
9	900 NORTH DRIFT	39	500 SWITCH STATION
10	900 No 1 HAULAGE CROSSOVER	40	500 EAST EXHAUST CROSSCUT
11	CAN BACK DUMP, TYP	41	700 DECLINE STATION
12	SUMP SYSTEM	42	950/1100 RAMP
13	CRUSHER SYSTEM	43	1100 VENT CROSSCUT
14	CRUSHER CONVEYOR, TYP	44	CONCRETE HOLE No 9
15	SULFIDE POCKET, TYP	45	VENT SHAFT No 1
16	400 DECLINE STATION CROSSCUT	46	" " No 2
17	900 " VENT CROSSCUT	47	OXIDE SHAFT No 3
18	5C SUMP ACCESS DRIFT	48	VENT SHAFT No 4
19	1100 TRANSFER STATION	49	" No 5
20	1150 DECLINE STATION	50	ORE PASS
21	1150 HAULAGE ACCESS	51	950 DECLINE STATION
22	SULFIDE EXTRACTION DRIFT, TYP	52	1400 " "
23	SLUSHER DRIFTS, TYP, OXIDE	53	400 " "
24	900 WEST CROSSCUTS No 1 & 3	54	1700 WATER & HANDLING BAYS
25	400 ORE PASS DRIFT	55	NORTH DECLINE
26	350 CROSSCUT OVER SOUTH DECLINE	56	SOUTH DECLINE
27	350 DECLINE STATION	57	MAIN OXIDE STATION
28	900 SOUTH DRIFT	58	NORTH DECLINE HEADFRAME & PORTAL
29	8C/400 ACCESS RAMP	59	SOUTH DECLINE PORTAL
30	500/250 ACCESS RAMP	60	HOIST HOUSE
30 A	250 D.D. STATION No 2	61	900/950 VENT RAISE
30 B	1150 REFUSE STATION	62	500 No 8 RAISE CROSSCUT
30 C	No 1 EXTRACTION VENT CROSSCUT	63	950 POWDER MAGAZINE
30 D	No 2 " "	64	950 MUCK BAY
30 E	900 SUB STATION	65	900 No 5 DRIFT

COLOR CODE

- DECLINES, DECLINE STATIONS & SUMP SYSTEM
- 500 LEVEL DEVELOPMENT
- 1100 " "
- ORE HANDLING SYSTEM
- VENT SHAFTS & RAISES

REV. L

DWG No 002-B



DETAIL A
DETAIL B
DETAIL C
OXIDE EXTRACTION AREA
SULFIDE EXTRACTION AREA
OXIDE MAINTENANCE BAY
OXIDE SHAFT
MUCK BAY
SULFIDE MAINTENANCE BAY
CRUSHER SYSTEM
ORE POCKET, TYP
1100 REFUGE STATION
1100 MUCK BAY
TEMP REPAIR SHOP
FAN INSTALLATION
0
500
FEET
COMPOSITE PLAN
FINAL UNDERGROUND DEVELOPMENT
HECLA MINING CO.
LAKESHORE MINE
PINAL COUNTY, ARIZONA
01-A
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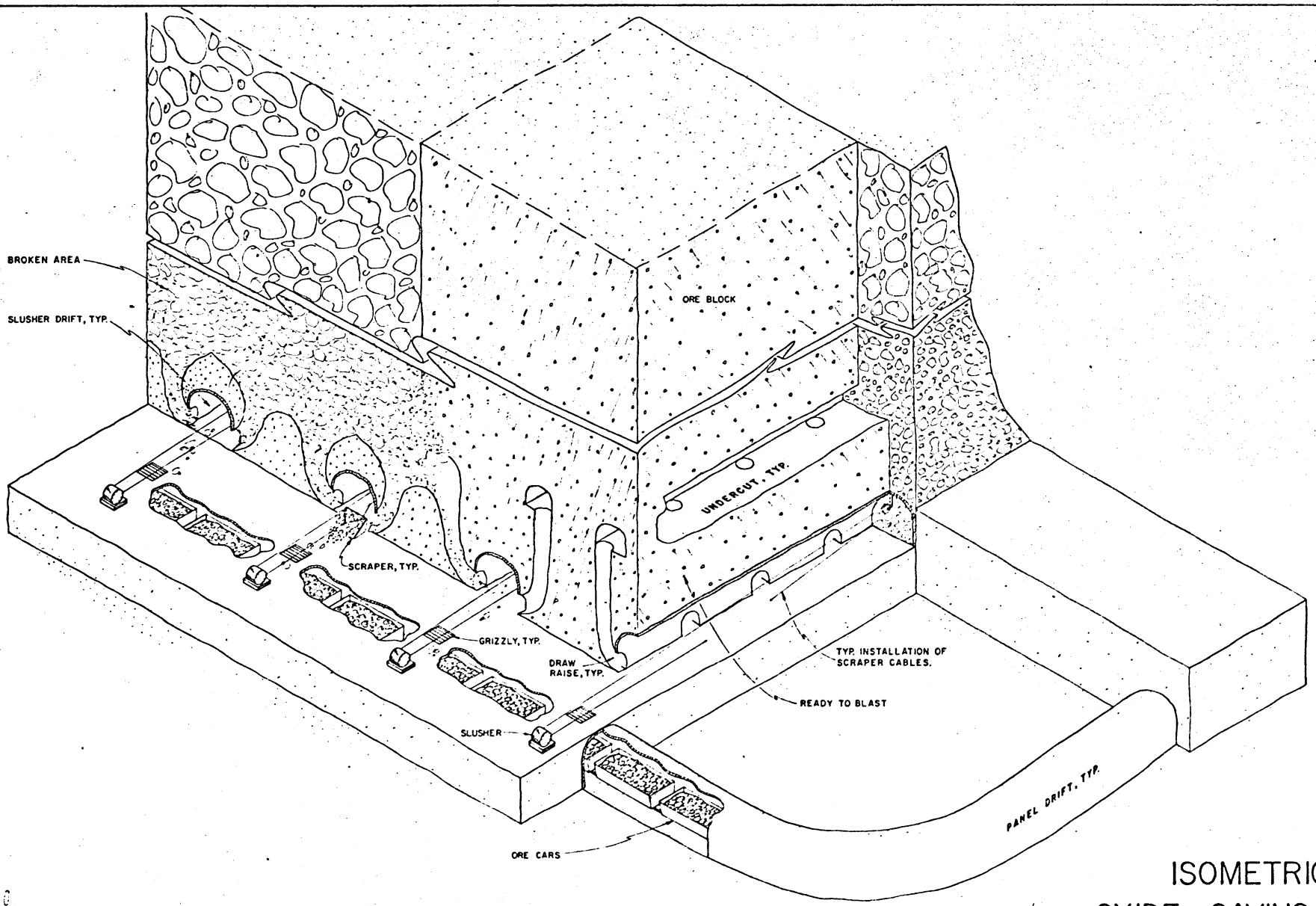
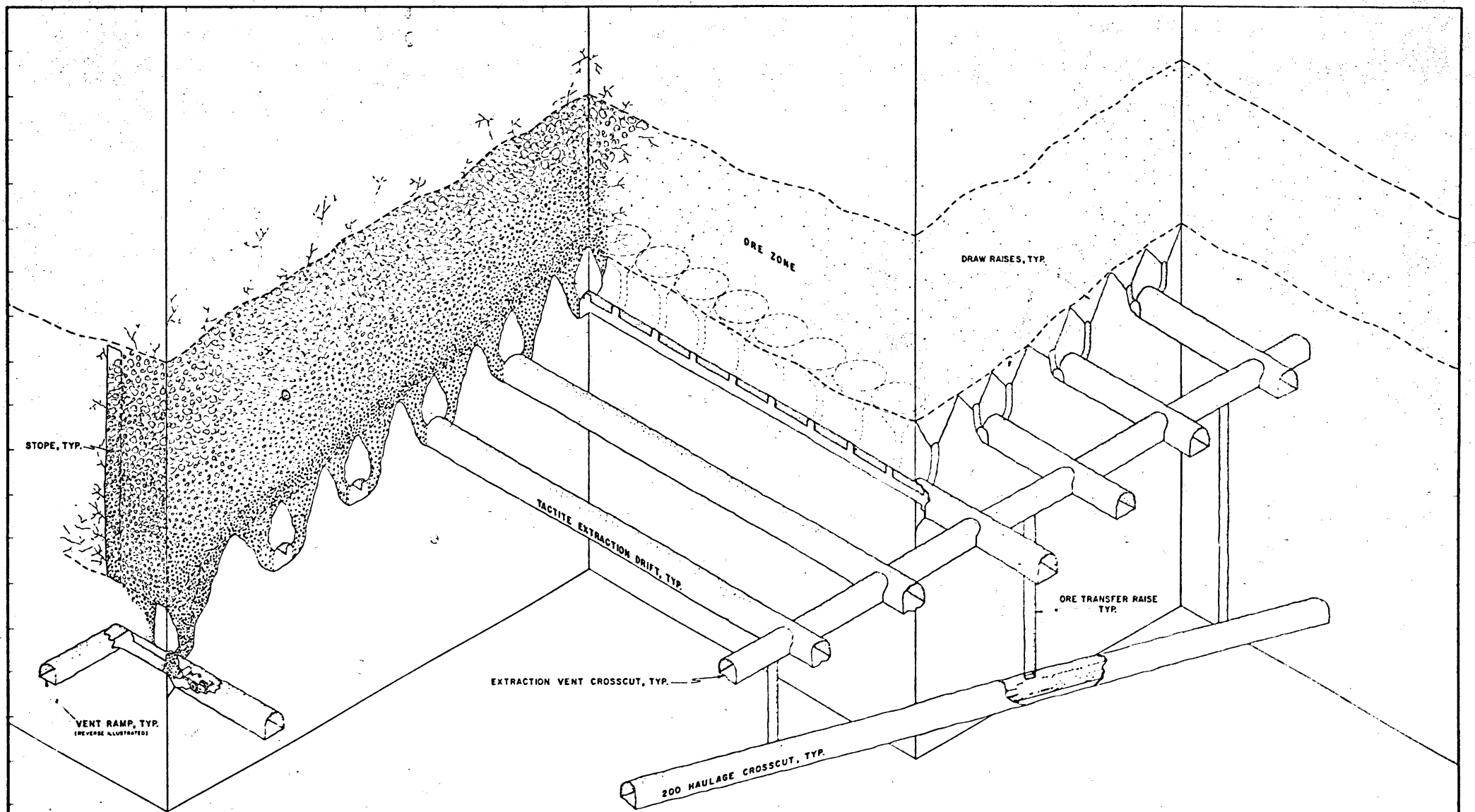


ISOMETRIC OF OXIDE CAVING SYSTEM

HECLA MINING COMPANY
LAKESHORE PROJECT

DWG BY [signature] DATE 12/6/73

DWG. 03-B



ISOMETRIC OF SULFIDE CAVING SYSTEM

HECLA MINING COMPANY
LAKESHORE PROJECT

DWG BY [illegible] DATE 4/23/76

DWG. 04-B

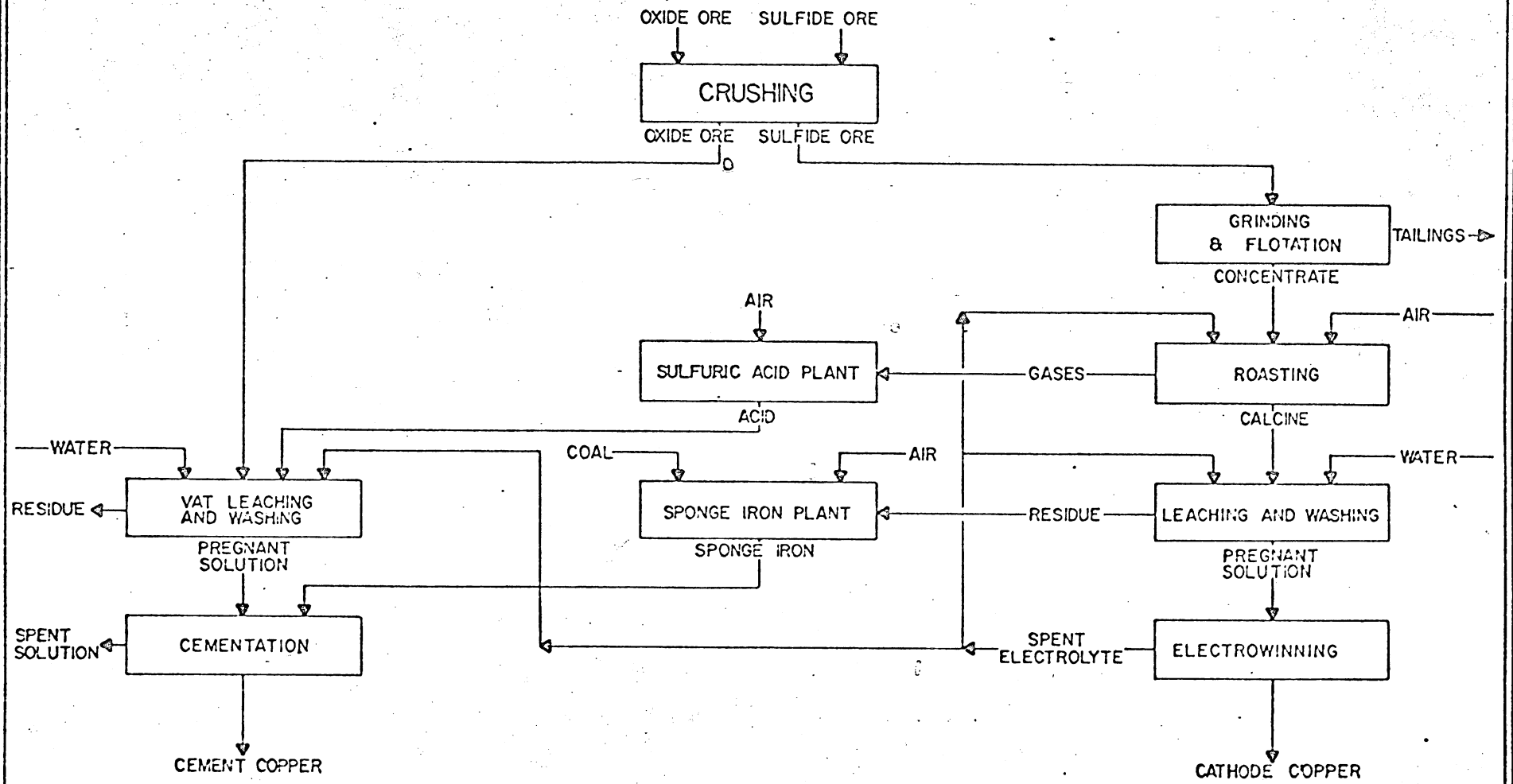
PROPOSED PLANT SURFACE FACILITIES

HECLA MINING COMPANY

LAKESHORE MINE

CASA GRANDE, ARIZONA

Lakeshore Project
Plant Flowsheet



AC-016

avoid verbal orders

CVO

TO Paul W. O'Malley LOCATION Ft. Wayne, Indiana

FROM E. Grover Heinrichs LOCATION Tucson, Arizona

SUBJ. Hecla Mng. Co. Lakeshore Mine DATE March 10, 1978
RE: Letter to Harry J. Gray from
Lehman Bros. Kuhn Loeb (copy enclosed)

COPY TO

The Lakeshore Mine as it now sits is not an economically viable operation and there is some reason to believe that it will take from 3 to 5 years before the price is such that it could be a paying proposition. It is one of the higher cost copper operations in Arizona and was the first mine to close during the current economic crisis.

I have heard that many experts believe the mining phase was not well thought out and some basic conceptual errors were made in the initial mine design. The present system simply does not work. It has been said that the major question now is can the mine and mill be resurrected at some reasonable cost in order to produce ore at a profit.

To determine what could be done and how would be a very expensive study and might require from six months to a year to complete by a team of experts.

The milling and metallurgical phase was studied in some detail by a former Essex employee, Lyle Lichty, and I have included his report as part of the current study.

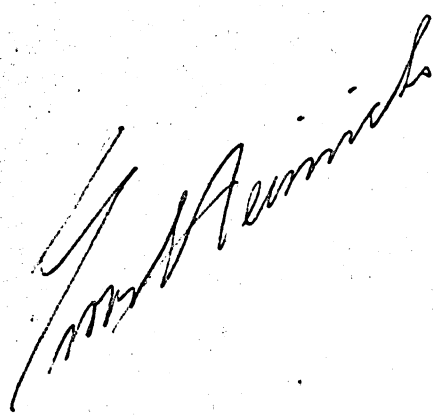
In summary, I would have to recommend that Essex shy away from the Lakeshore property because of the apparent technical problems that may or may not be solvable and the massive amounts of money that will be required to determine this.

The orebody contains a very large amount of copper and it will be mined one day but a major mining company with the expertise readily available would be a logical candidate to take on the project.

One possible opportunity to this that might be worth investigating would be an approach to Newmont on a suggested joint venture basis in which Essex put up some limited cash for a limited feasibility study and Newmont agrees to throw in its Vekol Mine as part of the package. The Vekol is 12 miles from Lakeshore and is not developed; together they might make an economic unit.

A joint study with Newmont would also have some beneficial side effects in getting Essex and United people acquainted with Newmont people in the event a merger is contemplated at some future date. See attached report by R. A. Kelly dated April 26, 1973.

One other approach to consider in all this would be a tender offer for Hecla Mining Co. In my opinion 100% of Hecla at the moment would be easier and cheaper to buy via a tender offer than Hecla's 50% of the Lakeshore Mine.



Comments on Lakeshore Metallurgy

Summary of Current Proposed Plan

1. There are two main classes of ore at the Lakeshore property, namely (1) oxide largely in a high lime gangue and (2) sulfide largely chalcopyrite and these will be treated separately.
2. It is proposed to float a sulfide concentrate and to roast the concentrate forming sulfur dioxide gas which will be converted to sulfuric acid.
3. The sulfuric acid will be used to leach copper from the oxide zone in vats to produce a copper solution.
4. The roasted sulfide concentrate will be leached with water and the copper solution will be sent to an electrolytic copper recovery system to produce cathode copper.
5. The residue from the leaching operation containing some unleached copper iron oxides and whatever gold and silver is present will be reduced to metallic iron in a Lurgi reduction unit using natural gas or oil.
6. The leach copper solution (3 above) is treated with the metallic iron to precipitate copper mud. Any gangue minerals and the gold and silver of the flotation concentrate will report with the copper mud. This produce will be sold to a conventional smelter.
7. In my estimation, overall copper recovery from oxide and sulfide ores will be about 75%.

Criticism of Metallurgical Plan and Recommendations

1. The copper mud production could be low grade compared to other properties and will command a higher smelting charge.

2. The cathode copper may be high in iron and other inclusions, such as silica, since the solutions are not purified after leaching. A similar installation at Ray Mines of Kennecott produces cathodes which require melting and fire refining before being acceptable for sale.

3. The reduction of the iron oxide residue to metallic iron is costly and is not done without difficulties (see 5 above).

4. It is questioned why Hecla did not spend some 25% more capital to produce a product of superior copper grade with a higher overall recovery and no more difficulty with E.P.A. regulations. To accomplish this would entail several radical changes in the overall flow sheet with a LIX plant to treat the leach solutions from the oxide ore and direct electrolytic recovery for the oxide copper in the present electrolytic tank house.

5. In place of the roasting and leaching procedure, it probably would have been better to treat the flotation concentrates in a Noranda type furnace with the sulfur providing most of the energy for the smelting operation. The products of this more conventional operation would be copper anodes containing the gold and silver which would provide good feed for the electrolytic plant and a sure method to recover gold and silver which in the present plan is lost. All the cathode copper thus produced would command a top price or would be suitable for wire bars or rod directly.

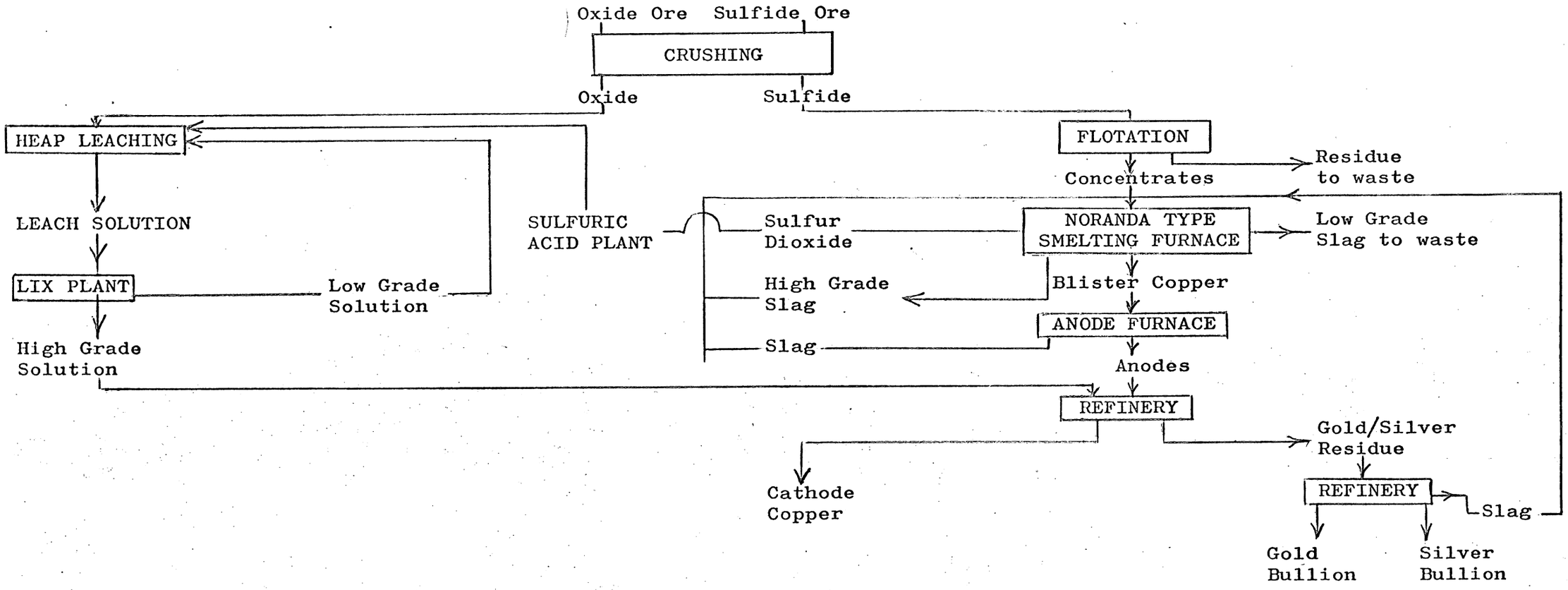
6. Overall copper recovery from oxide and sulfide ores would approximate 85% by these suggestions.

Prepared by: Lyle Lichty, May 1975

SUGGESTED LAKESHORE FLOWSHEET

To Improve The End Product

11/13/75



LJL/rpj

LAKESHORE MINE

SUMMARY REPORT ON CURRENT STATUS

Prepared by

E. Grover Heinrichs

December 14, 1978

Principals representing the Papago Tribe are as follows:

Tribal Chairman:

Cecil Williams
Sells, Arizona

Tribal Attorney and Chief Advisor:

William E. Strickland
Suite 802 Transamerica Bldg.
Tucson, Arizona 85701
Phone: 602/622-3661

Advisor in Mining:

Addison Smith
Suite 802 Transamerica Bldg.
Tucson, Arizona 85701
Phone: 602/622-3661

Technical Advisor to the Tribe:

Thomas O'Neil, Professor of Mining
University of Arizona
Tucson, Arizona

In addition, the U.S. Dept. of Interior passes on all dealings with the Indians through the Bureau of Indian Affairs and the Interior Department further relies on the expertise of the U.S. Geological Survey and the U.S. Bureau of Mines.

Principals representing Hecla Mining Co. are William Love, President and Chief Executive Officer, Hecla Building, Wallace, Idaho 83873; telephone 208/752-1251.

El Paso Natural Gas Company has turned all their interest over to Hecla and whatever has been agreed on by Hecla is binding on El Paso Natural Gas Co.

Hecla Mining Company on November 1, 1978, along with El Paso Natural Gas Company, ended its lease on the Lakeshore Mine with the Papago Indian Tribe.

A new agreement between Hecla and the Papagos gives the Papago's an option to purchase at an unspecified figure all the surface facilities currently valued at $96,000,000. The underground facilities belong to the tribe as non-removable permanent fixtures. Total investment by Hecla and El Paso Natural Gas is $260,000,000.

The Papago tribal attorney (a personal friend) contacted me to determine if Essex has any interest in the property, and these are the current facts as given to me:

Papagos are soliciting bids on the property:

1. The bidder would acquire or buy the Papago-Hecla option for an estimated 5¢ to 10¢ on the dollar, the specific amount to be the bid figure. The successful bidder would become the operator under terms as specified in the bid.

2. In addition, the Papagos want an advance royalty of $160,000.00 per month.

3. Holding costs for labor, insurance, etc. are $83,000.00/month.

4. The processing facility to properly handle the oxide will cost an estimated $8-10 million (solvent extraction plant). The tank house has been built.

5. The experts all agree the oxide portion of the orebody may be viable at a production rate of 6,000 tons/day at an estimated mining cost in 1977 of 42¢/lb.

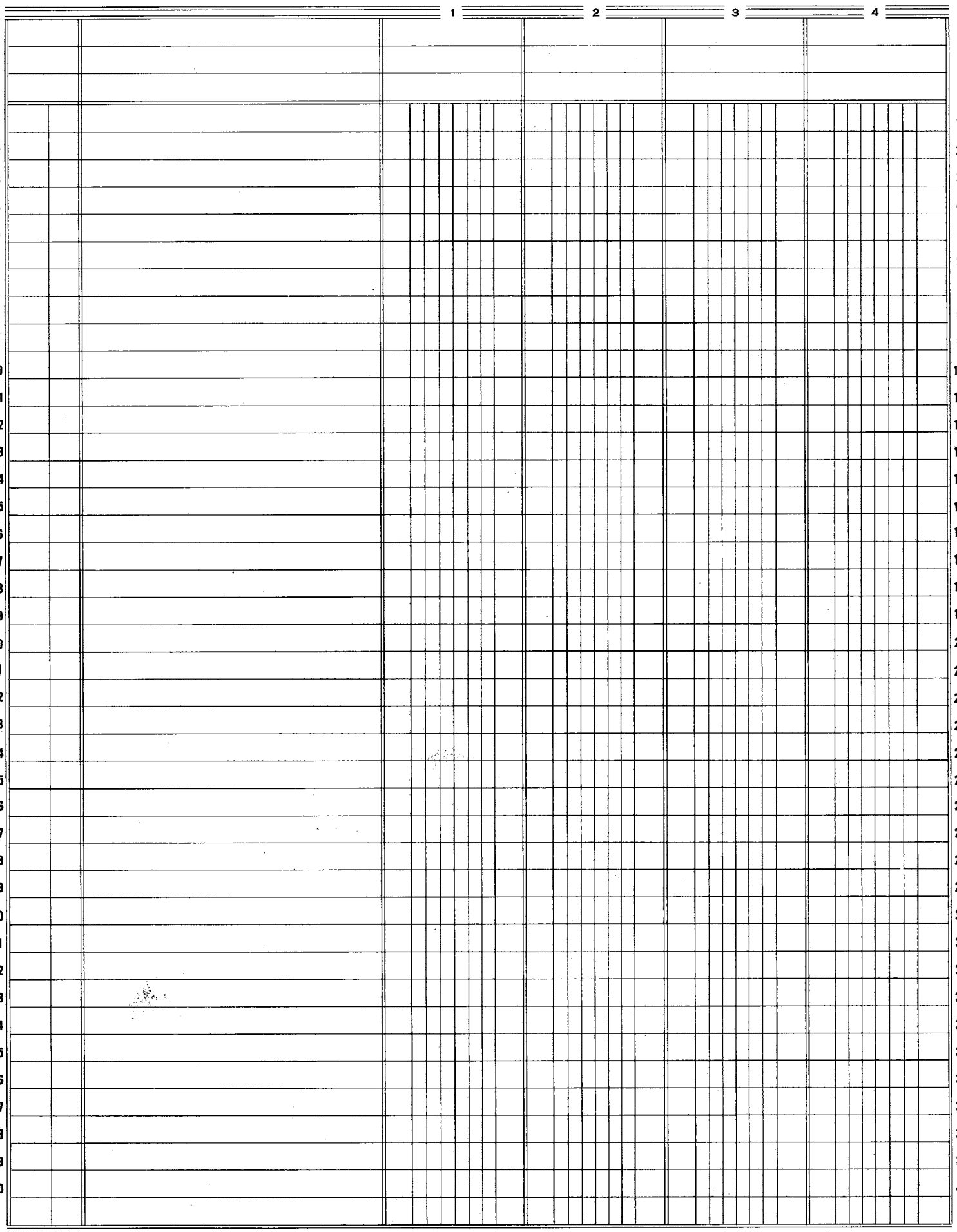
Financial Information
ORE RESERVE STUDY
LAKESHORE MINE

12/15/78

ORE Reserves	51,416,000	(oxide ore body only)
Avg. GRADE	1.0% Cu	
Pounds of Cu	1,028,320,000	
Capital Invest	$18,000,000	(option purchase & LIX Plant)
Advance Royalty	$160,000/mo.	
Carrying Costs incl. insurance etc.	83,000/mo.	
Production Costs Mng. & leaching	$0.58/lb. of Cu.	
Production Rate	21,000 Tons of Cu./yr.	
Viable production Rate at 0.7¢/lb Cu.	6000 T/day	
Revenue annually	$29,400,000	
Life of mine	24.4 years	

The oxide portion of the mine is apparently the only viable part of mine at the moment

© WILSON JONES COMPANY G7204 GREEN 7204 BUFF MADE IN U.S.A.


1
2
3
4

July 1976

VEKOL HILLS COPPER CO.

51% Newmont

48.97% Superior
.03% Other

105,000,000 Million Tons
0.54% Cu with dilutions normal 10%
.051 Mo
35¢ Ag @ 4.00/oz.
No Au
87.8% recovery

Drilled & Bulk Sampled
Engineered by Nordberg, Handings, Newmont

Cost to put in Production
85 to 90 Million Dollars

Prestrip 40 to 65 Million Tons Gravel & Alluvium

Waste to Ore 1.87:1

Ore Reserves 51,416,000
Ore Grade 1.0% Cu
Pounds of copper 1,028,320,000
Capital investment $18,000,000
(Lix plant 8,000,000
Option 10,000,000)
Advance Royalty 160,000/mo.
Carrying cost, Ins. etc. 83,000/mo.
Production Costs → 52¢/lb.
(Mining costs 42¢/lb.
Leaching costs 10¢/lb.)
Price of copper 70¢/lb

Avg. annual
Revenue $29,400,000
Cash flow

Ore Reserve

		Total Cu	% Cu. Sol. Acid
0.90% Cutoff	51,416,000 T	1.687	1.319

51,416,000 x 75% recovery = 38,562,000 T
@ 20 lbs. Cu/T. = 38,562,000 x 20
= 771,124,000 lbs Cu.

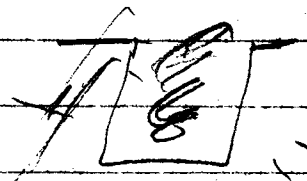
38,562,000 ÷ 6000 Tons/day = 6427 days ÷
350 day/yr. = 18 yrs. mine life

771,124,000 ÷ 18 yrs. 42,840,222 lbs/yr.
21,420 Tons copper/year.

Plant (design & construction total) INVESTMENT $8,000,000
Option cost 9,600,000

51,416,000 T x 20 lbs Cu./T. = 1,028,320,000 # Cu

2.06



5000
20
12,000 lbs /day

200
20
4000

22
12
8
63

12
4
48

360
48
312

77 27,562

LAKESHORE MINE

PINAL COUNTY, ARIZONA

HECLA MINING COMPANY

OXIDE MINE
(UNDERGROUND)

OXIDE MINE
SHAFT & CRUSHER

SULFIDE MINE
(UNDERGROUND)

DECLINES

CRUSHER
(UNDERGROUND)

RADIAL
STACKER AREA

DECLINE
PORTALS

FINE CRUSHER

SULFIDE ORE

SULFIDE CRUSHED
ORE STORAGE

OXIDE ORE

OXIDE ORE
VAT LEACH
TANKS

SULFIDE ORE
CONCENTRATOR

LEACH RESIDUE

$CuSO_4$

Fe PELLETS

TAILINGS

WASTE
TO
TAILINGS POND

CEMENTATION
PLANT

FILTER
PLANT

SULFIDE
CONCENTRATE

LEACH
RESIDUE

SPONGE IRON PLANT

COPPER PRECIPITATE
PELLETS

$CuSO_4$

H_2SO_4

ROASTER

ELECTROWIN
TANK HOUSE

H_2SO_4
ACID PLANT

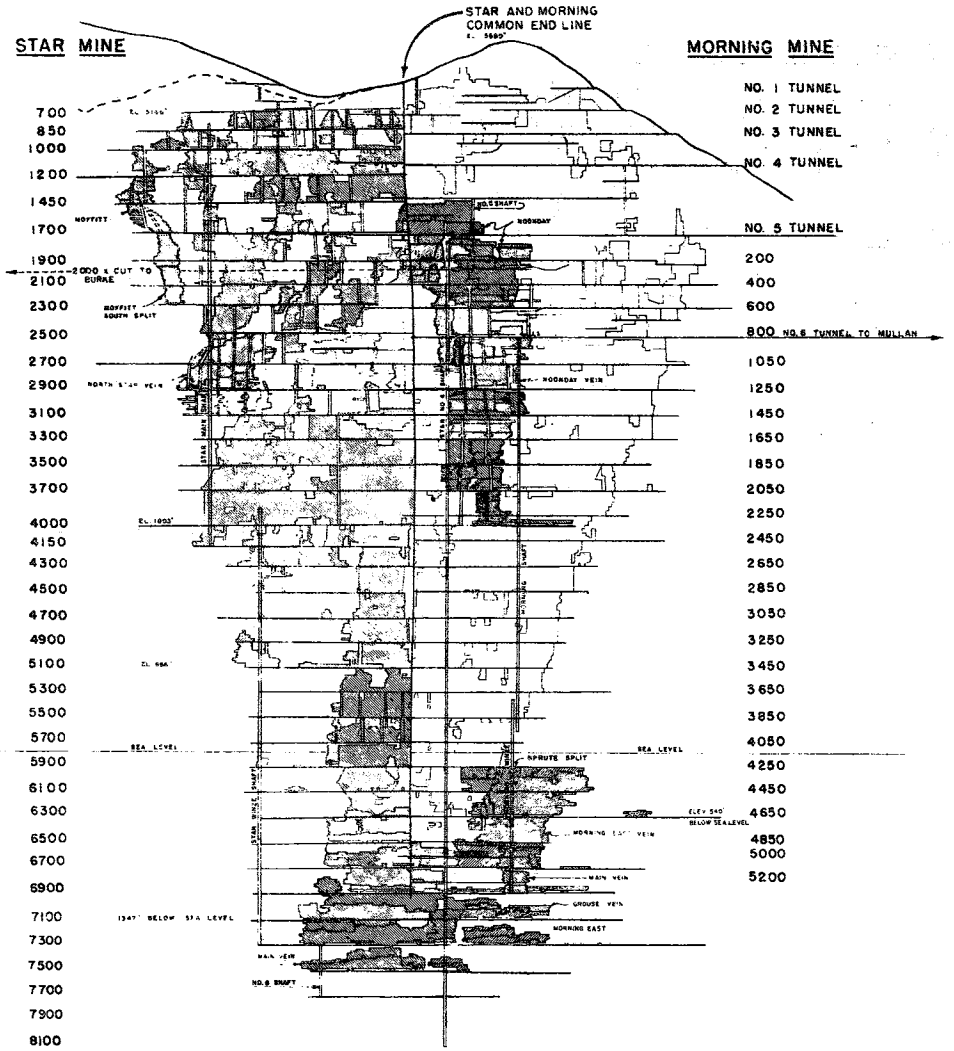
65% COPPER PRECIPITATES
TO ASARCO SMELTER

99.95% COPPER CATHODES
TO MARKET

TAILINGS SETTLING
POND

This pictorial drawing of the Lakeshore Copper Operation is designed to give a simplified representation of the extraction of the copper ore from underground and its flow through the metallurgical processing plants.

From the oxide mine the ore is hoisted to the surface through a vertical shaft and the ore from the sulfide mine is transported by a conveyor in the south decline. All of the ore is deposited in the radial stacker area from which it is conveyed to the fine crusher. After being crushed the oxide ore is treated in the vat leaching facilities to produce copper precipitate pellets. The crushed sulfide ore is conveyed to the sulfide ore concentrator where sulfide concentrates are produced for the roasting-leaching-electrowinning process, which produces copper cathodes. Sponge iron and sulfuric acid are recovered as by-products from the roast-leach-electrowin plant and used in the treatment of the oxide ores.



LONGITUDINAL SECTION THRU

STAR — MORNING VEIN

HECLA MINING COMPANY

STAR - MORNING MINE

BURKE, IDAHO

The Star-Morning Unit is owned by The Bunker Hill Company (70% interest in production) and operated by Hecla Mining Company (30% interest in production). Under a 1961 agreement with American Smelting & Refining Company, ore from the adjoining Morning Mine is being mined via the Star Mine. The Morning Mine was purchased by Hecla in February of 1966 and the Star and Morning mines are being mined jointly as the Star Unit.

The mine is reached through the 2000 level adit which bears southerly for 11,000 feet from the Burke surface plant to the No. 4 Shaft. Mine workings extend 1300 feet above and 6100 feet below the 2000 level. It is the deepest lead-zinc orebody in the world. The present bottom workings (7700 level) are 1946' below sea level and approximately 7700 feet below the surface. There are more than 60 miles of workings in the Star and Morning mines. The Star No. 4 Shaft extends from the 1750 level to the 8100 level and a new 2500-horsepower hoist has been installed with the capability of reaching the 9100 level. This hoist will handle 10-ton skip loads traveling at 2034 feet per minute.

1975

PRODUCER OF:	Lead----------13,135 Tons
	Zinc----------15,114 Tons
	Silver----------652,343 Ounces
ORE PRODUCTION:	Average is 1119 tons per day during 1975 (5 days per week)
ANNUAL PRODUCTION:	283,161 Tons
EMPLOYMENT:	Office & Engineering---------13
	Surface----------68
	Mill----------20
	Underground----------230
	Total 331
PAYROLL:	$6,217,537

1. DRILLING

Pneumatic rock drills are used to drill blast holes in the mining faces along the ore vein. These blast holes are 1-3/8" to 1-5/8" in diameter and average about 7 feet in depth. The number of holes required to drill out a "round" in a face of ore will vary widely with the vein width and mining method used. Holes are spaced about 2 feet apart each way according to the hardness of the material to be broken.

2. BLASTING

Each blast hole in the mining face is loaded with several sticks of 60% high explosive (dynamite) or with ammonium nitrate - fuel oil blasting agent (94% ammonium nitrate and 6% fuel oil). Blasts are detonated either by cap and fuse or electrically. Holes are timed to give proper sequence of firing.

3. SLUSHING OR MUCKING

Broken ore is removed to the ore pass or chute leading to the level below with a scraper which is pulled by a small double-drum air or electric hoist.

Rock broken while drifting, cross-cutting, etc., is loaded with a mechanical over-shot loader directly into rail cars.

4. HAULAGE

Broken ore is pulled from chutes into mine ore cars holding approximately three tons. Cars are then pulled by a battery-powered electric locomotive to the shaft station, where the ore is dumped into the "skip-pocket" for loading into the shaft conveyance or "skip".

5. HOISTING

The ore is hoisted in the skip to the skip dump at the top of the shaft. A man called a skip-tender loads ore from the skip pocket into the skip.

There are three vertical shafts at the Star Unit - one serving the mine between the 850 and 4000 levels, one serving the 4000 to 7300 levels and the new No. 4 shaft now in operation between the 2000 and 8100 levels. This shaft may eventually be extended to the 9100 level. A new 500-foot shaft called the No. 5 shaft is being driven to serve the 1700 level from the 2000 level on the Noonday Vein. Also a new auxiliary shaft called No. 6 shaft will serve the lower part of the mine from 7300 to 7700 levels.

Hoist operating speeds in the three major shafts vary from 1200 to 2000 feet per minute. The ore skips hold from 3 to 10 tons of broken ore. Double-drum hoists are used to permit hoisting in counter-balance. Men and materials are hoisted at speeds varying from 1000 to 1500 feet per minute.

6. TRANSPORTATION TO SURFACE

Ore is loaded from the storage bin or shaft loading pocket at the top of the shaft into 7-1/2 ton main haulage cars on the 2000 tunnel level. Twelve of these cars make up an ore train, which is pulled by a 15-ton diesel locomotive to the portal where the train is dumped into the coarse ore storage bin.

7. CRUSHING AND GRINDING

The ore is fed from the coarse ore bin into a primary jaw crusher which reduces it to 3-1/2" size. Secondary cone crushers reduce the ore to 1" size ball mill feed which is stored in a 3000-ton fine ore bin.

The ore is then ground in large ball mills with closed circuit classification until an average particle size of 200 mesh (about 0.0029 inches) is reached. Water is used to facilitate grinding and to prepare the pulp for further treatment.

8. FLOTATION TO SEPARATE & CONCENTRATE LEAD & ZINC SULFIDES

Reagents are added to the pulp and it is sent to flotation cells, where the lead minerals and zinc minerals are caused to "float".

Separate lead concentrates and zinc concentrates are made - the lead concentrate is about 65% lead, the zinc concentrate about 53% zinc. Tailings run about 0.3% lead and 0.3% zinc. Silver values are carried in the lead concentrate, averaging about 28 ounces/ton of concentrate.

9. BACKFILLING

Tailings are pumped back underground as hydraulic sandfill to backfill mined-out areas.

10. SHIPMENT TO SMELTER

Concentrates are loaded into Union Pacific gondolas for shipment to The Bunker Hill Company's lead smelter and electrolytic zinc plant at Kellogg, Idaho, where they are refined into the metallic state.

LAKESHORE COPPER MINE
OPERATIONS REVIEW
by
HECLA MINING COMPANY
July, 1978

G.H.

LAKESHORE COPPER MINE
OPERATIONS REVIEW

By

Hecla Mining Company

July, 1978

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INTRODUCTION

The Lakeshore copper mining-processing complex, located within the Papago Indian Reservation in Pinal and Pima Counties, Arizona, is a joint venture of Hecla Mining Company and El Paso Natural Gas Company, with Hecla as the designated operator. Lakeshore lands, totaling 10,505 acres, are held under mining and business leases granted by the Papago Indian Tribe. The property includes a major copper ore deposit in current production, mine surface plant facilities, and an operating metallurgical complex producing electrowon copper and pelletized copper cement precipitate. The cathode copper is sold to Southwire Company, Carrollton, Georgia; and pelletized cement copper is sold in part to ASARCO smelters, and is in part toll-refined by ASARCO and marketed by Hecla.

The purpose of the accompanying material is to describe the Lakeshore operation, including the ore body, the mine and plant, the history and status of its development, its operating performance to date, and plans and prospects for the future.

THE PROPERTY

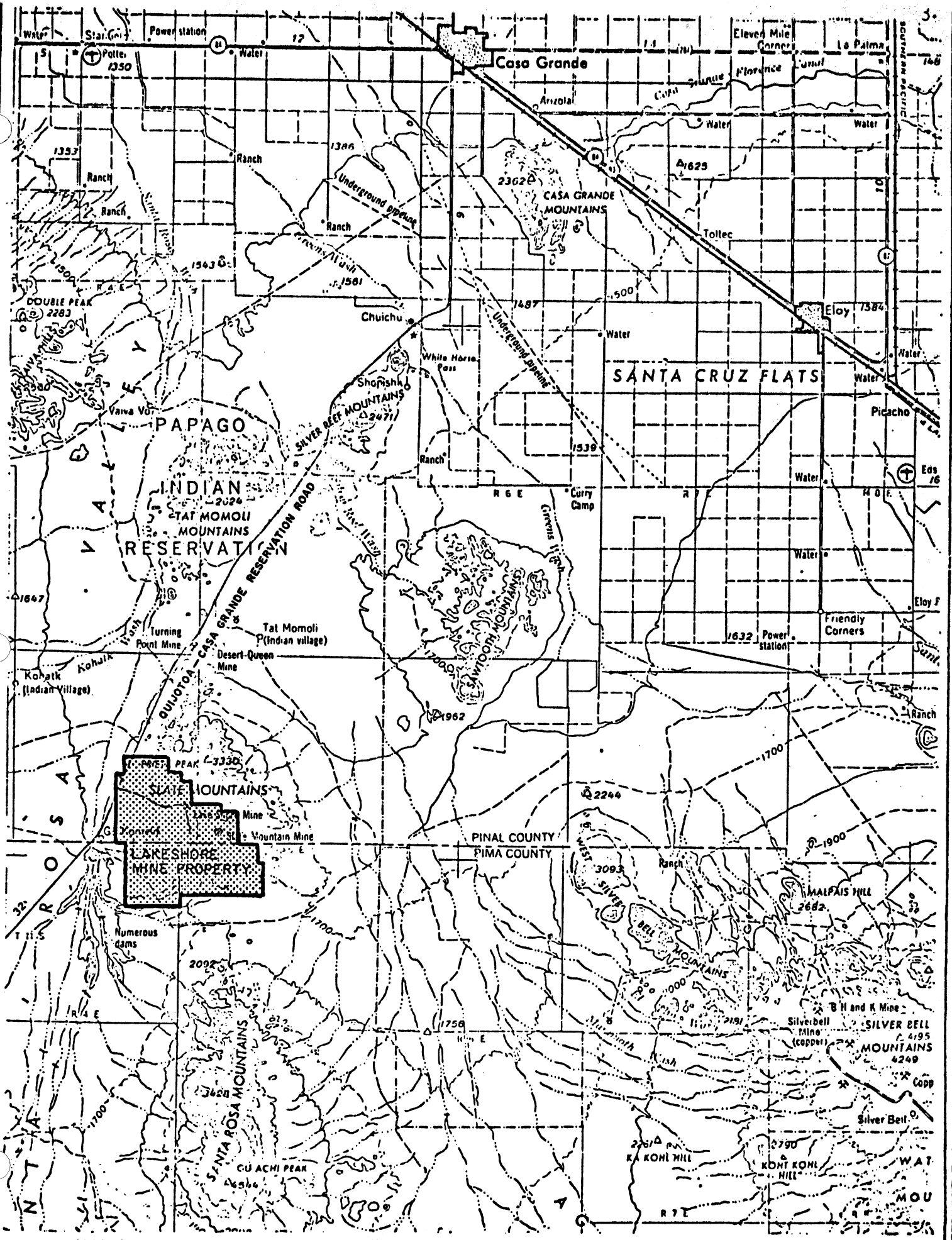
The Lakeshore mining property is located in the north part of the Papago Indian Reservation, in Townships 10 and 11 South, Ranges 4 and 5 East, Gila and Salt River Meridian, Pinal and Pima Counties, Arizona (see Figure 1). It lies approximately thirty miles south of the city of Casa Grande, Arizona. Access is via the paved Casa Grande-Quijotoa highway. Elevation of the property is about 1900 feet. The climate is semi-arid, and vegetation is typical of the Arizona-Sonoran desert region.

The Lakeshore lands, totaling 10,505 acres, are held by Hecla Mining Company and El Paso Natural Gas Company, as lessees of equal interest, under contractual agreements granted by the Papago Tribe as Lessor.

A mining lease is held for lands containing the Lakeshore mineral deposit, and are granted for periods of ten years and as long thereafter as minerals are produced from the properties. A business lease is held on lands contiguous to those held under the mining lease, providing the lands necessary for plant construction, waste dumps, tailings disposal, and other functions related to the mining operation. It is granted for a period of 25 years, with an option of renewal for a like period.

Water supplied for the Lakeshore operation is derived from a well field constructed in the vicinity of Santa Rosa Wash, about 6 miles west of the plant site, under provisions of a 25-year contract granted by the Papago Tribe.

A shipping and receiving facility is owned in an industrial park in Casa Grande. This installation includes railroad spurs, and facilities for loading and unloading railcars and trucks.



INDEX MAP SHOWING LOCATION OF LAKESHORE MINE PROPERTY

SCALE: 1" = 4 miles

Figure 1

THE ORE BODY

Geology

In regional setting, the Lakeshore copper deposit is typical of the numerous large-tonnage disseminated copper ore deposits which comprise the Porphyry Copper Province of southeastern Arizona, western New Mexico, and northern Sonora, Mexico. Deposits within a 150-mile radius of Lakeshore supply approximately 55% of the copper mined annually in the United States.

At Lakeshore, as with several of these deposits, Upper Precambrian and Lower Paleozoic sediments and an overlying Cretaceous andesitic sequence have been intruded by a stock of intermediate composition and Laramide age. The intrusive event was followed closely in time by primary mineralization, largely pyrite and chalcopyrite, of the fractured cupola of the stock and the invaded formations, and, in later time, by secondary enrichment of the upper part of the deposit. Subsequent to the period of enrichment, a thick fanglomerate of continental origin covered the deposit in mid-Tertiary time. This was succeeded by faulting, and then by oxidation of a major part of the enriched chalcocite ore. In present time, the Lakeshore ore deposit is a composite body consisting of a blanket-like oxide ore zone overlying a thick column of disseminated primary sulfide ore; some chalcocite ore is preserved in the down-faulted western part of the deposit, and substantial bodies of primary sulfide ore replace favorable tactite-altered horizons in the Precambrian and Paleozoic formations extending away from the thick central zone of disseminated mineralization.

The general geologic relationships at Lakeshore are shown in Figures 2-5. Older Precambrian Pinal schist is overlain by the Dripping Springs quartzite and Mescal limestone members of the Upper Precambrian Apache Series, with some included diabase sills, and by impure limestones and clastic sediments of Lower Paleozoic age. Above the metasedimentary sequence, apparently in thrust contact, is a thick sequence of Cretaceous andesitic volcanics and sediments, including flows, breccias, quartzites, and graywackes. In Laramide time, these formations were intruded by the Lakeshore stock of quartz monzonite and quartz monzonite porphyry, followed by disseminated pyrite-chalcopyrite mineralization of the porphyritic cupola of the stock and of the invaded formations, and by more concentrated pyrite-chalcopyrite-magnetite mineralization of tactite-altered beds and diabase in the Apache series and in the impure limestones of Lower Paleozoic age.

In a following erosional interval, the upper part of the body of disseminated mineralization was secondarily enriched, forming a blanket-like zone of chalcocite ore. More rapid erosion of adjacent highlands then spread a thick layer of silt, sand, cobbles, and boulders as a fanglomerate over the mineralized area.

The region was subjected to Basin and Range faulting in late Tertiary time. The cupola of the Lakeshore stock and the invaded formations, which contain the ore deposit, together with the overlying fanglomerate, were faulted downward relative to the footwall of the west-dipping Lakeshore fault. In the footwall, the root portion of the stock and the older Precambrian schist have been exposed. The schist is the principal formation of the present Slate Mountains. In the west part of the deposit, east-dipping reverse faulting in what is termed the C Fault zone displaced a part of the chalcocite zone, associated mineralization and fanglomerate relatively downward to a protective depth, preserving the chalcocite ore in this area. The principal part of the Lakeshore ore deposit lies between the C Fault zone and the Lakeshore fault. Oxidizing conditions since the Basin and Range faulting have converted the chalcocite mineralization in the main part of the deposit largely to chrysacolla and tenorite, forming the blanket-like oxide ore body. The deposit, as it now lies, is largely covered by 400 to 1,500 feet of semi- to well-consolidated fanglomerate.

In summary, the Lakeshore copper deposit is a composite body consisting of (1) an oxide ore body about 4,000 feet in length and 2,000 feet in width, averaging about 150 feet in thickness, with a top which ranges from 400 to 1,500 feet beneath the desert surface; (2) a thick body of disseminated sulfide ore underlying the major part of the oxide ore in the approximate same area and averaging about 435 feet in thickness; (3) a chalcocite sulfide ore body lying west of the main body of disseminated sulfide ore and separated from it by a zone of faulting which has displaced the chalcocite body downward such that its top is from 1,500 to 2,200 feet below the ground surface; the chalcocite ore body is about 1,300 feet in length, 850 feet in width, and averages 228 feet in thickness; and (4) a tactite sulfide ore body lying marginal to and south of the disseminated sulfide ore body, about 1,500 feet in length, 1,600 feet in width, and averaging about 100 feet in thickness, with its top ranging from 800 to 1,500 feet beneath the ground surface. The disseminated sulfide ore body includes elements of the tactite and chalcocite phases of mineralization as well as disseminated mineralization; the interface with the overlying oxide ore is generally distinct, and there is little intermixing of oxide and sulfide ores.

Ore Reserves

Exploration of the Lakeshore deposit from the surface by rotary drilling through the fanglomerate and core drilling in the host formation was initiated by El Paso in 1968, continued by Hecla in 1969-1971, and briefly resumed by Hecla in 1977. At the end of 1971, the surface drilling data base (shown in Figure 6, p. 12) upon which the initial ore reserve estimated was made, consisted of 168 drill holes totaling 287,060 feet comprised of 79,078 feet of rotary drilling and 207,982 feet

of core drilling. Subsequent underground development, mining, and 107,508 feet (to December 31, 1976) of underground exploration drilling have generally confirmed the presence, grade, and location of the mineralization calculated as reserves in November 1971. Precise definition of ore block limits will necessitate a continuing program of underground exploration drilling as development headings are extended through the deposit. In addition, a program of fill-in surface drilling, briefly resumed by Hecla in 1977, is planned to better define the mineralization in the north part of the deposit, currently explored by surface drill holes on 400-foot centers.

To date, Lakeshore mine production has come from the southerly parts of the oxide and tactite ore bodies described in the preceding Geology section and shown in Figure 5.

In early 1977, services of the consulting firms of Pincock, Allen, and Holt, Inc. and Computer Associates, both of Tucson, Arizona, were utilized to produce a detailed reserve analysis of the major part of the Lakeshore deposit for purposes of planning and scheduling the large-scale mining program. The consulting firms produced a computer block model of the main part of the Lakeshore deposit, including that part of the deposit lying between the Lakeshore and C faults (Figure 5) and between elevations of 1,400 feet above and 350 feet below sea level, but excluding the current tactite mine area in the south part of the deposit and the chalcocite ore block lying west of the C Fault. Through geostatistical analysis the effects of geologic structure, assay variance within individual rock units, and mineralization trend characteristics were incorporated in the analysis, and categories of "measured" and "indicated + inferred" ore at various grade cutoffs were established, based on acceptable interpolation search distance parameters from sample points.

The Pincock, Allen and Holt, Inc. estimate of total reserves in the described part of the Lakeshore deposit as of June 30, 1977, is summarized in the following table:

Lakeshore Computer Model Geologic Reserve
(Within Block Limits as Described)

Ore Type	Cutoff Grade	Tons	% Total Cu	% Acid Soluble Cu
Oxide*	0.70	73,653,000	1.414	1.067
Oxide*	0.90	51,416,000	1.687	1.319
Sulfide	0.50	225,226,000	0.743	0.019
Sulfide	0.60	160,721,000	0.822	0.021

*This reserve includes oxide material within the area of current mining above 925 elevation.

In addition to the above reserves figures, a substantial body of sulfide ore, principally chalcocite, has been partly delimited in the area west of the C Fault (see preceding section, Geology). A preliminary estimate of this body (indicated by intercepts in nine holes), utilizing the polygon method of estimation, indicates a reserve of 24,314,000 tons averaging 1.41% copper in this area.

Also not included in the Pincock, Allen and Holt, Inc. computer model is a relatively small tonnage of tactite ore lying south of the model limits and remaining in the area of current tactite mining. It is planned to implement this remaining tactite reserve as a supplemental source of ore during the early stage of the large-scale mining program.

A potential for developing additional sulfide ore exists in the area of chalcocite ore lying west of the C Fault. The ore zone has not been closed off laterally by drilling in the vicinity of the nine holes completed in this area. Also, in one of the nine holes, a substantial thickness of sulfide mineralization, 353 feet averaging 0.99% copper, is present at a depth greater than depths tested by nearby holes; this mineralization, not included in the 24 million tons reserve estimate, indicates a potential for additional ore at greater depth.

In the long-range view, the Lakeshore deposit offers a future potential for recovery, perhaps by in-situ leaching, of large amounts of low-grade copper mineralization unrecovered in the mining operation or enveloping the bodies mined by conventional methods. As evidence of this potential, a mineral inventory of the deposit based on all drilling, surface and underground, completed through March 1975, was calculated in April 1975, without the limitations specified above for the Pincock, Allen and Holt estimate. In developing the mineral inventory, economics were not considered. Three-dimensional boundaries of the rectangular block containing the deposit were determined, locations and assay data of all drill holes within the block were entered, and copper values of blocks 100 feet by 100 feet in dimension through elevation intervals of 50 feet within the deposit were derived. Total amounts of copper mineralization within the deposit at various grade cut-offs were then calculated, with the following results:

Lakeshore Mineral Inventory, April 1975 (In-situ)

Grade Cut-Off	Oxide Mineral Inventory		Sulfide Mineral Inventory	
	Tons	% Acid Soluble Copper	Tons	% Copper
0.10	825,375,000	0.45	808,583,000	0.47
0.30	142,583,000	0.72	523,083,000	0.62
0.40	103,000,000	0.86	401,500,000	0.70
0.50	79,583,000	0.99	293,583,000	0.80
1.00	28,250,000	1.52	50,583,000	1.39

It is evident that the Lakeshore ore body is a major porphyry copper deposit, with excellent long-range potential for development of additional ore and for the recovery of additional copper from low-grade material.

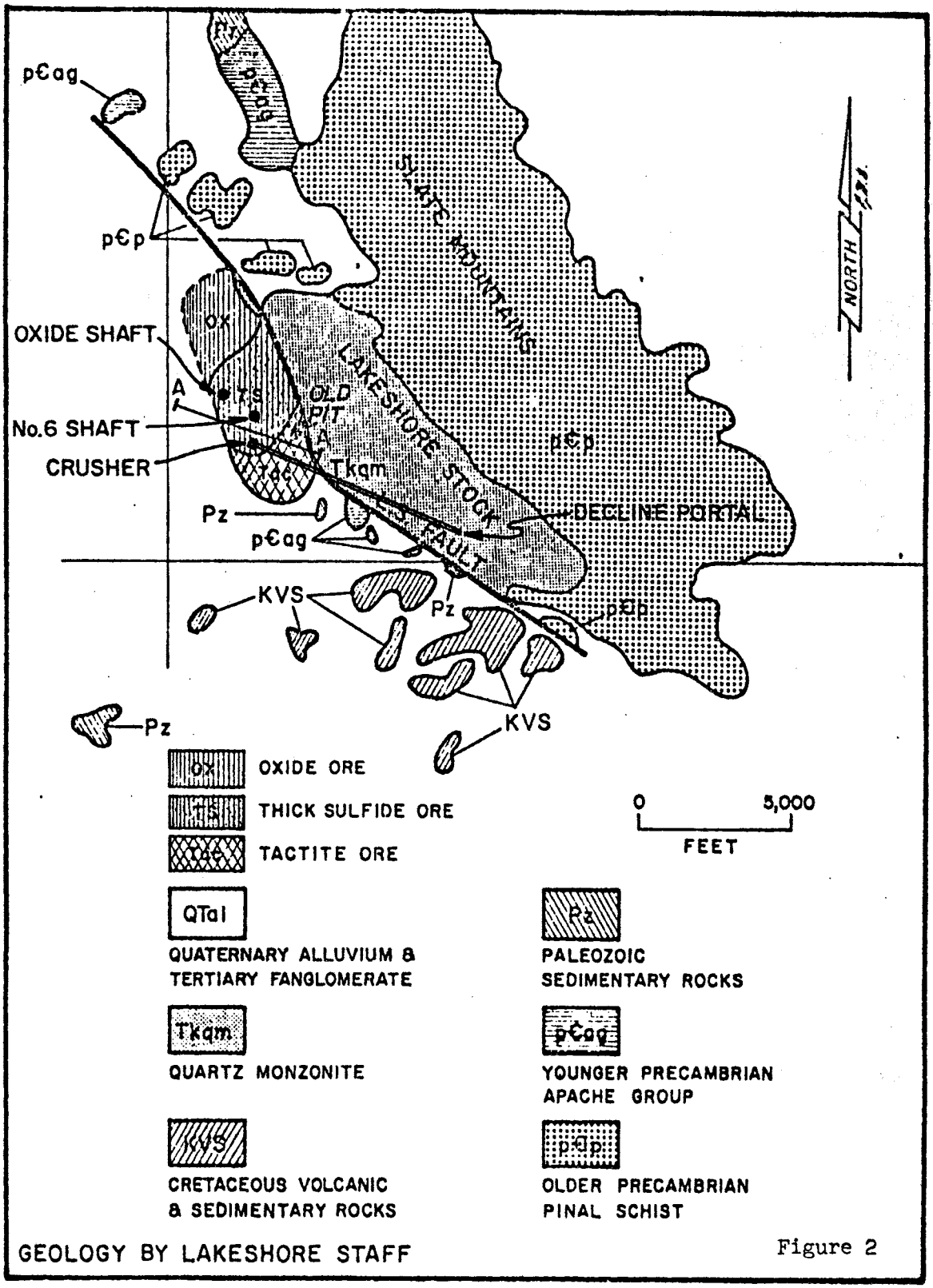


Figure 2

SURFACE GEOLOGY, LAKESHORE MINING AREA

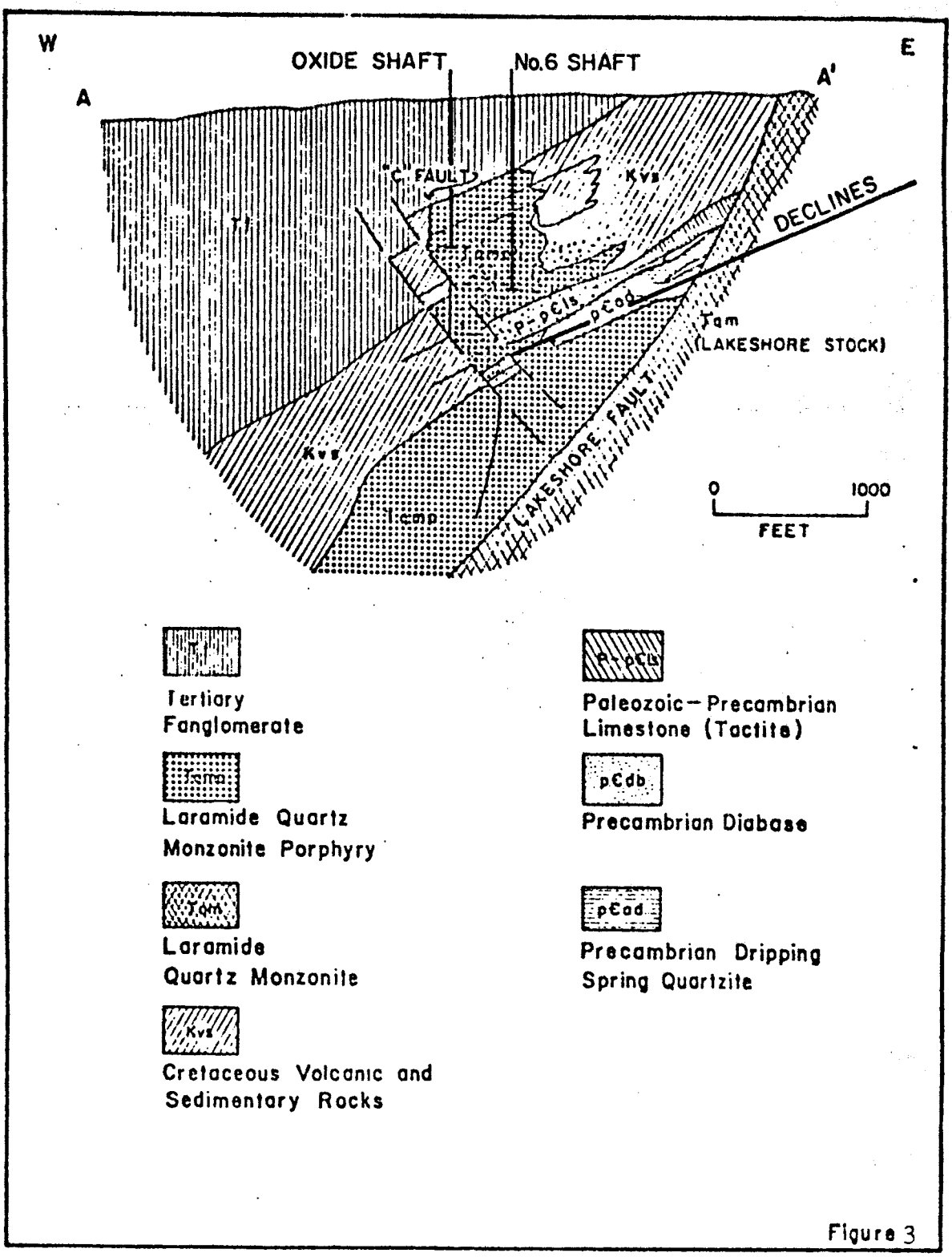


Figure 3

GENERALIZED GEOLOGIC CROSS SECTION, LAKESHORE MINE, ARIZONA

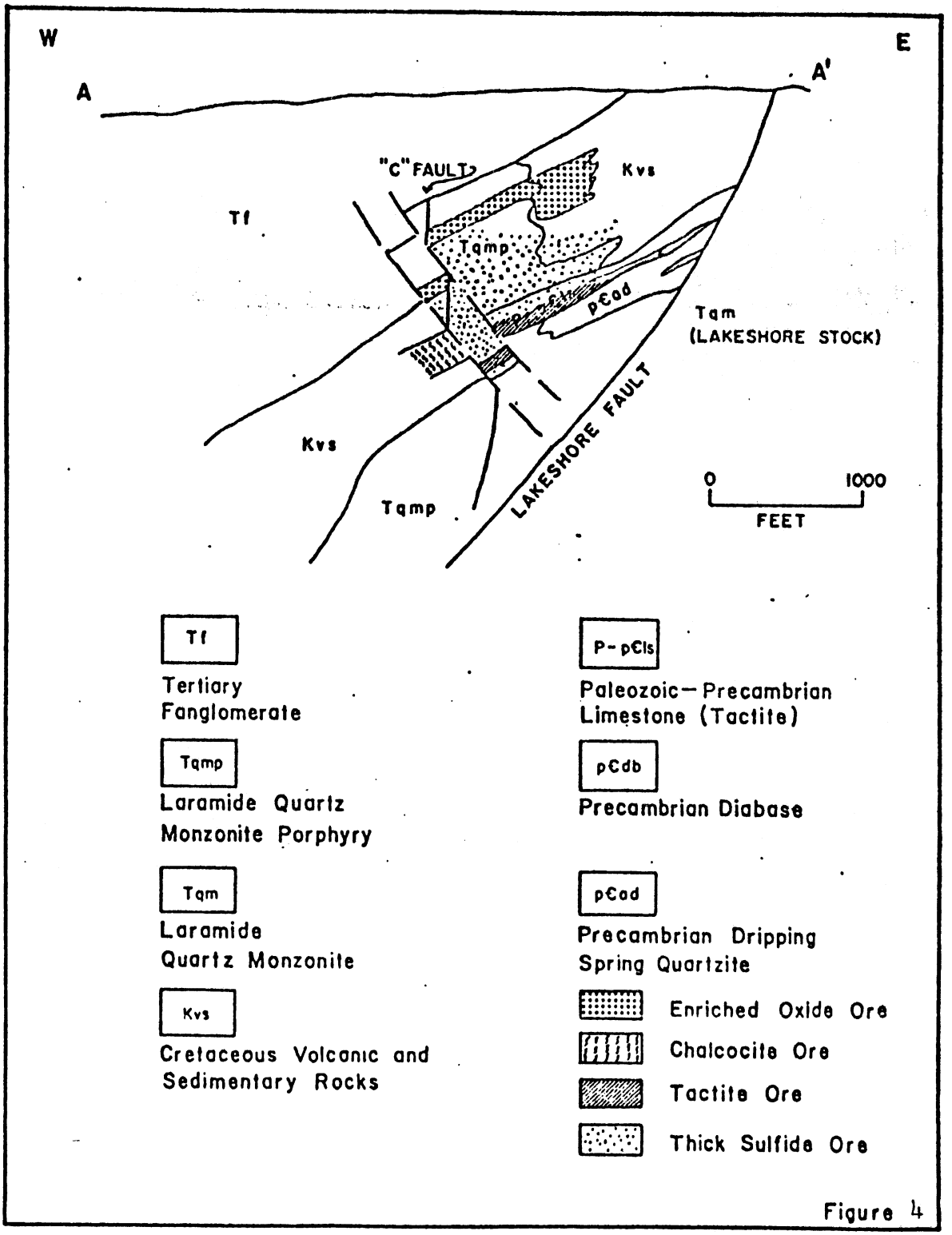


Figure 4

GENERALIZED ECONOMIC CROSS SECTION, LAKESHORE MINE, ARIZONA

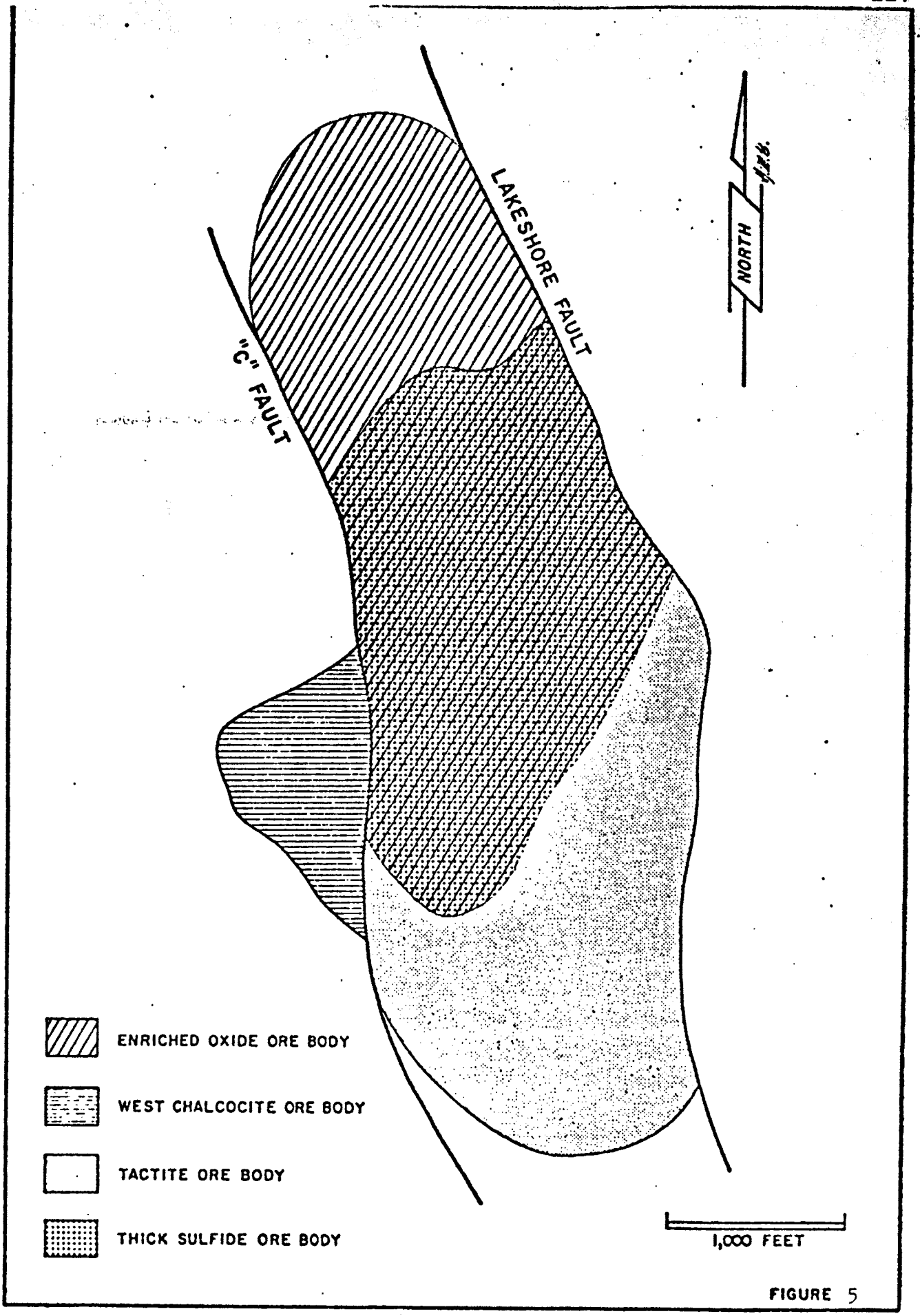


FIGURE 5

GENERALIZED COMPOSITE ECONOMIC PLAN: LAKESHORE ORE BODY

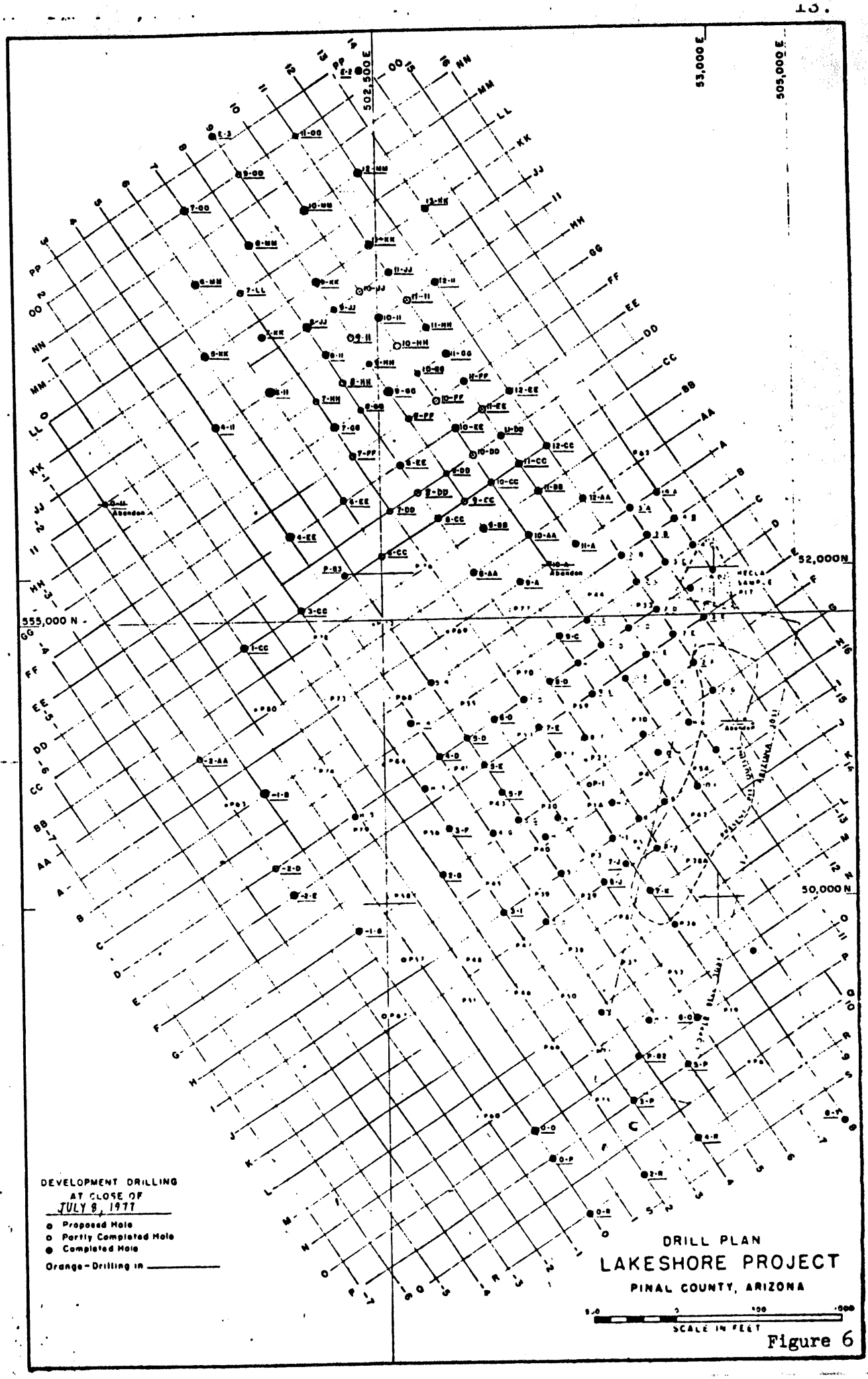

502,500 E
503,000 E
555,000 N
52,000N
50,000 N
DEVELOPMENT DRILLING
AT CLOSE OF
JULY 8, 1977
Proposed Hole
Partly Completed Hole
Completed Hole
Orange - Drilling in
DRILL PLAN
LAKESHORE PROJECT
PINAL COUNTY, ARIZONA
SCALE IN FEET

Figure 6

THE MINE

The viability of mining the deposit by a combination of open pit and underground methods was given careful consideration during initial mine planning. Feasibility studies by Hecla and by Fluor-Utah as a consultant determined that, because of the cost of stripping the excessive depth of overburden, open pit development would not be economic. Continued study led to a decision that the deposit should be developed and mined as an underground operation. The plan involved concurrent mining of the oxide ore and the thinner tactite sulfide ore by modified caving methods in the early years of operation, followed by standard block-cave mining of the thick body of disseminated sulfide ore in later stages.

Development was initiated in January 1970, when twin decline entries were collared approximately 5,800 feet east of the ore body at the site of the present mine surface facilities and metallurgical complex. The north decline, 18 ft. 8 in. by 14 ft. in cross-section, and the south decline, 14 ft. 8 in. by 14 ft., are 100 feet apart, and were driven on a 15° slope for 7,400 feet from the collar elevation of about 1900 feet to a point at sea level elevation beneath the west side of the main part of the Lakeshore deposit. A skip system on standard gauge rails in the north decline is operated as a service facility for men and materials, employing a single-drum electric hoist with two 500-Hp motors and a skip speed of 1,370 feet per minute. A 42- by 70-inch Nordberg gyratory primary crusher is installed underground, at the foot of the south decline, from which crushed sulfide ore is conveyed to the surface through the south decline on 42-in. steel cable belt conveyors to the surface radial stacker for stockpiling prior to fine crushing and concentration.

To July 1, 1977, a total of 117,337 feet of level and ramp development had been completed in preparing the tactite sulfide and oxide section of the mine for production, as shown in isometric view, Figure 7, and in plan view, Figure 8. Production of tactite sulfide ore at a rate of up to 6,100 tons per day was drawn from two sections of the tactite ore zone. Oxide ore yielded a daily production of up to 6,500 tons of ore.

The blanket-like tactite ore body dips about 20° westerly and forms the south part of the Lakeshore deposit, averaging about 100 feet in thickness. It is divided into three panels. The No. 1, or southeast panel, is fully developed and has provided the bulk of the sulfide production. No. 2 Panel is in the southwest and is divided into two areas. The area adjacent to No. 1 Panel has been mined by sublevel caving. The westerly area has been partially developed for block caving. No. 3 Panel, to the north, is in an advanced stage of planning. An inclined block caving system, shown in

isometric view in Figure 9, has been employed in mining of Panel No. 1. Extraction drifts on 40-foot centers 10 ft. by 10 ft. in raw dimension and concreted to a 7.5 by 7.5-ft. section, were driven southerly, parallel to and beneath the ore. Drawpoints, drawpoint raises, and undercutting completed the development. The ore was loaded with Wagner ST-2B loaders in the extraction drifts and trammed to ore passes, dropped to the 200 elevation rail haulage level, and transported by 15-ton Plymouth diesel locomotives and 10-ton Granby cars to the two 1,300-ton ore pockets, where it was fed to the underground crusher. The ore passes were bored to 5-ft. diameter with a Robbins 32-R raise-boring machine, and then lined with 1/4-inch welded steel plate to 4-ft. diameter. Some of the ST-2B loaders have been replaced with 75-Hp slushers and scrapers.

Panel 2 was developed as an experimental sublevel caving system with ore handling by the Wagner ST-2B loaders, as shown in isometric view, Figure 10.

Economic considerations indicate it will be advantageous to proceed in the near term with development and mining of the thick body of disseminated sulfides in the central part of the deposit. It is currently planned to mine this body, with a column height of about 400 feet and an average grade of about 0.74% copper, by a block-caving method utilizing slusher draw. Ore from the tactite panels will supplement the block-caving production in the early stage of the large-scale mining program.

The oxide and tactite sulfide sections of the mine, although interconnected by the declines, are operated as essentially separate entities. Oxide ore produced from the 1100 level, and to be produced from the 900 level, was transported to the surface in a 14-ft. circular concrete-lined vertical shaft located west of the ore zone. At the surface, it was crushed in a 42- by 48-in. Birdsboro jaw crusher, and then hauled by 35-ton trucks a distance of one mile to stockpiles at the metallurgical plant.

The blanket-like oxide ore body trends northerly and dips westerly about 20°, averaging about 150 feet in thickness, with an average grade of about 1.55% acid soluble copper. On the 1100 level, it has been mined by a modified block caving system with slusher drifts, as shown in the isometric view, Figure 11. The ore was slushed through grizzlies into 10-ton Granby cars on the rail haulage level immediately below the slusher drifts, and transported by rail to the 600-ton ore pocket and skip loading station at the shaft.

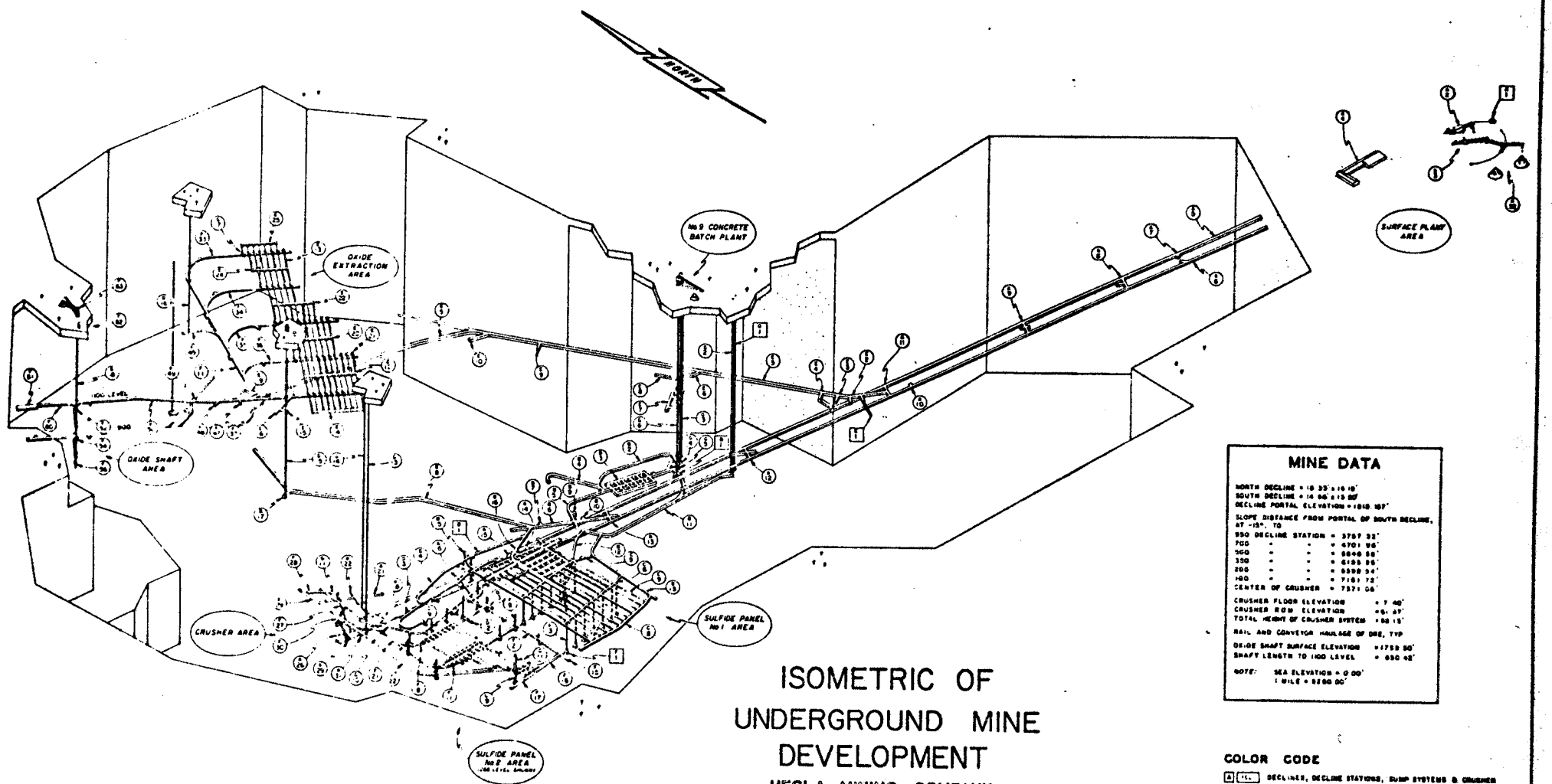
Details of the oxide development are shown in Figures 12 and 13. The panel drifts (crosscuts) were driven on 350-ft. centers, with a trapezoidal cross-section 9 ft. high and

averaging 9 ft. in width, supported by 10-in. by 10-in. steel sets, and lined with 12 inches of concrete. Vent drifts midway between the panel drifts, and slusher drifts on 35-ft. centers, 7 ft. by 7 ft. in finished section, were driven at the crown elevation of the panel drifts and concreted; the slusher drifts are at right angles to the panel and vent drifts. Drawpoints, drawpoint raises, and undercutting complete the development.

With diesel-operated mining equipment, a large volume of air is required for adequate ventilation. The ventilation air intakes through the north decline, the oxide shaft, and a 12-ft. diameter, concrete-lined bored shaft. It is provided to the faces through 48-in. duct by auxiliary fans. Exhaust is through the south decline and three additional bored shafts. 1,300,000 c.f.m. of ventilating air can be provided to the mine. A total of 21,000 c.f.m. of compressed air is produced, and 50,000 kilowatts of power are available.

The four ventilation shafts, one intake and three exhaust, were bored from the surface to a depth of 1,300 feet, using a Robbins 81-R raise boring drill. These shafts were constructed by drilling a 13-7/8-in. pilot hole, followed by reaming to 12-ft. diameter and concreting to a finished diameter of 11 feet. In addition to serving for ventilation, one of the shafts, No. 6, is supplied with a hoist and man-cage as an alternate escapeway. A 4-ft. diameter bored service shaft containing air, power, and water lines also extends to 1,300 feet depth. Several 14-in. material holes have been drilled from the surface to supply shotcrete and concrete to the 100, 500 and 1100 levels.

The mine is equipped with four 8-cubic-yard Wagner ST-8 Scooptrams, twenty-eight 2-cubic-yard ST-2B Scooptrams, five 1-cubic-yard HST-2AS Scooptrams, seven 15-ton Plymouth locomotives, sixty-four 10-ton Granby cars, twelve development cars, one Gardner-Denver minibore jumbo, a large number of Gardner-Denver 83 jacklegs, three concrete transporters, and Ensign personnel carriers. Large underground bays are constructed and equipped for immediate maintenance of the equipment. Surface installation include office and dry buildings, heavy equipment shop facilities, power, compressor, and hoist facilities, the radial stackers for coarse ore stockpiling, water supply, and sewage facilities. In addition, there is a rail siding facility in Casa Grande equipped for rail car loading and unloading.



ISOMETRIC OF UNDERGROUND MINE DEVELOPMENT

HECLA MINING COMPANY

LAKESHORE MINE

DWG BY [illegible] DATE 7/8/77

MINE DATA

NORTH DECLINE = 18 33' x 16 18'
SOUTH DECLINE = 14 66' x 15 80'
DECLINE PORTAL ELEVATION = 1818 187'

SLOPE DISTANCE FROM PORTAL OF SOUTH DECLINE, AT -15°, TO

950 DECLINE STATION	=	3757 32'
700 " "	=	4701 96'
500 " "	=	5846 58'
350 " "	=	6185 86'
200 " "	=	6598 54'
100 " "	=	7161 72'
CENTER OF CRUSHER	=	7371 06'

CRUSHER FLOOR ELEVATION = 7 40'
CRUSHER ROOF ELEVATION = 61 37'
TOTAL HEIGHT OF CRUSHER SYSTEM = 58 13'

RAIL AND CONVEYOR HAULAGE OF ORE, TYP

OXIDE SHAFT SURFACE ELEVATION = 1759 50'
SHAFT LENGTH TO 1100 LEVEL = 630 42'

NOTE: SEA ELEVATION = 0 00'
1 MILE = 5280 00'

COLOR CODE

A	[illegible]	DECLINES, DECLINE STATIONS, SUMP SYSTEMS & CRUSHER
B	[illegible]	500 LEVEL DEVELOPMENT
C	[illegible]	SULFIDE PANEL No 1 DEVELOPMENT
D	[illegible]	SULFIDE PANEL No 2 DEVELOPMENT
E	[illegible]	1100 (OXIDE) LEVEL DEVELOPMENT
F	[illegible]	ORE HANDLING SYSTEMS
G	[illegible]	VENTILATION, MANWAYS & SHAFTS

KEY TO ALPHA/NUMERIC LOCATIONS PROVIDED SEPARATELY.
NOTE

ISOMETRIC LARGE SCALE DETAIL

OF OXIDE MINE AREA	SEE DWG No 20-B
OF OXIDE SHAFT DETAIL	SEE DWG No 21-B
OF OXIDE MANWAY & CRUSHER DETAIL	SEE DWG No 17-B
OF SULFIDE MINE AREA & 200 HAULAGE SYSTEM	SEE DWG No 18-B
OF SULFIDE PANEL No 2 DETAIL	SEE DWG No 19-B
OF SULFIDE MANWAY & TIMBERING DETAIL	SEE DWG No 22-B
OF UNDERGROUND CRUSHER & CONVEYOR SYSTEM	SEE DWG No 135-D-1000
OF 200 SCALE MINE PLAN UP DATE	SEE DWG No 12-A (ORTHOGRAPHIC)

Figure 7

DWG No 2-B

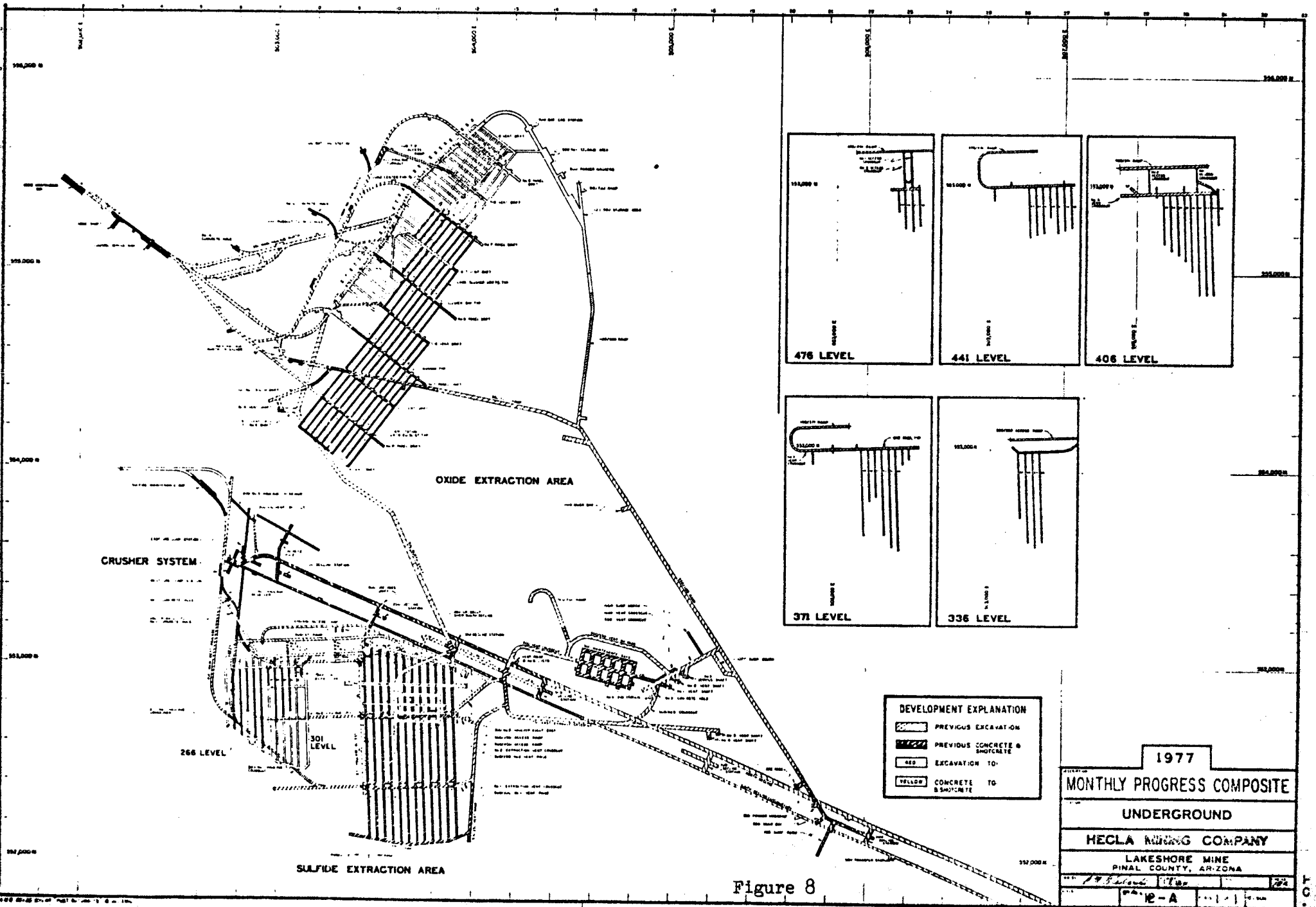

476 LEVEL
441 LEVEL
406 LEVEL
371 LEVEL
336 LEVEL
OXIDE EXTRACTION AREA
CRUSHER SYSTEM
301 LEVEL
266 LEVEL
SULFIDE EXTRACTION AREA
DEVELOPMENT EXPLANATION
PREVIOUS EXCAVATION
PREVIOUS CONCRETE & SHOTCRETE
EXCAVATION TO
CONCRETE TO & SHOTCRETE
1977
MONTHLY PROGRESS COMPOSITE
UNDERGROUND
HECLA MINING COMPANY
LAKESHORE MINE
PINAL COUNTY, ARIZONA
12-A

Figure 8

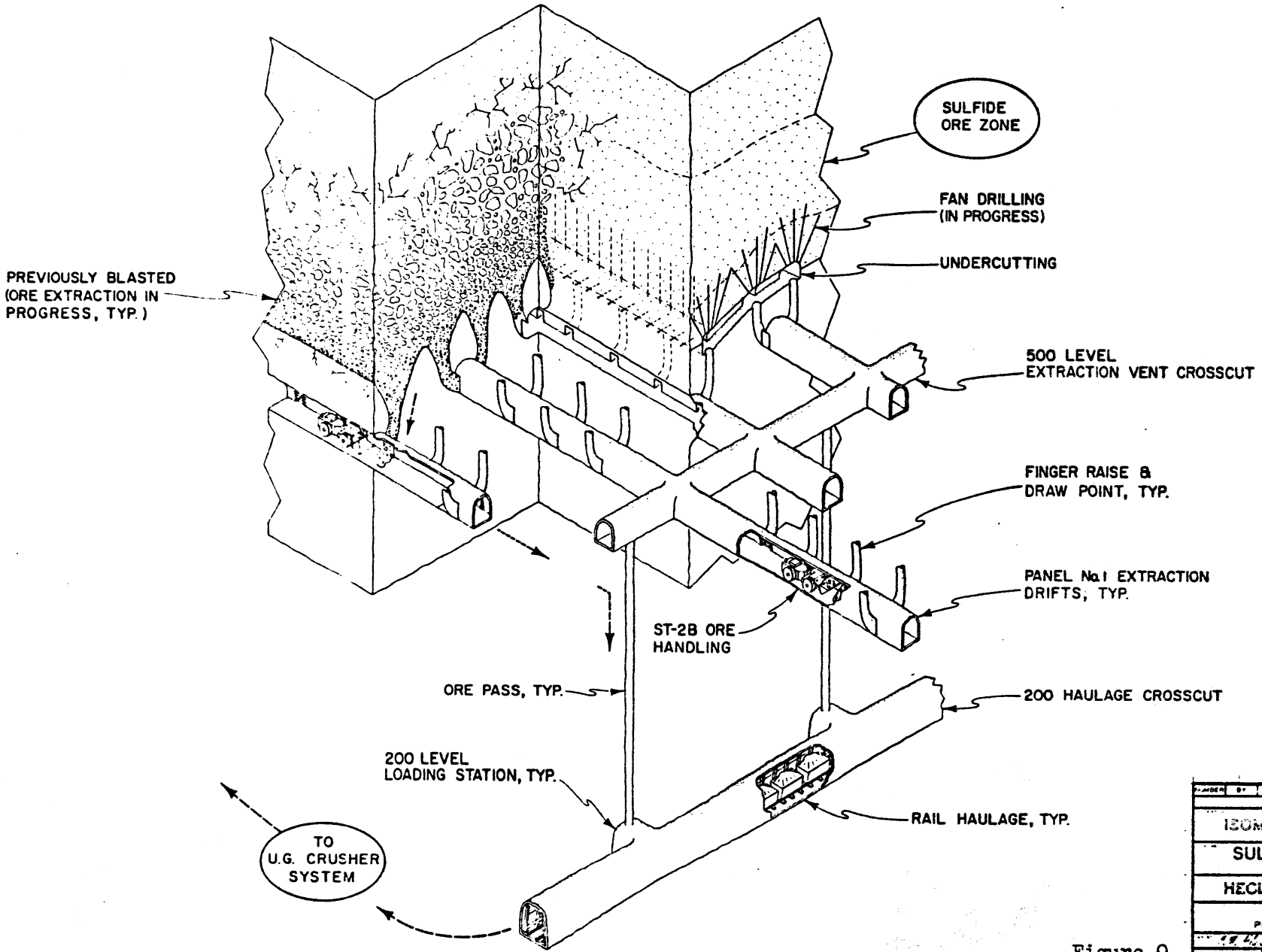
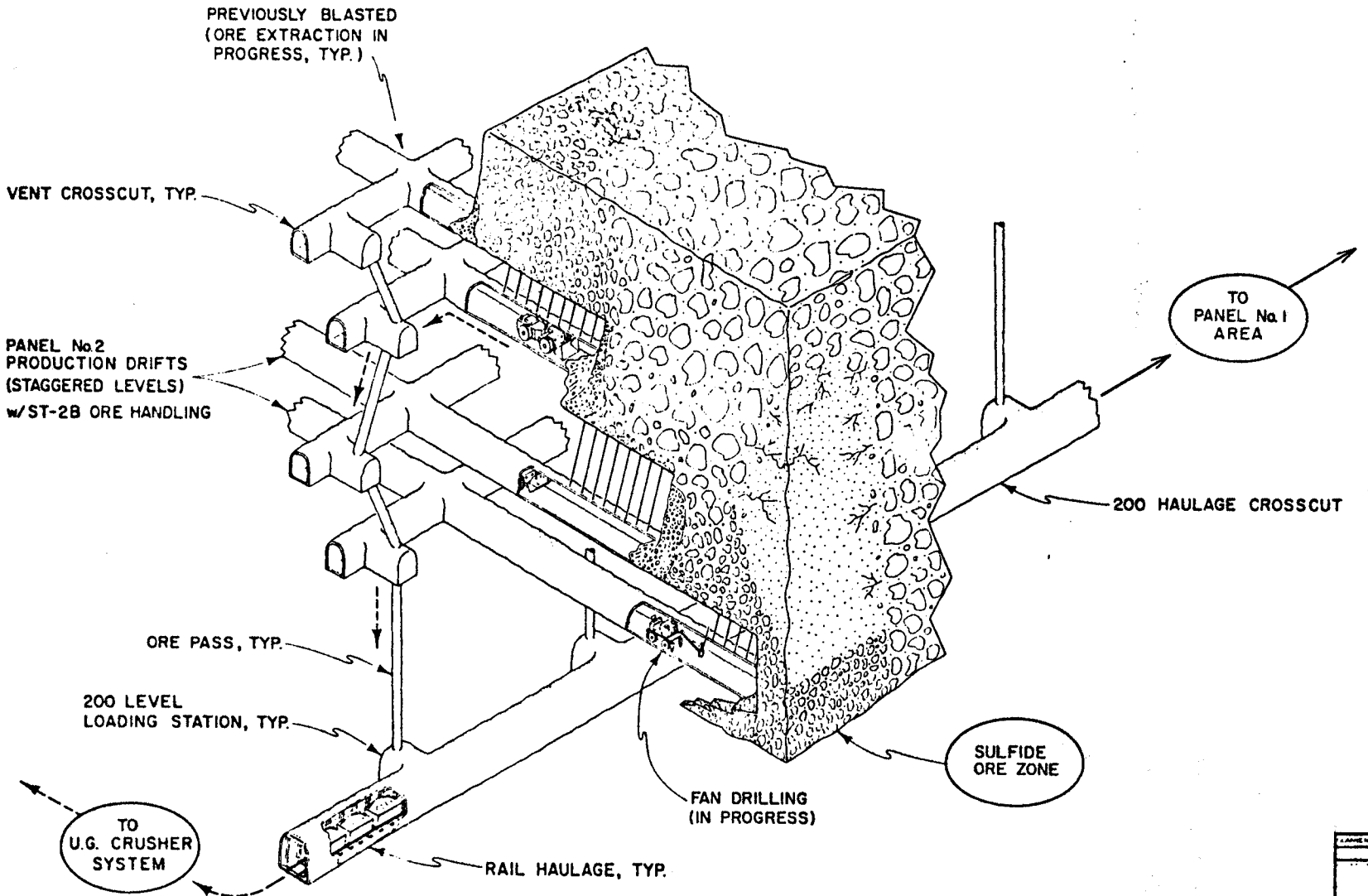


Figure 9

NUMBER	BY	DATE	DESCRIPTION
REVISION DATA			
ISOMETRIC CONCEPTION			
SULFIDE PANEL No.1 BLOCK CAVING SYSTEM			
HECLA MINING COMPANY			
LAKESHORE MINE PINAL COUNTY, ARIZONA			
			11/18/75
NONE	25-B	1-5	



ISOMETRIC CONCEPTION

SULFIDE PANEL No.2

SUBLEVEL CAVING SYSTEM

HECLA MINING COMPANY

LAKESHORE MINE

PINAL COUNTY, ARIZONA

25-B | 2 5

Figure 10

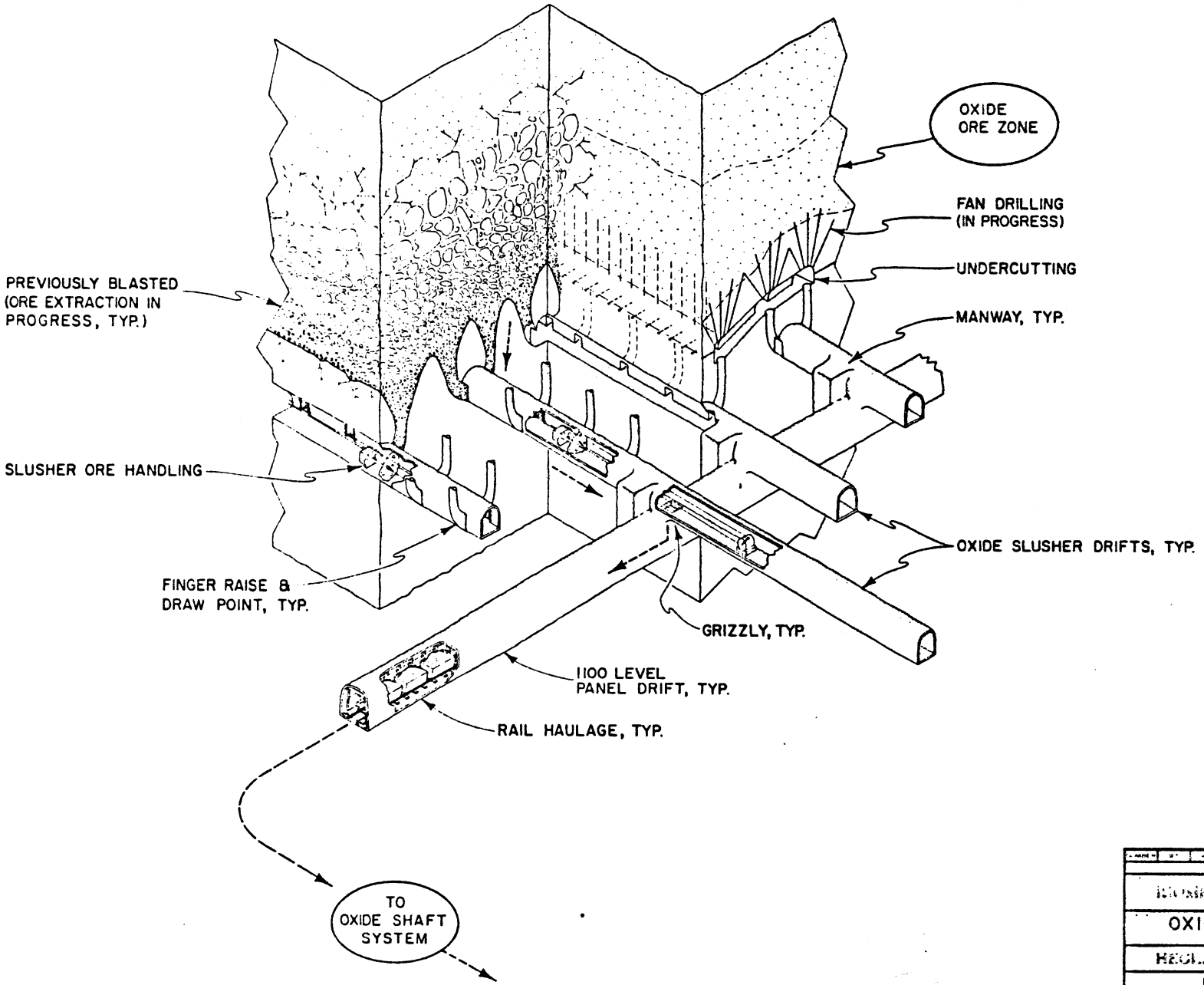


Figure 11

OXIDE 1100 LEVEL
BLOCK CAVING SYSTEM
HECLA MINING COMPANY
LAKESHORE MINE
PINAL COUNTY, ARIZONA
NONE | 25-B | 35

REF. DWG. 12-A

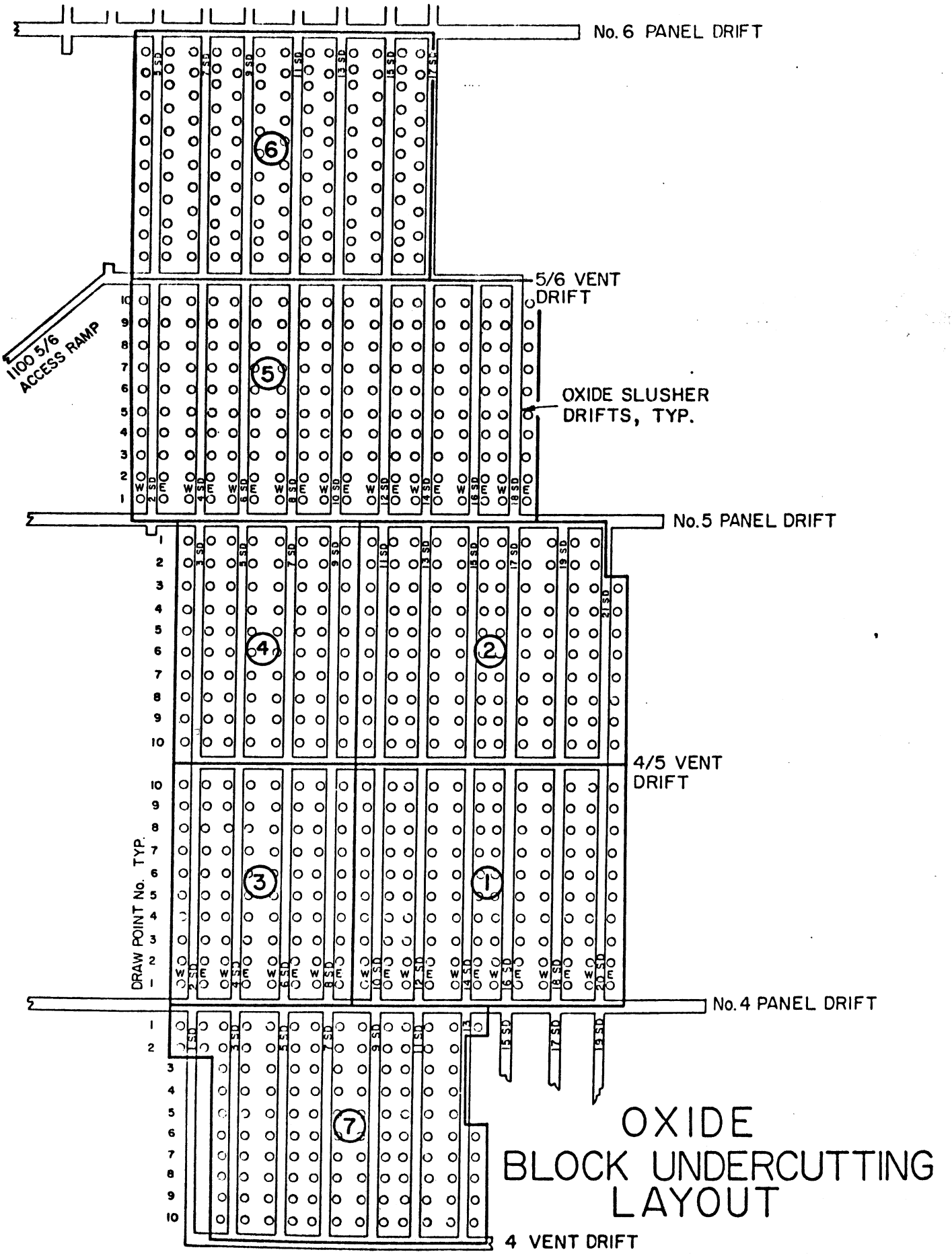
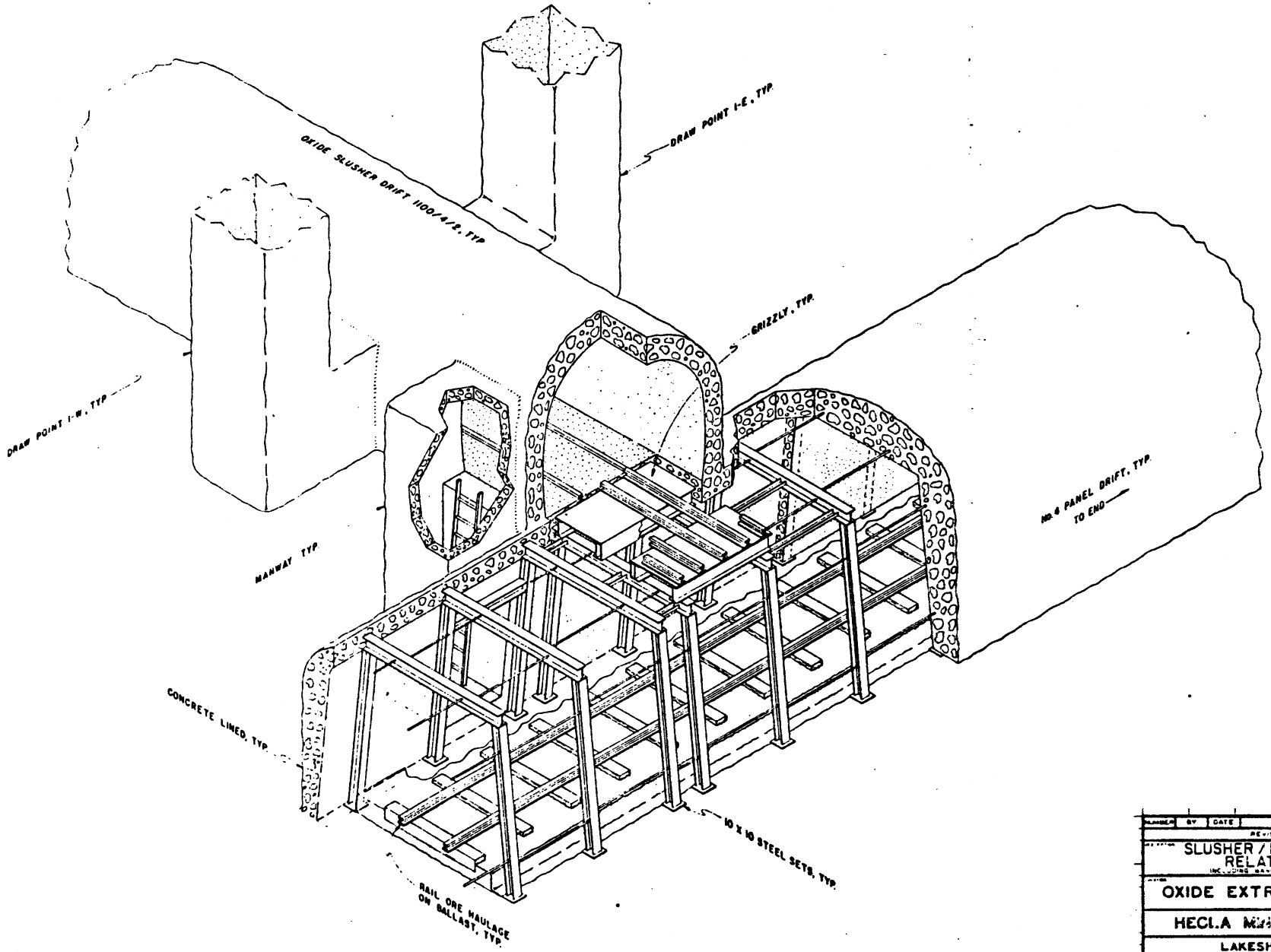


Figure 12



NUMBER	BY	DATE	DESCRIPTION
REVISION DATA			

SLUSHER / PANEL DRIFT RELATIONSHIP
INCLUDING GRIZZLY & DRAW POINTS

OXIDE EXTRACTION AREA

HECLA MINING COMPANY

LAKESHORE MINE
PINAL COUNTY, ARIZONA

3/8"=1'0"	17-8		

Figure 13

METALLURGICAL PLANT

The Lakeshore operation includes a fully operational metallurgical plant to produce pelletized cement copper precipitates from oxide ore, and electrowon cathode copper from sulfide ore, while complying with all present and anticipated environmental regulations. The plant was conceived at a time when uncertainties over environmental regulations made it impossible to negotiate contracts for treatment of sulfide flotation concentrates by existing custom smelters. Accordingly, it carries the treatment of sulfide ore all the way to copper metal. The metallurgical processes employed were chosen to fit the rather unique situation of separate oxide and sulfide ore bodies in the close proximity that can be mined concurrently. The operation utilizes all by-product sulfuric acid produced in treatment of sulfide flotation concentrates for the leaching of oxide ore, the production rates of the two types of ore having been chosen to maintain this acid balance. An iron-bearing residue generated in the treatment of sulfide concentrate is also utilized for production of sponge iron, which is used in the production of the cement copper precipitate from oxide ore. The pelletized cement copper product is suitable for direct charging into the converters of conventional smelters, utilizing otherwise wasted capacity, without contributing to their otherwise onerous pollution problems.

The Lakeshore metallurgical operation is shown pictorially in Figure 14, and a simplified metallurgical flowsheet is provided in Figure 15. An aerial view of the entire surface plant is shown in the aerial photograph, Figure 16.

Oxide ore is drawn from stockpiles in the radial stacker area, through the secondary and tertiary stages of crushing in the fine crushing plant, and bedded into a conventional vat leach system. Ore is crushed to approximately 75% minus 1/2 inch, and an average crushing rate of 950 tons per operating hour has been demonstrated on oxide ore. During crushing and bedding, fines are agglomerated by the addition of water with mixing at belt transfer points. The oxide ore treatment facility includes 10 epoxy lined leaching vats, each of 6,500 tons capacity. Using concentrated sulfuric acid from the by-product sulfuric acid plant, and dilute acid contained in the spent electrolyte bleed from the electrowinning plant, the ore is leached on a 10-day cycle.

The residue from the vat leaching operation is excavated, and hauled by conveyor and truck to the tailings disposal area where it is used to build the dam for confinement of the concentrator tailings. The barren liquid effluent from the cementation plant flows to a 200-acre sealed evaporative pond complex in the tailings disposal area.

The pregnant solution from vat leaching, containing 20 to 25 grams of copper per liter, flows to a cementation plant where pulverized by-product sponge iron is used to precipitate cement

copper. The precipitate, containing about 55% copper, is filtered, pelletized, and sun-dried before shipment. Because the precipitate is made with sponge iron produced from the roast-leach residue after treatment of copper sulfide concentrates, it also contains the gold and silver originally present in those sulfide concentrates. These metals, present in concentrations of about .03 ounces of gold and 3.0 ounces of silver per ton in precipitate, are payable elements in the smelter contracts under which precipitate is treated. The plant has a design capacity of approximately 110 tons per day of copper contained in precipitate, for an annual production rate of about 38,000 tons of metal.

A facility to redissolve up to 36 tons per day of this copper contained in precipitate, supplementing electrolytic tankhouse feed to assure full cathode production rate regardless of concentrate availability or roaster performance, has recently been placed into operation.

The same fine crushing facilities used for oxide ore are used to crush sulfide ore. This ore is normally crushed to about 75% minus 1/2 inch in size, and a crushing rate in excess of 980 tons per operating hour has been demonstrated. The sulfide ore flows to crushed ore storage bins, from which it is withdrawn to a conventional sulfide flotation concentrator. This plant, with a demonstrated capacity of about 10,000 tons of ore per day, produces a concentrate containing about 25% copper, .04 ounces of gold per ton, and 1.8 ounces of silver per ton. Both the fine crushing plant and the concentrator are designed for expansion to about double their present size when the mining operation shifts from tactite to the block caving of the disseminated sulfide ore, so that concentrate production will be maintained with the lower ore grade.

Concentrator tailings are impounded in a tailings disposal area located on business lease land to the south of the plant site. A starter dam and pond are operational. As the amount of tailing increases, the dam is being raised using washed leach residue from the vat leaching operations. A tailings thickener is currently being installed as part of a water reclamation system which, upon completion, will recycle approximately 7,000 gallons of water per minute to the metallurgical operation.

The sulfide flotation concentrate is treated by a process of sulfate roasting, leaching, and electrowinning to produce cathode copper. The flotation concentrate slurry flows to storage tanks, where it can be supplemented by the addition of purchased concentrate. The concentrate slurry is pumped at the rate of about 450 tons per day to two 24-foot diameter Lurgi fluosolids roasters, the gas streams of which feed a 200 ton-per-day contact sulfuric acid plant. The calcine from the roasting operation is quenched and leached in acidic spent electrolyte from the electrowinning tankhouse. It is then thickened, washed, and clarified to produce a pregnant solution suitable for the direct electrowinning of high quality cathode copper. This plant has a demonstrated

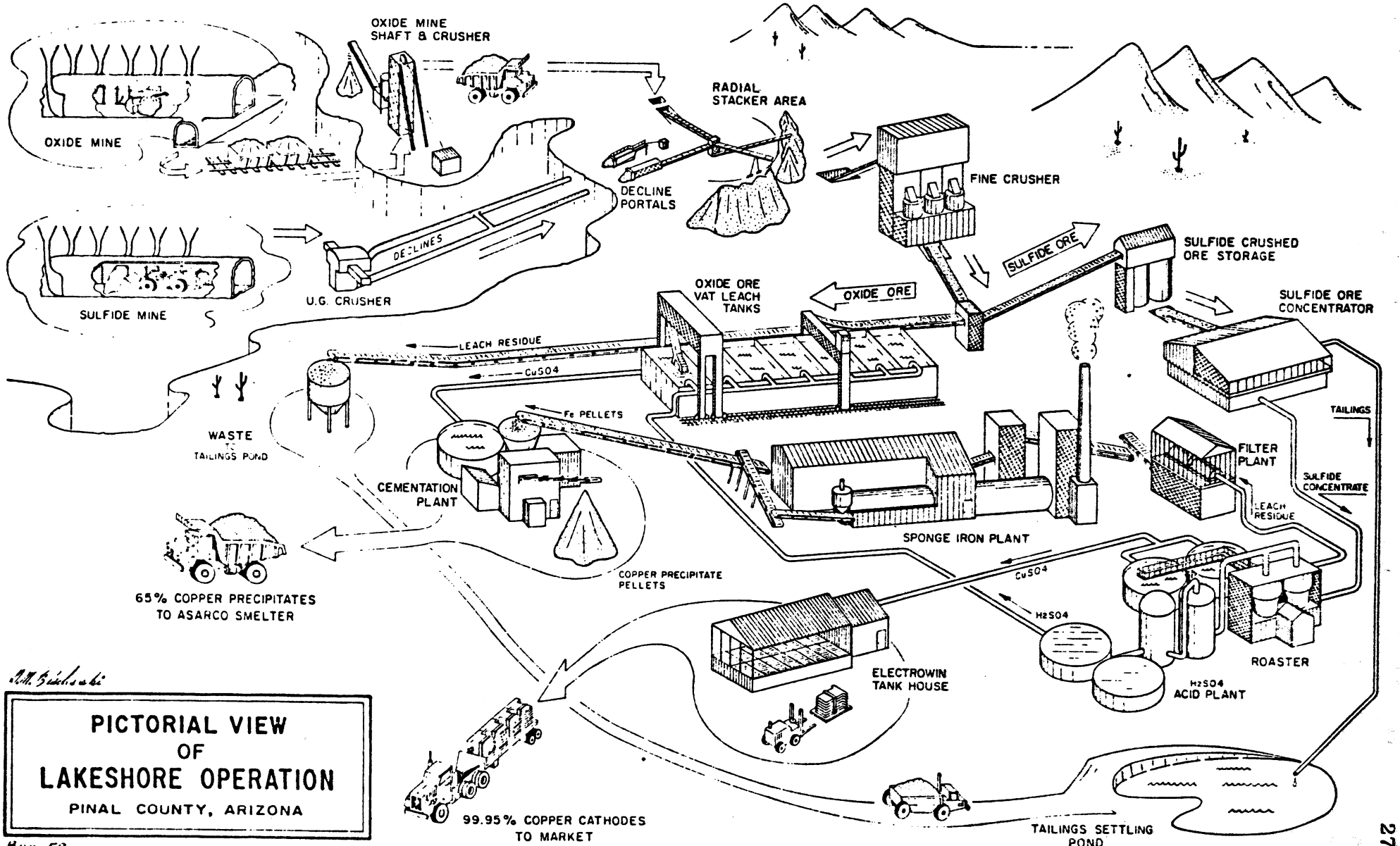
capacity of about 30,000 tons of electrowon copper annually. The plant has a demonstrated capability of producing a high proportion of its output in the form of cathode suitable for direct charging into continuous copper rod drawing systems.

The filtered leach residue from the concentrate roast-leach operation, which is essentially iron oxide with gold, silver, and some unrecovered copper values, is fed at a rate of 290 tons per operating day to the sponge iron plant, which employs the SL/RN process, with coal as a reductant. To supplement the feed, a magnetite concentrate is recovered in the concentrator from the rougher tails. The sponge iron plant yields 180 tons per day of pelletized sponge iron for use as a precipitant in the oxide ore vat leach-cementation circuit.

The two products, cathode copper and pelletized cement copper, are delivered by truck to a rail loading facility in Casa Grande, Arizona, 30 miles to the north. From that point, the cathode copper is shipped by rail to fabricators, and the cement copper is shipped by rail to ASARCO smelters in Hayden, Arizona; El Paso, Texas; or Tacoma, Washington. About 60% of the cement copper is sold to ASARCO under long-term contract, and about 40% is toll-refined and returned for marketing by Hecla-El Paso.

Water for the Lakeshore operation is supplied from two shallow and five deep wells in a well field near Santa Rosa Wash, about 6 miles west of the plant site. The wells are drilled under a long-term water permit from the Papago Tribe. Estimated new water requirements for the operation under the full water reclaim system now under construction are about 3,500 gallons per minute, well within the capacity of the well field. The water is pumped to a one million-gallon storage tank at the plant site, where it is distributed as required.

Electric power for the Lakeshore operation is purchased from the Papago Tribal Utility Authority and supplied by Arizona Public Service Company. A 230-kv line connects with the APS system 9.3 miles from the plant site; power at 230 kv is received in the main substation and distributed at 69 kv to various substations, at which it is further reduced to 4.16 kv for distribution to individual plants.



PICTORIAL VIEW
OF
LAKESHORE OPERATION
PINAL COUNTY, ARIZONA

BSK-59

Figure 14

PLANT FLOWSHEET
HECLA MINING COMPANY
LAKESHORE MINE
CASA GRANDE, ARIZ.

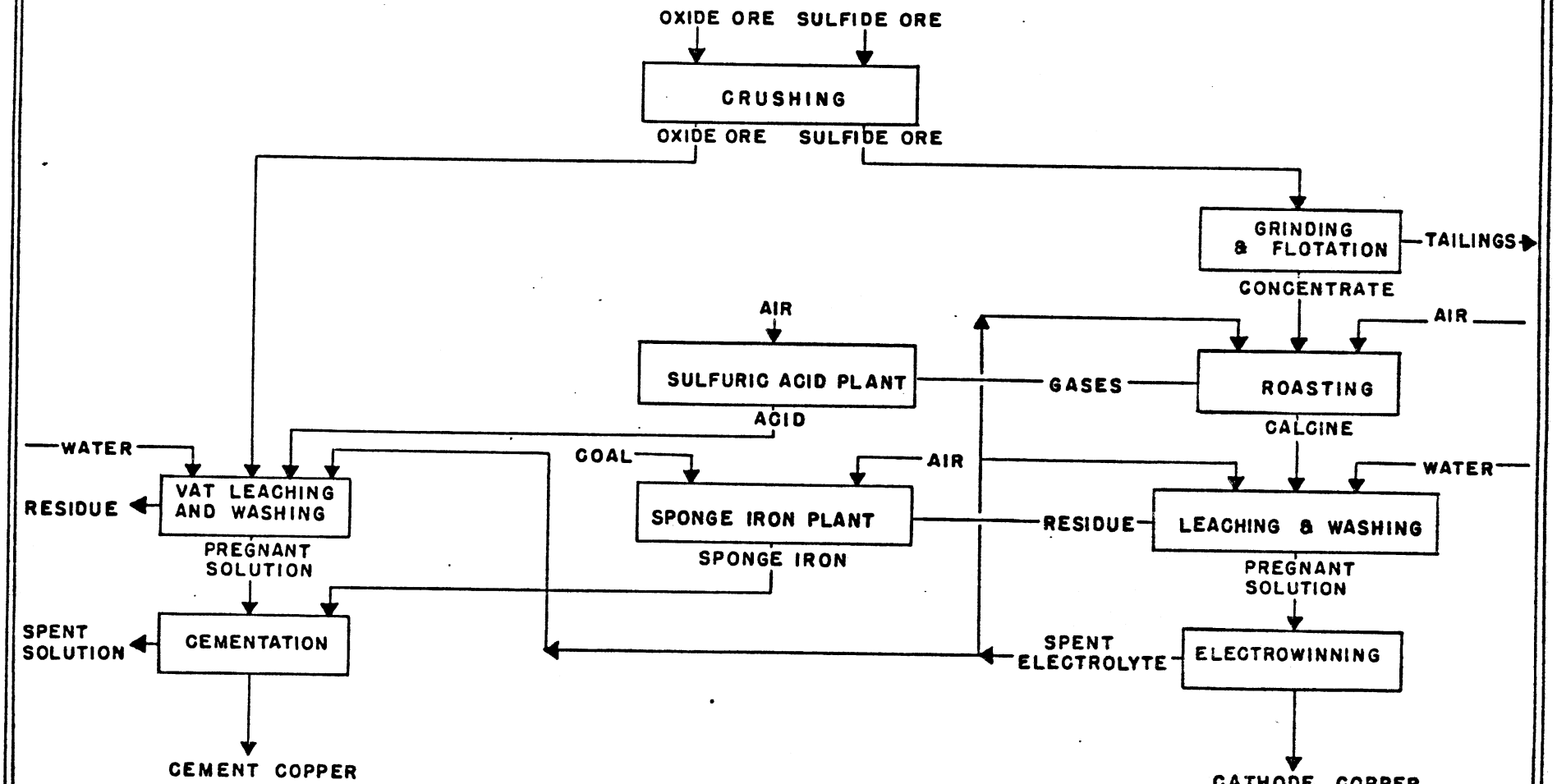
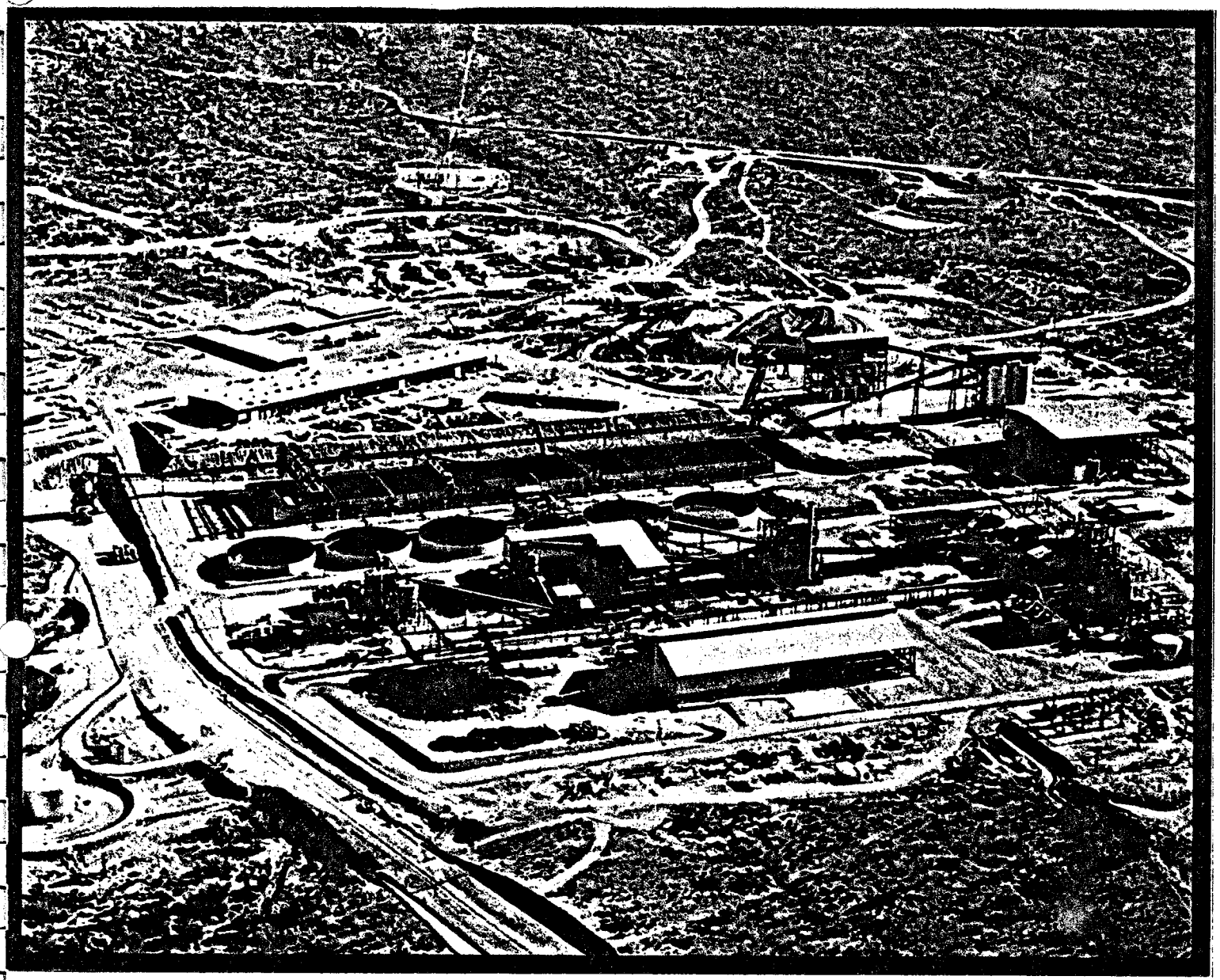


Figure 15



AERIAL VIEW, SURFACE PLANT

Figure 16

BUSINESS ARRANGEMENTS

Hecla and El Paso

The current business arrangement between Hecla and El Paso is a joint venture, the terms of which are contained in an amended operating agreement (joint venture agreement) effective January 1, 1973. Under this agreement, Hecla and El Paso each hold a 50% interest in the lease with the Papago Tribe and a 50% interest in all buildings, structures, equipment, etc. Hecla is the operator of the property, with authority to conduct operations as it deems advisable, but consistent with a specified work program. Hecla is required to obtain El Paso's prior agreement to major changes on the work program and to any single new project involving capital expenditures in excess of $300,000. Under the terms of this agreement, Hecla and El Paso now share all capital and operating costs equally.

Each partner has the right to receive its 50% share of all products to market as it sees fit, but in fact all production to date has been marketed by Hecla.

Under terms of Federal income tax rulings effective January 1, 1973, the relationship between Hecla and El Paso is classified as a partnership for Federal income tax purposes, and does not constitute an association taxable as a corporation. Although the agreements between Hecla and El Paso contain specific provisions for allocation of investment tax credits and other income tax benefits, since early 1975 all tax deductions and other tax benefits are being shared equally.

The joint venture agreement runs for 50 years from 1969, with automatic renewal for an additional 50 years or so long as commercial ores can be mined from the properties. Either party must obtain the consent of the other for assignment of its interest and each has the right of first refusal in any sale, but there is no limitation in the agreement between Hecla and El Paso on assignment by way of merger or consolidation. Each party has the right to withdraw, with its interest being assumed by the other party. The agreement is governed by the Uniform Partnership Act of the State of Arizona.

In addition to its 50% interest in the joint venture agreements, El Paso owns, through a wholly owned subsidiary, 1,171,662 shares (16.77%) of the capital (common) stock of Hecla and is the largest single stockholder in Hecla.

Thc Papago Tribe

Hecla and El Paso each hold a 50% interest in a Mineral Lease from the Papago Tribe (No. H50C14200521) covering approximately 4,180 acres, and a Business Lease (No. H50C14206911) covering an additional 6,325 acres for plant and tailings disposal sites.

The Mineral Leases run for a 10-year period commencing August 17, 1976 and so long thereafter as minerals are mined in paying quantities, but with reasonable adjustment of the royalty rates each five years. The present royalty is 10% of net smelter returns for precipitates sold to and/or treated at smelters, and a lesser but equivalent percentage of net sales revenue for cathode produced from sulfide concentrate on the property, currently 6.14%. There are also provisions for minimum advance royalties, currently $160,000 per month.

The Business Lease runs for 25 years, commencing September 12, 1969, with option to renew for an additional 25 years at the then existent terms and conditions. The rental for the first 25 years was fully prepaid in 1969.

Neither the mineral lease nor the business lease is assignable without approval of the Secretary of the Interior and Papago Tribe of Indians except that no approval is required for:

(a) HECLA'S or EL PASO'S assignment of its entire interest in the leases, or any part thereof, to a wholly owned subsidiary of HECLA or EL PASO, and HECLA or EL PASO, as the case may be, remains liable for performance by such subsidiary of all such assignee's lease obligations, or

(b) HECLA'S or EL PASO'S assignment of its entire interest in the Leases, or any part thereof, to

(i) the other party, or

(ii) an affiliated or associated company in which HECLA or EL PASO own fifty percent (50%) or more of the voting stock and such assigning party and HECLA or EL PASO, as the case may be, remains liable for performance by the assignee of all such assignee's lease obligations, or

(iii) a company of financial responsibility with which HECLA or EL PASO is merged or which acquires all or substantially all of HECLA'S or EL PASO'S operating assets, or

(iv) a company having a net worth of not less than $100,000,000 and HECLA or EL PASO, as the case may be, remains liable for performance by the assignee of all such assignee's lease obligations.

The Lease agreements provide further that HECLA or EL PASO, or their respective successors and assignees, may encumber its leasehold interest in the leased premises for the purpose of borrowing capital for the development and improvement of the leased premises subject to the approval of the encumbrance instrument by the Secretary and the Papago Tribal Attorney.

In addition to the above leases, the partners have rights of way for water and natural gas pipelines, water permits for use of water at no charge, and agreements covering the purchase of power from the Papago Tribal Utility Authority, who in turn purchase the power from Arizona Public Service Company.

Although doing business on an Indian reservations involves dealing with a large array of governmental agencies charged with responsibilities for protecting Indian rights, the relationships with the Papago Tribe are generally amicable and we expect them to remain so.

Marketing

Hecla and El Paso have parallel agreements for sale of 60% of their respective shares of cement copper precipitates to ASARCO Incorporated, and for the toll smelting and refining of the remaining 40%. Sales are at the METALS WEEK US Producer prices, less usual smelting, refining and transportation charges, escalated to reflect actual cost increases. The contracts are for six years, from 1976, with option to renew for up to four more years. They require ASARCO to take and pay for material as produced, regardless of market conditions. The financial terms reflect the desirability of the pelletized copper precipitate as smelter feed as compared with sulfide flotation concentrate.

Both Hecla and El Paso's share of the copper returned on toll is marketed by Hecla, utilizing the services of Brandeis, Goldschmidt & Co., Inc. as agents.

All of the cathode produced is sold to Southwire Company, Carrollton, Georgia, under terms of a 3-1/2-year agreement effective 1975, which obligates Southwire to take and pay for the material as produced. The cathode is sold at a price related to a blend of 75% METALS WEEK US Producer and 25% Comex prices, with discounts, freight and treatment charges dependent on its quality.

All of these agreements have proved attractive during the soft copper markets of recent years.

THE PEOPLE

The Lakeshore operation had a total payroll as of July 1, 1977 of 1,641 people. It is headed by a highly skilled staff of 321 persons, including mining and metallurgical engineers, geologists, and other skilled supervisors and technicians, a large percentage of whom have been with the project for most of its life. The hourly paid work force is assigned as follows:

Mining	694
Metallurgical	253
Central Maintenance	323
General and Administrative	50
Total	1,320

It is anticipated that full production can be achieved with a total salaried and hourly work force of 1,600 people.

PERFORMANCE TO DATE

Capital Investments

The total Joint Account capital expenditures to April 1, 1976, when the project became operational for accounting purposes, was $192,186,000, including working capital of $7,425,000. Other capital expenditures since that time for mine development, such deferred projects as the water reclamation system, precipitate re-dissolve, and additions to working capital, have increased this to $199,483,000 at December 1, 1977, including working capital of $8,458,000. A breakdown of these expenditures is shown in Table I.

Operating losses since April 1, 1976 have totaled $45,985,000, so that total Joint Account investment to date is $245,468,000.

Production Results

The significant operating results during 1976 and the first eleven months of 1977, including the first quarter start-up period, are summarized in Table II. This table reflects the production shutdown during the month of September 1977 which has continued to date.

The product tonnages reflect the treatment of purchased concentrate in the roast-leach-electrowinning plant during this period, taking advantage of available plant capacity to reduce operating losses during this start-up period. They also reflect the diversion of some vat leach pregnant solution directly to electrowinning, taking advantage of available tankhouse capacity to produce more cathode in place of lesser value copper precipitate during the start-up period.

Operating Financial Results

Operating financial results for the twenty months since April 1, 1976, when the project became operational, are summarized in Table III. A further breakdown of operating costs is presented in Table IV.

Much emphasis has been placed on improving operating costs, and considerable improvement was made prior to suspension of operations.

TABLE I

LAKESHORE MINE

CAPITAL EXPENDITURES

Total Project to Date December 1, 1977

Capital costs	
Preproduction and capital costs	
Mine	$ 85,358,000
Metallurgical plant	60,963,000
General plant	12,131,000
Other indirects and other	19,411,000
Other capitalized expenditures	3,386,000
Subtotal	181,249,000
Preproduction start-up costs to March 31, 1976	9,776,000
Working capital	8,458,000
Subtotal	199,483,000
Operating losses from April 1, 1976	45,985,000
	$ 245,468,000

TABLE II
SUMMARY OF OPERATING RESULTS

Months	1976 Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1977 Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
Mine production																							
Oxide ore - 1,000 tons/mo.	11	39	79	102	142	166	153	195	175	173	113	112	115	116	157	169	174	195	189	150	6	- -	- -
- % Acid sol. Cu	1.21	1.24	1.14	1.35	1.26	1.24	1.06	0.93	0.84	0.87	0.85	0.78	0.84	1.06	1.09	1.12	1.05	0.96	0.85	0.90	0.99	- -	- -
Sulfide ore - 1,000 tons/mo.	29	48	69	93	111	116	116	147	138	121	120	123	117	130	151	155	150	182	172	159	- -	- -	- -
- % Total Cu	0.66	0.67	0.73	0.73	0.83	0.80	0.76	0.73	0.66	0.70	0.90	0.82	0.82	0.93	0.92	0.96	1.02	0.94	0.78	0.88	- -	- -	- -
Sulfide concentrate treated																							
Hecla - Tons/mo.	- -	1,597	3,787	2,973	1,632	4,394	3,185	4,184	2,529	4,118	3,585	4,552	3,197	3,825	5,879	4,942	4,466	4,905	4,373	4,348	2,739	- -	- -
Purchased - Tons/mo.	- -	800	634	4,049	2,075	2,463	3,538	3,463	4,839	4,058	4,170	4,557	8,095	9,091	6,919	9,249	9,144	5,999	5,057	5,783	224		
Total	2,626	2,397	4,421	7,022	3,707	6,857	6,723	7,647	7,368	8,176	7,755	9,109	11,292	12,916	12,798	14,191	13,610	10,904	9,430	10,131	2,963	- -	- -
Product - Tons																							
Cathode - Class I	- -	46	248	975	521	46	0	1,008	103	451	919	1,545	1,347	1,132	1,429	2,478	1,087	133	64	336	144	20	20
- Class II	- -	138	173	348	264	701	577	500	231	1,241	665	350	795	1,286	1,236	317	1,394	66	285	282	393	153	- -
- Class III	29	206	476	237	244	1,145	1,268	354	1,126	153	206	1	74	55	5	10	80	2,297	1,172	1,583	656	161	- -
Scrap	16	47	34	9	8	31	21	28	122	34	13	14	11	13	12	18	23	64	33	35	17	1	6
Total	45	437	931	1,569	1,037	1,923	1,866	1,890	1,582	1,879	1,803	1,910	2,227	2,486	2,682	2,823	2,584	2,560	1,554	2,236	1,210*	335*	26*
Copper as precipitate	0	0	60	965	968	1,119	1,521	1,568	1,092	1,434	1,154	915	1,675	1,657	2,282	2,703	2,504	1,608	1,502	816	272	34	151

*Note: Includes S/X pilot plant production.

TABLE III
OPERATING FINANCIAL RESULTS

(Thousands of Dollars)

Months	1976 Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1977 Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
Net sales revenue																				
Cathode	1,305	1,992	1,606	2,392	3,163	1,600	2,858	2,288	1,480	2,330	4,018	3,393	3,273	4,822	1,620	1,947	2,366	1,845	752	200
Scrap	79	- -	1	- -	- -	138	- -	- -	- -	106	126	- -	- -	- -	- -	- -	94	80	- -	44
Precipitate and toll copper net of charges	357	703	653	900	973	894	762	(246)(4)	793	713	860	2,678	2,152	1,269	3,021	66	(98)	2	1,471	1,302
Total	1,741	2,695	2,260	3,292	4,136	2,632	3,620	2,042	2,273	3,149	5,004	6,071	5,425	6,091	4,641	2,013	2,362	1,927	2,223	1,546
Sales deduction (1)	184	253	239	319	363	118	187	(3)	203	263	32	501	468	492	248	(65)	232	33	141	122
	1,557	2,432	2,021	2,973	3,773	2,514	3,433	2,045	2,070	2,886	4,972	5,570	5,017	5,599	4,393	2,078	2,130	1,894	2,082	1,424
Cost of sales																				
Costs - Table IV	5,320	5,201	5,433	6,293	5,860	5,913	5,619	4,889	5,513	6,114	6,196	6,558	7,213	7,500	8,396	6,621	5,058	1,405	1,351	1,596
Inventory adjustments	(321)	(742)	(1,920)	(392)	(448)	(37)	1,064	1,285	(663)	(998)	(376)	83	(1,396)	514	(863)	(486)	1,705	1,376	2,295	1,235
	4,999	4,459	3,513	5,901	5,412	5,876	6,683	6,174	4,850	5,116	5,820	6,641	5,818	8,014	7,533	6,135	6,763	2,781	3,646	2,831
Income (loss) from operations	(2,842)	(2,027)	(1,492)	(2,928)	(1,639)	(3,362)	(3,250)	(4,129)	(2,780)	(2,230)	(848)	(1,071)	(801)	(2,415)	(3,145)	(4,057)	(4,633)	(857)	(1,564)	(1,407)
Other income (expense)	0	0	36	13	9	7	1,284	14	56	14	7	9	6	(5)	15	10	9	19	10	9
Net income (loss) (3)	(2,842)	(2,027)	(1,456)	(2,915)	(1,630)	(3,355)	(1,966)	(4,115)	(2,724)	(2,216)	(841)	(1,062)	(795)	(2,420)	(3,130)	(4,047)	(4,624)	(868)	(1,554)	(1,398)
Avg. Cu. price (2)	0.686	0.700	0.700	0.740	0.740	0.740	0.725	0.700	0.658	0.656	0.680	0.719	0.739	0.725	0.708	0.674	0.632	0.600	0.600	0.600

(1) Papago royalty, severance tax, etc.
(2) Metals Week U.S. Producer Cathode.
(3) Before depreciation and amortization.
(4) Accumulated toll charges for year to date deducted here.

TABLE IV
OPERATING COST SUMMARY

(Thousands of Dollars)

Months	1976 Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1977 Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
Mining																				
Oxide ore	598	761	590	911	567	624	667	714	742	1,022	945	1,045	1,012	919	930	915	979	189	57	123
Sulfide ore	589	494	472	500	515	499	495	502	584	989	985	927	1,024	1,176	1,173	1,165	1,080	138	44	143
General	1,486	1,621	2,048	2,016	1,872	1,821	1,567	1,340	1,204	476	483	739	552	552	661	755	592	219	238	450
Total	2,673	2,876	3,110	3,427	2,954	2,944	2,729	2,556	2,530	2,487	2,413	2,711	2,625	2,647	2,764	2,835	2,651	546	339	716
Metallurgical																				
Fine crushing	46	41	61	79	61	73	74	50	73	63	44	64	63	84	94	83	96	20	3	1
Concentration	130	129	193	145	181	185	234	143	148	165	172	217	195	155	219	274	262	62	11	13
Roast-leach-electrowin	335	264	521	339	331	335	395	307	330	376	374	421	401	398	545	629	520	275	194	192
Sponge iron	390	290	254	403	400	(48)	413	269	240	236	327	336	350	303	411	277	116	169	17	55
Vat leach - Cementation	207	211	297	348	324	285	338	303	251	227	244	292	323	342	380	465	426	81	107	115
Other	29	23	30	25	27	26	26	27	21	27	24	23	21	25	22	18	17	15	374	120
Total	1,137	953	1,356	1,339	1,324	856	1,480	1,099	1,063	1,094	1,185	1,353	1,353	1,312	1,671	1,746	1,437	622	706	496
General and administrative	311	542	683	602	470	512	420	508	726	698	545	503	550	718	781	668	709	626*	725*	404*
Total operating costs	4,121	4,371	5,149	5,368	4,748	4,312	4,629	4,163	4,319	4,279	4,143	4,567	4,531	4,677	5,116	5,249	4,797	1,794	1,770	1,616
Purchased concentrate	1,199	830	284	925	1,112	1,601	990	726	1,194	1,835	2,053	1,991	2,682	2,823	3,280	1,372	261	(389)	(419)	(20)
Total costs	5,320	5,201	5,433	6,293	5,860	5,913	5,619	4,889	5,513	6,114	6,196	6,558	7,213	7,500	8,396	6,621	5,058	1,405	1,351	1,596

*Note: Includes suspended operations costs.

Problems and Accomplishments

The primary problems during the first twenty months of operation, more or less in order of their impact on financial results, were as follows:

(1) The low price of copper, as detailed in the following tabulation:

	Cents Per Pound			
	M.W. US Prod. Del.	M.W. NY Dealer	M.W. US Prod. Cathode	Comex 1st Position
1976 - 2nd Qtr	70.16	71.10	69.55	69.70
3rd Qtr	74.62	71.70	74.00	70.07
4th Qtr	69.67	60.50	69.04	58.73
1977 - 1st Qtr	69.14	68.45	68.50	66.43
2nd Qtr	72.73	64.85	72.39	63.10
3rd Qtr	64.14	57.62	63.53	55.08
Average (6 Qtrs)	70.08	65.70	69.50	63.85
Price on week ending 12-2-77	60.62	58.40	60.00	56.44

(2) Difficulty in bringing the sulfide mine up to full production rate.

Mining was planned to start in the southeast part of the tactite ore body which is, unfortunately, the lowest grade part of the tactite deposit. This was because it was felt desirable to retreat from the most southerly and up-dip portion of the deposit. Extraction drifts were driven under Panel 1 and fully concreted before detailed information on the ore body was available, and without an adequate analysis of existing information, and are located several tens of feet below the base of the ore. The intervening material, containing highly incompetent diabase, averaged only about 0.3% Cu and provided much excessive dilution. As mining proceeds northward, this mistake becomes much less important.

Production ore from the extraction drifts is loaded from drawpoints by Wagner ST2B load-haul-dump units and is dumped into ore passes to the main haulage level. These ore passes are 5-ft. bored raises, lined to 4-ft. diameter. Early during their use, these ore passes plugged and proved extremely difficult to reopen. Surge chambers were excavated at the bottom of each ore pass, which provide adequate storage without allowing the raise to fill. This problem has thus been alleviated. However, this took much time. Since it delayed drawing ore from undercut sections, it led to excessive ground weight and failure of large sections of the extraction drifts. The weight problem was

intensified because of incomplete undercutting, leaving an occasional pillar. As crews and supervision have become more trained, this problem has become of much less effect.

An effort to repair extraction drifts was carried on longer than it should have been, and in the meantime undercutting was temporarily halted. As a result, the mine simply did not have enough active drawpoints to maintain production. Undercutting is now proceeding at a satisfactory rate, and production is expanding as we add available drawpoints each day.

Ground support in the Tactite mining area has been improved by installing epoxied rockbolts in the concreted extraction drifts and by grouting voids between the concrete and the rock. In addition, strict control of undercutting procedures has reduced ground problems and greatly reduced the incidence of stub pillars, which transmitted pressure to the drifts consequently destroying the concrete which then required extensive repairs. The above repair then caused a loss of production because of the restrictions to the passage of haulage equipment in the extraction drifts.

Shortcomings in layout and draw methods in Tactite I are prevent this area from achieving desired output. This pioneer development in the tactite area was supplemented by other sulfide production from a sublevel caving development.

(3) The fall-off of production from the oxide mine, after achieving the full tonnage production rate in August, 1976.

This fall-off occurred because we did some rather poor planning of production and undercut scheduling, and we exhausted the mining reserve in the first four blocks being mined before making an adequate number of drawpoints available in the next blocks. The physical layout of the slusher drifts on the 1100 level of the oxide mine does not allow the required flexibility for good scheduling; however, we do not expect to experience any further production dips of serious amount or duration.

The lower oxide ore tonnage production also affected the grade, because we over-pulled the original blocks to get enough ore for vat leaching in order to dispose of acid being made in the roaster plant.

(4) A problem with labor productivity.

Starting an operation of this size is a large task. All of the crew, including management, all supervision and all of the hourly workers, required time and training to learn their jobs. We now feel the crew as a whole has come a long, long way and has become an effective work force. Continuous training is still required, however, for underground personnel.

(5) Difficulty in buying enough concentrate to make up our concentrate production shortfall.

Although the profitability of treating purchased concentrate is modest compared with that projected for treatment of our own concentrate, it helped significantly in reducing our operating losses to date and will continue to do so until mine production is normal.

(6) Some difficulty in maintaining copper cathode quality.

As indicated in the Summary of Operating Results, Table II, p. 35, some difficulty was experienced in maintaining production of a consistently high percentage of the more profitable Class I and Class II cathode. Although production of a high proportion of Class I and Class II cathode was achieved during the early months of operation, copper quality deteriorated badly during the period June to September, 1976, primarily as a result of efforts to supplement tankhouse feed with vat leach pregnant solution. This situation improved late in 1976, as the operators learned to handle vat leach solutions in the tankhouse and production from concentrate roasting increased, until the record month of April, 1977, when 99% of production was of this quality. During May and June, however, cathode quality deteriorated badly again, as a result of an unfortunate series of power interruptions and operator errors, including those associated with start-up of the new redissolve facilities.

(7) Some concentrator recovery problems early in the year.

(8) Inadequate supplies of leach residue raw material from the roast-leach plant for sponge iron manufacture, requiring purchase of iron pellets (from Kaiser Steel of Eagle Mountain, California) during the early months of operation.

(9) Filtering and drying problems with the cement copper precipitate, leading to an abnormal build-up in cement copper in-process inventory.

The Lakeshore precipitate sales contract with ASARCO, Inc. requires that the precipitate be pelletized and dried for direct charging into converters. The precipitate filter cake has proved to have a higher moisture content than projected, necessitating solar drying and extra handling before pelletizing. This and other operational problems in pelletizing led to the accumulation of an excessive in-process inventory of 9,000 tons by March, 1977. Improvements in operations reduced this to 4,000 tons by July, 1977.

The cement copper to date has also been lower grade than anticipated. The filter cake has averaged 54% copper instead of the 64% projected on the basis of pilot plant work, and this has been further diluted to about 40% copper during drying and pelletizing as a result of oxidation and addition of lime as a binder for making pellets. This has led to handling, shipping, and smelting charges higher than anticipated.

(10) An accumulation of toll copper inventory as a result of the soft market conditions.

(11) Miscellaneous normal start-up problems.

(12) A slump in metallurgical plant output during May, June, July, and August 1977.

The tonnage of cathode produced during these months dropped from the high levels of March and April, even though enough concentrate was available for roaster feed. The slump in May reflected a number of power outages in the tankhouse and a drop in roaster operating time from 90% of scheduled to 83%. Further drops in operating time and consequent drops in production followed in June and July. The primary cause was a design error in the roaster gas cooling system which became apparent for the first time as a result of the unusually high temperature and humidity experienced during these months. The cooling problem prevented continuous high strength acid production with both roasters on line, necessitating periodic cutbacks to a one-roaster operation. Production rates began to improve with the advent of cooler weather in August. The problem is correctable at modest cost, and corrective action will be completed before the summer of 1978.

The tonnage of copper produced in precipitate also dropped in June to the lowest level in four months, even though the amount of acid soluble copper available in ore mined remained near the all time high. This reflects a downward trend in the leach extraction of acid soluble copper as production of ore increased and available leach time diminished. There is reason to believe this trend can be corrected by improvements in leaching practice.

On the other hand, we put some important hurdles behind us during the initial year of operation. They included the following:

(1) Underground development work and underground drilling confirmed grades of ore in place as estimated from surface drilling.

(2) The oxide mine has been brought up to full production and the oxide ore processing facilities have demonstrated full designed capacity.

(3) The work force was reduced from a high of 2,000 to 1,600, and turnover was reduced.

(4) The fine crushing plant and sulfide ore concentrator were demonstrated to have more than their originally designed capacity.

(5) The roast-leach-electrowinning system and its associated acid plant demonstrated designed capacity, an unexpected capability of treating a variety of purchased concentrates, and the capability of producing a high proportion of cathode of quality adequate for direct charging to SCR continuous rod drawing systems.

(6) The feasibility of utilizing excess electrowinning tankhouse capacity for the direct production of additional cathode copper from vat leach (oxide ore) pregnant solution was demonstrated.

(7) The feasibility of producing a pelletized cement copper product suitable for direct charging into copper converters was demonstrated.

(8) Great strides were made in developing a skilled, efficient and cohesive work force.

THE FUTURE

Introduction

The future prospects of the Lakeshore operation depend on:

(1) The future of the copper market or, more specifically, the relationship between copper prices and the average cost of production of the industry world-wide.

(2) Our ability to improve the competitive position of the Lakeshore operation relative to the rest of the U.S. domestic industry and that of the remainder of the world.

We remain bullish concerning the long-term future of copper in general, and the prospects of the Lakeshore operation in particular, for the reasons explained below.

The Copper Market

As is well known, the copper market has historically been cyclical. Furthermore, it has been characterized by the fact that very small surpluses world-wide lead to very severe free market price depression, and very small shortages lead to exaggerated free market price escalation. At the moment, and for the past three years, we have been in a severe price depression cycle, accentuated by the economically undisciplined behavior of political groups in the governments of the CIPEC nations who are in the process of learning how to handle their new found power over their respective recently nationalized copper industries.

Nevertheless, it is our conviction that the per capita consumption of copper world-wide will increase substantially as industrialization and higher standards of living spread throughout the developing countries of the world, that the price of copper must in the long run reflect its cost of production if this need is to be met, and that there will continue to be a healthy copper industry world-wide and domestically.

It must be recognized and emphasized that copper price improvement brought about by pressures of increasing costs of production can only be expected in the long-term view. At present the industry is still in a condition of oversupply because production has become relatively inelastic. A substantial part of Free World copper production comes from countries where the industry is state-owned or controlled. In most such cases copper is a large and important part of the national economy, and the governments of these countries are most reluctant to reduce production. Other factors include the excessive cost of temporary mine and smelter closures and the high-debt, cash-poor, condition of most major producers.

The over-supply condition is projected to prevail until 1979 or 1980, at which time consumption is projected to increase beyond utilized production capacity.

New copper capacity is now estimated to cost $6000 to $7000 per annual ton. Such an investment would require that the copper price be much higher than at present, and little new capacity will be built until the market improves markedly.

As a result, a production shortfall can be expected in the future. Some observers project such a shortfall to occur in the late 70's or early 80's. If and when such an event occurs, we can expect sharply higher prices.

Forecasting of the price of any commodity is an uncertain and risky business, particularly over the short term. Forecasts tend to be too high when made at the top of the cyclical swings, and too low when made at the bottom of price troughs. Furthermore, the speed of price changes, once begun, are usually underestimated. Nevertheless, over the long term the primary influence which determines the price of copper or any commodity is the cost of production. The price trend over the long term can thus be predicted with some reasonable degree of confidence based on the historical relationship of production cost to price.

According to AMETALCO, Inc., and quoting from their report "Outlook for Copper," dated January, 1975, "During the past twenty years, the price for copper has ranged between a low of 1.4 times the cost of production to a high of 2.4. While the average has been 1.8 times costs, the ratio is usually at one extreme or the other. In 1972, the LME price for copper averaged 1.4 times cost. In 1973, the price rose to a ratio of 1.9 and dropped back to a ratio of 1.8 in 1974." In reference to cost, AMETALCO said "The cost of producing refined copper in 1973 from mines that are considered competitive averaged 42¢ per pound. These costs include depreciation, transportation, and take into account full credit for by-product values but do not include taxes."

Commodities Research Unit, Ltd., in its COPPER STUDIES report dated March 5, 1974, published the table reproduced below, giving copper prices for 19 years in 1973 values.

Copper Prices Adjusted for Inflation and Parity Changes - Table II

Year	LME Price £/ton	LME Price ¢/lb	Weighted Average Price £/ton	Weighted Average Price ¢/lb	Prices in 1973 Currency Values £/ton	Prices in 1973 Currency Values ¢/lb	Deflated Prices in 1973 Values £/ton	Deflated Prices in 1973 Values ¢/lb
1955	345	43.9	329	41.8	407	45.6	678	75.9
1956	324	41.1	326	41.4	405	45.4	653	73.1
1957	215	27.4	221	28.1	275	30.8	433	48.5
1958	194	24.7	197	25.0	247	27.7	385	43.1
1959	234	29.7	237	30.1	302	33.8	466	52.2
1960	242	30.8	245	31.1	312	34.9	476	53.3
1961	226	28.7	228	29.0	289	32.4	432	48.4
1962	230	29.3	234	29.7	297	33.3	439	49.2
1963	230	29.3	233	29.6	296	33.2	338	37.9
1964	347	43.9	262	33.3	332	37.2	380	42.6
1965	461	58.5	313	39.8	397	44.5	559	62.6
1966	545	69.4	405	51.5	514	57.6	703	78.7
1967	410	51.6	385	48.0	481	53.9	646	72.4
1968	516	55.2	481	52.4	534	59.8	698	78.2
1969	611	66.5	567	61.8	631	70.7	789	88.4
1970	588	64.0	574	62.5	636	71.2	756	84.7
1971	444	49.0	450	49.6	499	55.9	561	62.8
1972	428	48.5	432	49.0	464	52.0	498	55.8
1973	727	81.1	680	75.9	680	75.9	680	75.9

Source: Commodities Research Unit.

The arithmetic average copper price over the 19-year period 1955 through 1973 was 66.3¢ per pound. By dividing the average price by average 1973 costs of 42¢, we arrive at a ratio of price to cost of 1.6.

Historically then, the price of copper has averaged 1.6 to 1.8 times the cost of production, as documented by the AMETALCO and CRU reports. Although we do not have additional supporting facts, it appears reasonable to project a ratio of price to production cost of 1.6 - with the understanding that such ratio at any specific point in time may be high, or low, and can only be regarded as an "average" result.

Assuming the expected average ratio of price tc production cost is 1.6, it then becomes necessary to determine the average cost of production. We have recently obtained a report (confidential) from Mountain States Research and Development which includes the following tabulation of weighted average cost for producing copper in cents per pound:

	First Half 1973	4th Qtr 1974	4th Qtr 1975	4th Qtr 1976
Integrated Mines	35.4	50.1	54.6	59.2
Non-Integrated Mines	40.4	50.0	62.9	66.5
Total	36.4	50.8	55.9	61.2
Percent Increase	- -	39.6	10.0	9.5

These costs exclude interest, debt repayment and income taxes, but do include depreciation and by-product credits (which are very significant in several cases). The weighted average cost covers production from 26 mines through 1975, and 34 mines in 1976, representing substantially all of U. S. production. According to both AMETALCO and CRU, the average weighted cost per pound of producing copper in the U. S. is essentially the same as for the rest of the world producers.

Considering that labor costs increased 12 percent in 1975 and smelter costs (which at 24.3¢ per pound represent over 40 percent of total cost) increased by about 28 percent in 1975, the overall increase of 10 percent in 1975 vs. 1974 shown by Mountain States may be low. The 9.5 percent increase in costs in 1976 as compared to 1975 appears accurate.

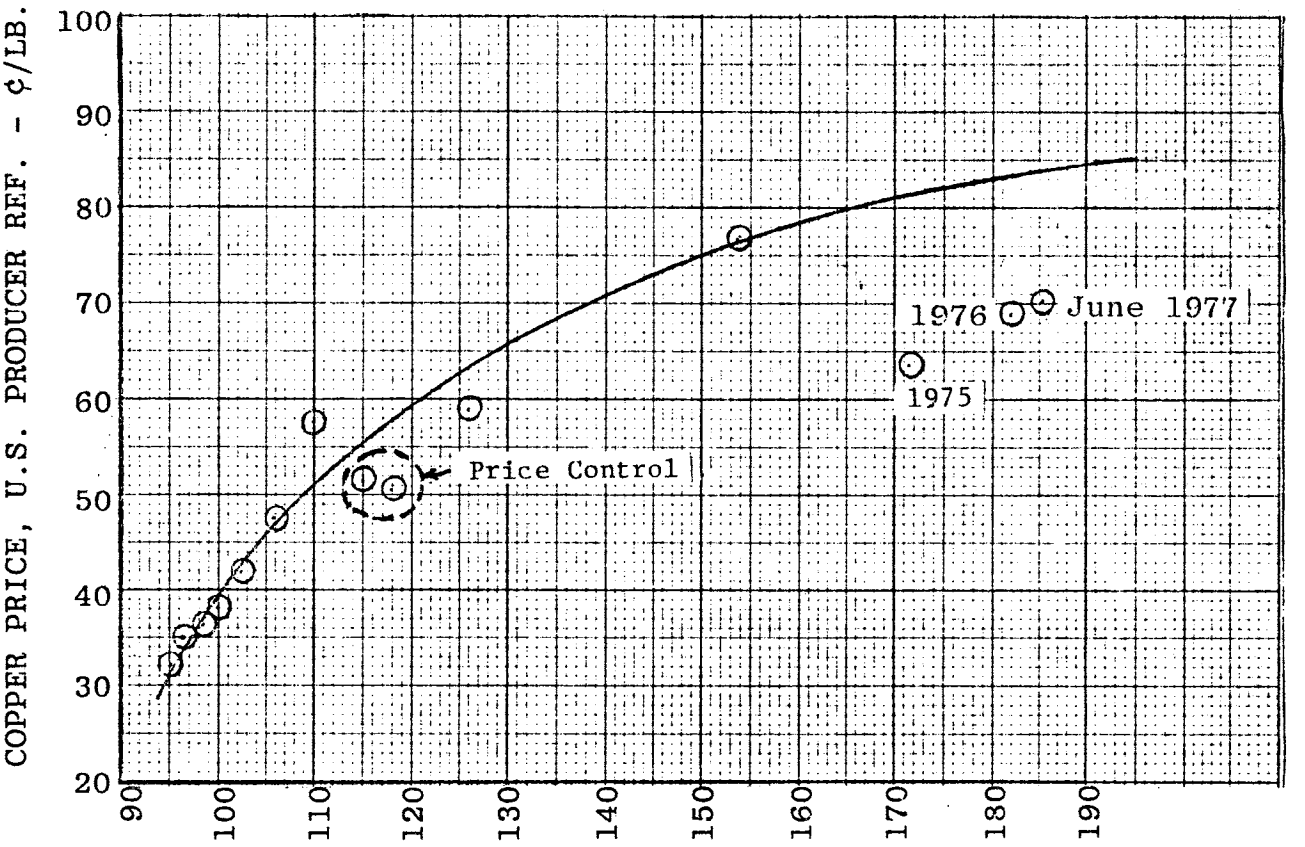
This is the best independent information we have available to us, and it indicates the cost figure of 61.2¢ per pound is a reasonable basis for price forecasting for the long term. From these facts, we conclude, the "normal", or "indicated" price of copper during the fourth quarter of 1976 would have equaled 1.6 x 61.2 or 98¢ per pound. (It should be noted that if demand for copper fails to improve, relative to production, some of the highest cost producers will be forced to close, the average weighted cost of producing copper will be proportionately lower and "normal" price would then be somewhat less than 98¢ per pound.)

The current copper price of about 63¢ per pound (US MW Producer cathode) therefore represents a greatly depressed price which is not representative of the long-term potential nor the normal cost-price relationship.

Another approach to the problem of evaluating the "normal" copper price is to note the correlation between it and the wholesale price index of all industrial commodities. This relationship, over the period of the past 16 years, is shown in Figure 17 and 18, the former for the US Producer price and the latter for the LME price. The plots again illustrate that the copper price during 1975, 1976 and 1977 to date was abnormally low, and that the current "normal" price lies in the region of 84¢ (US Producer) to 101¢ (LME) per pound.

FIGURE 17

COPPER PRICE, U.S. PRODUCER
VS.
WHOLESALE PRICE INDEX, TOTAL INDUSTRIAL
COMMODITIES



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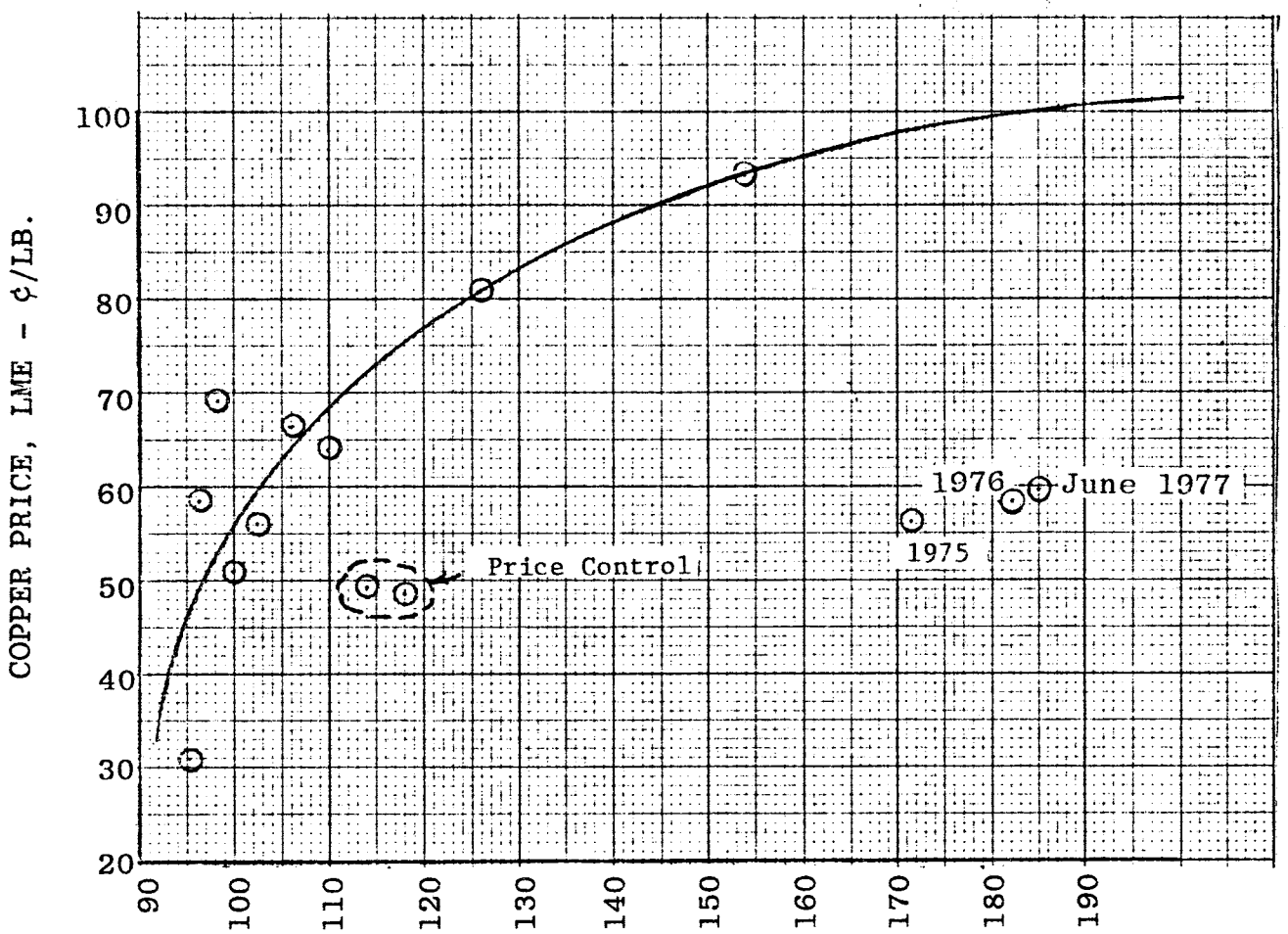
Revised: 7/11/77

FIGURE 18

COPPER PRICE, LME
VS.
WHOLESALE PRICE INDEX, TOTAL INDUSTRIAL
COMMODITIES



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Revised: 7/11/77

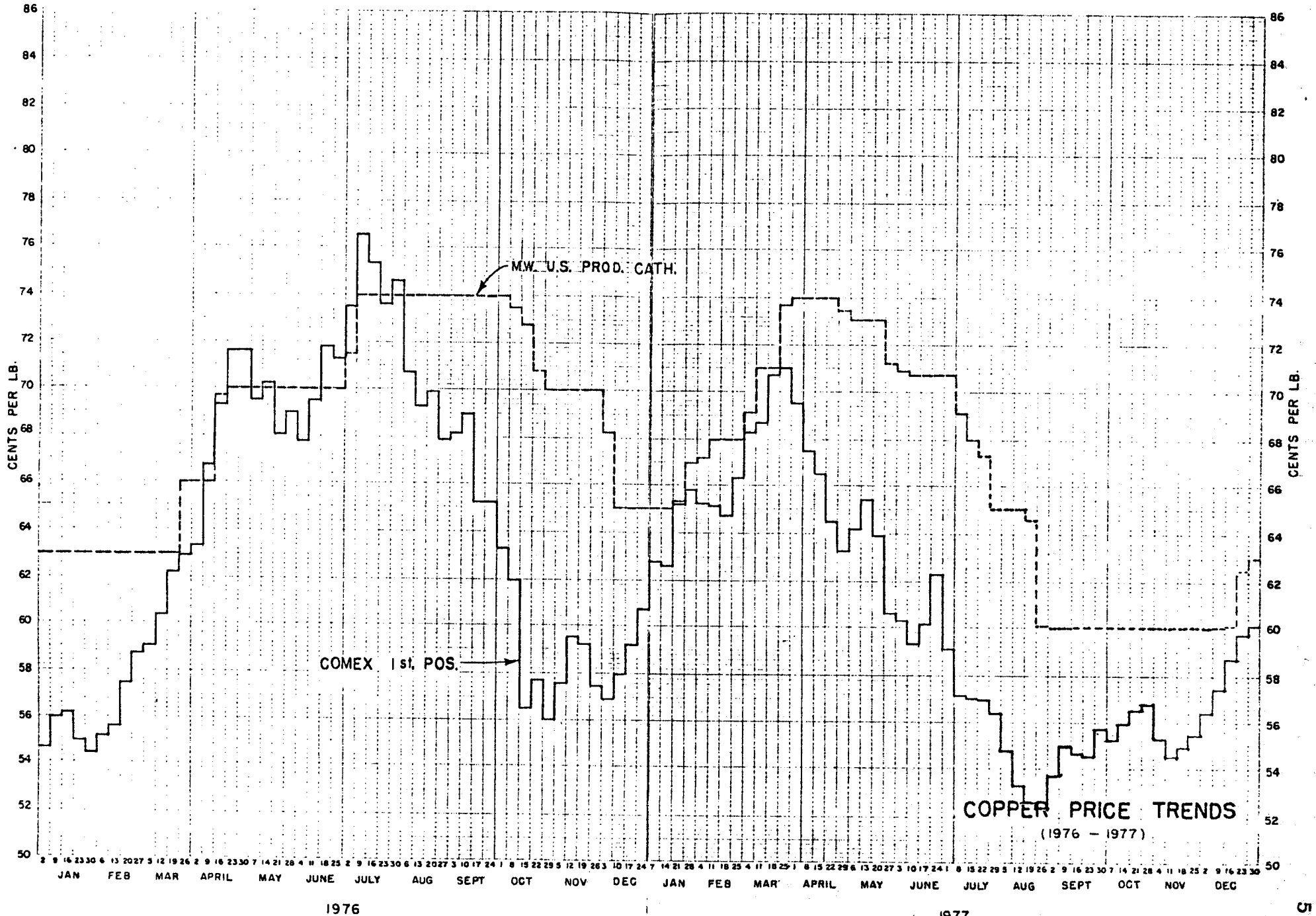

M.W. U.S. PROD. CATH.
COMEX 1st. POS.
CENTS PER LB.
86
84
82
80
78
76
74
72
70
68
66
64
62
60
58
56
54
52
50
JAN FEB MAR APRIL MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APRIL MAY JUNE JULY AUG SEPT OCT NOV DEC
1976
1977
COPPER PRICE TRENDS
(1976 – 1977)

Figure 13

During recent years the average copper price, the average U.S. cost for producing copper (estimated) and the price-cost ratio has been as follows:

Year	Average Price for Cu, Cents/Lb	Average Cost Cents/Lb	Ratio
1970	57.70	30.0	1.92
1971	51.50	32.0	1.61
1972	50.62	34.0	1.49
1973	58.87	37.0	1.59
1974	76.65	50.8	1.51
1975	63.54	55.9	1.14
1976	68.98	61.2	1.13
1977 (1st Half)	72.39	N/A	N/A

Figure 19, page 51, graphically shows copper price trends from January 1, 1976 to July 8, 1977.

The Competitive Position of the Lakeshore Operation

The Lakeshore mine has some intrinsic competitive advantages which are not yet apparent. The monetary value of these advantages which are summarized below, will become apparent as time passes.

(1) It has solved its environmental problems. Taking advantage of the opportunity presented by a unique ore situation and the opportunity to build a new facility from the grass roots, the Lakeshore operation was designed to meet and does meet all present environmental regulations for prevention of air pollution by sulfur oxides, particulates, and other pollutants. Ninety-six percent of input sulfur is captured and an unconditional operating permit has been received from the State of Arizona. The Lakeshore operation also meets all present and anticipated water pollution regulations. Furthermore, it meets these regulations by enough of a margin to provide some confidence that it will be able to meet regulations likely to be instituted in the foreseeable future without further expenditures. Furthermore, it will be able to do this without depending on the sale of sulfuric acid in the potentially glutted Southwestern market, or upon acid neutralization. As other producers, with their antiquated smelters, are forced to continue the pollution battle and its attendant heavy costs, the competitive position of the Lakeshore operation seems destined to improve.

(2) The Lakeshore operation has a competitive advantage in its economical use of energy. Whereas conventional open pit mines with conventional concentrating, smelting and refining facilities normally consume about 40,000 BTU per pound of copper produced, the Lakeshore

operation, even at its present low production rate, consumes only 30,400 BTU per pound, or 76% as much, even allowing for energy requirements in smelting and refining of precipitate copper. At full production this percentage should drop to 68%. With the rapidly escalating costs of energy, this circumstance should become an increasingly important competitive advantage. Furthermore, more than half of Lakeshore's energy requirements are met from coal, a fuel the cost of which is escalating relatively slowly, and only a small portion (via purchased power) depends upon natural gas.

(3) Even at its present production rate, the Lakeshore operation is able to move a pound of copper from sulfide concentrate to the ultimate fabricator of wire or brass products at a lower cost than would be incurred in conventional custom smelting and refining.

(4) With current rapid escalation in the cost of development of a copper producing facility (capital costs now being estimated at about $6,000 per annual ton of capacity), Lakeshore and any other existing copper producing facility has an increasingly important competitive advantage over facilities to be constructed in the future.

Plant Improvements and Expansions

1. Water Reclaim Project

The Lakeshore concentrator tailing disposal system was originally designed without a tailings thickener, but with water reclamation from the tailing pond. An economic analysis at the time indicated that, because of the then low pumping power cost and projected low make-up water cost, the capital investment for a thickener was not justified. A higher than projected water cost, rapidly escalating power costs, and other considerations led to a decision in late 1976 to install a tailings thickener system. The construction was 90% completed on September 1, at which time the estimated cost to complete was $196,000. It is estimated that the installation will pay for itself in about four years as compared with the original plan, as a consequence of lower needs for fresh, water, concurrent with reduced power and maintenance costs.

2. Solvent Extraction - Electrowinning Project

Because of our limited financial resources during development of the Lakeshore operation, we found it necessary to limit the Lakeshore processing facilities to those necessary to get to the first saleable product; i.e., cement copper precipitate and electrowon cathode. It was our intention, at the earliest opportunity, to add facilities to convert all of our production into the form of cathode copper saleable directly to fabricators, eliminating the costly treatment of cement copper precipitates by custom smelters and refineries.

Some temporary facilities have just been completed for re-dissolving up to 1,000 tons of copper per month from cement copper precipitates to supplement electrolytic tankhouse feed, taking advantage of projected available excess tankhouse capacity to produce an equivalent amount of additional high quality cathode copper. This project required an investment of about $550,000, and is expected to return a discounted cash flow rate of return on that investment of more than 300%.

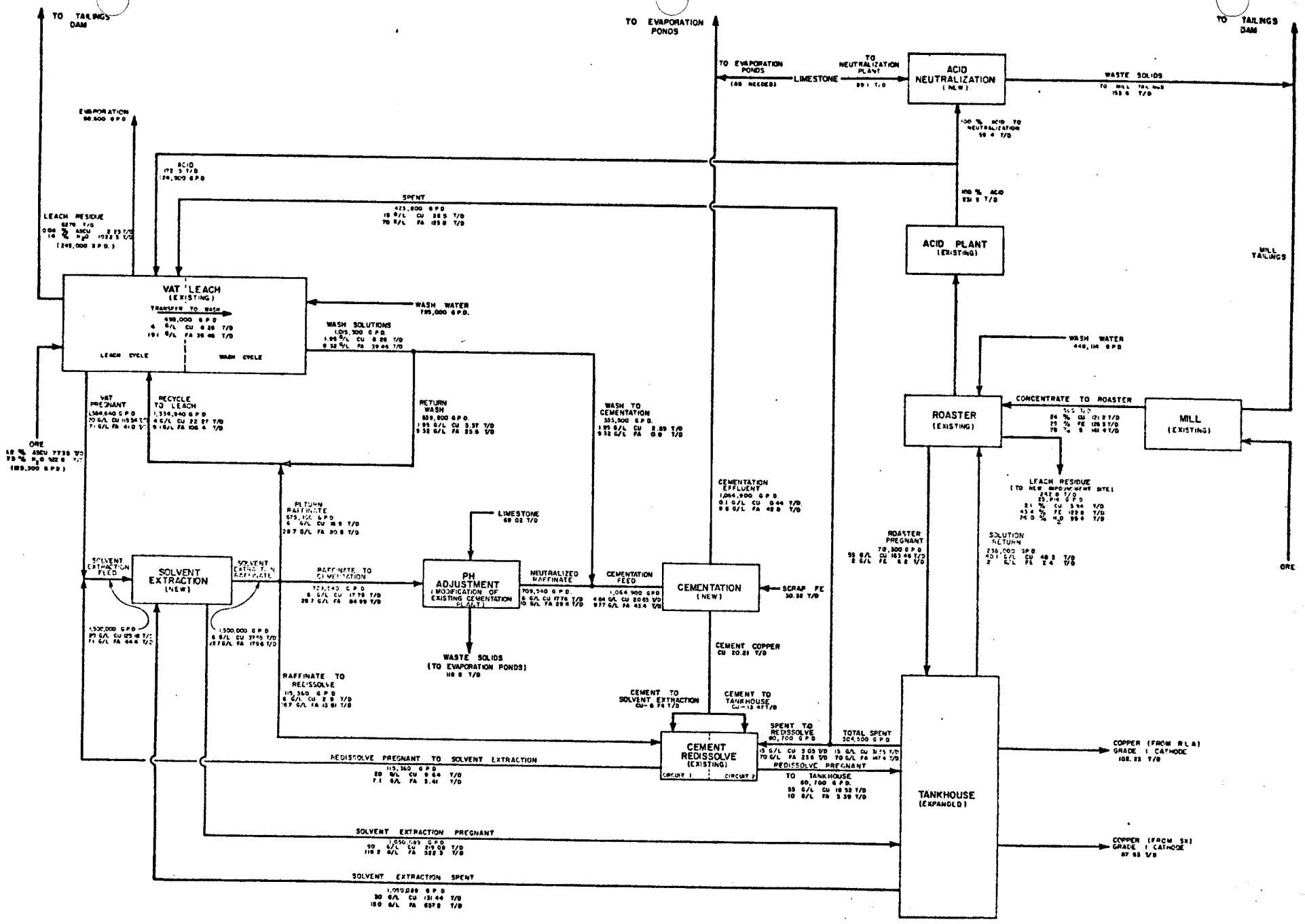
A permanent plant modification, which will eliminate the sale or tolling of any cement copper, and put the entire 65,000 TPY output of the Lakeshore project in the form of high quality electrowon copper cathode, is in the pilot plant and preliminary engineering stages. This program is scheduled for completion at an estimated capital cost of about $20,000,000. It is currently estimated that this project will provide a discounted cash flow rate of return on its investment of about 70%.

The plant modifications currently planned are shown in the process flowsheet, Figure 20. The basic process idea is to apply solvent extraction technology to the purificaiton and upgrading of vat leach pregnant solution, making it suitable for the electrowinning of high quality cathode, and eliminating cementation and the production of sponge iron. The state of the art of solvent extraction is such that some cementation will still be required to clean up bleed streams before discard, but the cement copper produced will be redissolved and recycled. The modification will also upset the acid balance of the Lakeshore operation, leading to an excess of acid which will be sold or neutralized.

This modification would include the following additional facilities:

(1) A new solvent extraction facility.

(2) An expansion of the existing electrolytic tankhouse.



PROCESS FLOWSHEET INCLUDING SOLVENT EXTRACTION

Figure 20

(3) The modification of the existing cementation plant to allow its use in pH adjustment of the solvent extraction raffinite prior to cementation, and the provision of a new cementation plant to strip that small amount of copper contained in the neutralized raffinite.

(4) Additional tankage and piping in the vat leach section to accommodate the changes.

(5) Additional facilities for the discard of roast-leach residue no longer to be used for the production of sponge iron.

(6) Additional facilities for the neutralization of the excess concentrated sulfuric acid that would be available as a result of these modifications.

The existing sponge iron plant would be scrapped or converted to other uses.

The breakdown of the capital cost estimate for this project is as follows. This estimate is a study or factored type estimate, which is all that is possible in advance of preliminary engineering and the development of general arrangement drawings, equipment lists, etc.

Summary of Capital Requirements

(Thousands of Dollars)

Item	Dollars
Process Testing	
Preliminary Engineering	$ 27
Test Cell Installation	86
Acid Neutralization Pilot Plant Installation	86
Solvent Extraction Pilot Plant Installation	76
Solvent Extraction & Electrowinning Testing	250
Acid Neutralization Operations	30
Subtotal	555
Engineering & Construction	
Solvent Extraction Plant	4,150
Solvent Extraction Reagent Inventory	1,880
Tankhouse Expansion	6,515
Modification of Cementation Facilities	400
Vat Leach Plant Modification	860
Leach Residue Discharge System	50
Acid Neutralization Plant	461
Subtotal	14,316
Contingency @ 15%	2,147
Escalation & Interest During Construction	3,158
Total	19,621
Grand Total	$20,176

3. Thick Sulfide and North Oxide Project

To relieve the sulfide mine's dependence on extraction of the tactite ores, which are relatively thin, erratic and have given us considerable trouble in mining, the thicker sections of disseminated sulfide ore should be developed and brought into production as soon as possible. Remaining tactite reserves would then be mined on an incremental basis.

The accelerated development of this ore is planned to begin immediately. Full production of 17,000 tons per day will be achieved to replace tactite ore production. Plans for this development are detailed elsewhere.

4. Crushing Plant and Concentrator Expansion

In order to treat the additional tonnage of lower grade ore to be mined from the disseminated sulfide ore body, the fine crushing plant and concentrator will be expanded to a concentrate production matching roast-leach capacity. The expanded capacity of the crushing plant will be 27,000 tons per day and that of the concentrate will be 17,000 tons per day. This construction is scheduled for completion at a total capital cost of $14,000,000.

The crushing plant expansion is currently planned to include the following changes and additions:

(1) An extension of the crushed ore stockpile and the addition of four more drawpoints to provide additional sulfide ore storage.

(2) An additional belt to convey ore from the coarse ore stockpile to the crushing plant, parallel to the existing crusher feed belt.

(3) An additional primary screen, standard Symons cone crusher, and secondary screen, paralleling the existing secondary crushing installation.

(4) An additional short-head Symons cone crusher in the tertiary crushing section.

(5) The speeding up of all conveyor belts, including the replacement of motors with larger ones.

(6) The installation of overhead crane facilities.

The concentrator expansion is currently planned to include the following changes and additions:

(1) The addition of crushed ore storage bins duplicating the present facilities.

(2) The addition of grinding sections duplicating the present facilities.

(3) The addition of a rougher flotation section which duplicates the present facilities and the addition of eight more flotation machines.

(4) The addition of another tailing thickener, duplicating the installation currently under construction.

The breakdown of the capital cost estimate is as follows. The estimates are factor type estimates, made by factoring from our actual costs for present facilities, and escalating these costs based on Marshall and Swift indices.

Summary of Capital Requirements

(Thousands of Dollars)

Item	Dollars
Crushing Plant	
Direct Costs	$ 3,780
Construction Indirects	405
Subtotal	4,185
Concentrator	
Direct Costs	8,277
Construction Indirects	886
Tailings Thickener System	657
Subtotal	9,820
Total	$14,005

This estimate is as of the fourth quarter of 1976, with no escalation allowance beyond that point.

Summary of Capital Requirements

(Thousands of Dollars)

Item	Dollars
Crushing Plant	
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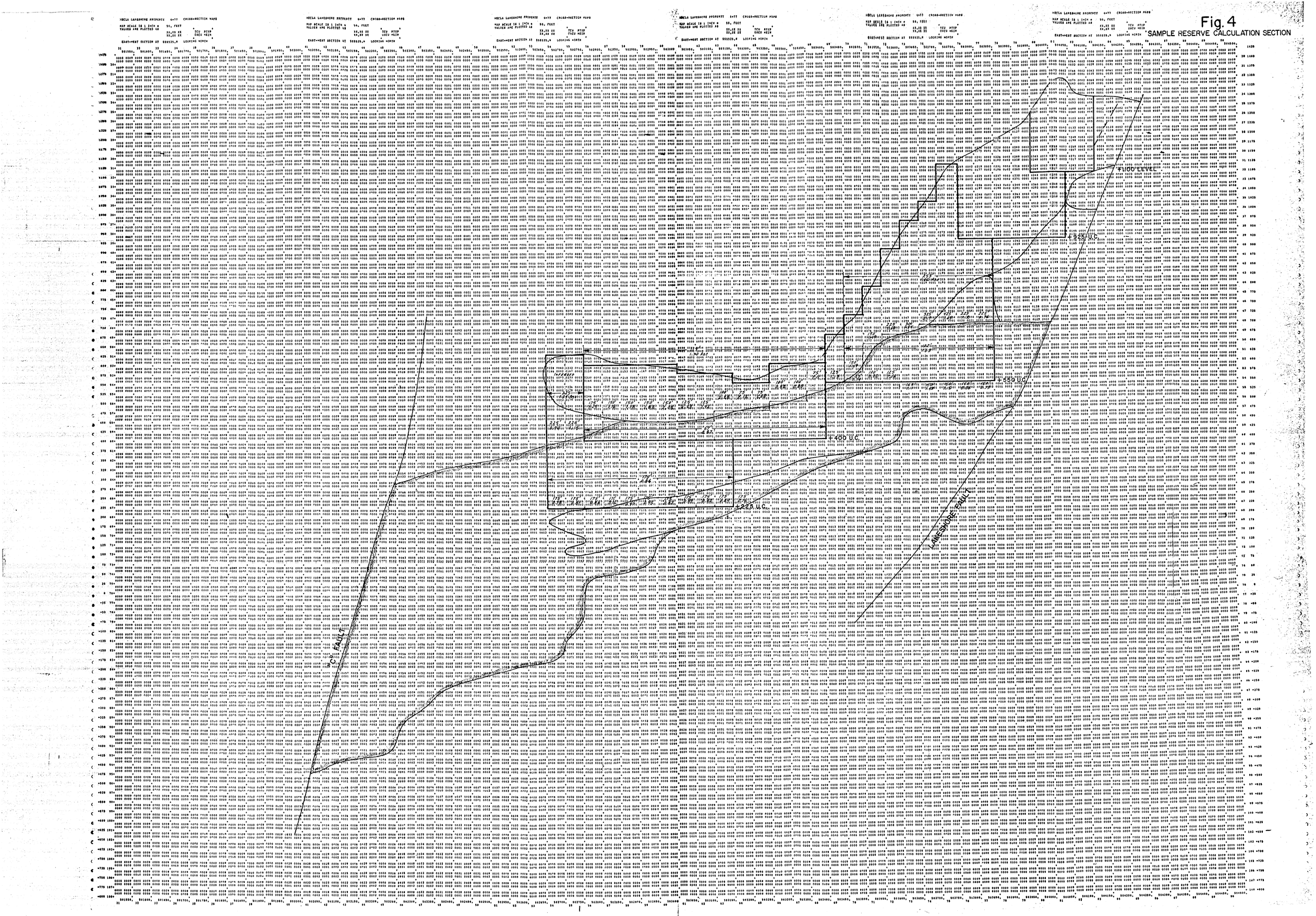
Fig. 4

SAMPLE RESERVE CALCULATION SECTION



IN SITU ORE RESERVES

DESCRIPTION	SULFIDE ORE TONS	SULFIDE ORE % Cu	OXIDE ORE TONS	OXIDE ORE % AsCu
1100 LEVEL OXIDE			2,294,000	1.42
900 LEVEL OXIDE			3,259,000	1.81
TACTITE PANEL 1	2,564,000	1.23		
TACTITE PANEL 2	2,183,000	1.73		
TACTITE PANEL 3, 500 LEVEL	1,853,000	1.67		
TACTITE PANEL 3, 365 LEVEL	2,902,000	1.79		
TACTITE PANEL 3, 200 LEVEL	1,513,000	1.82		
500 LEVEL, SOUTH PORPHYRY	5,332,000	0.79		
500 LEVEL, NORTH OXIDE (Ox/Phy)	1,333,000	1.20	2,522,000	1.68
500 LEVEL, NORTH OXIDE			648,000	1.25
500 LEVEL, SOUTHWEST PHY.	2,555,000	0.90		
365 LEVEL, S. & CENTRAL PHY.	19,681,000	0.77		
365 LEVEL, NORTH OXIDE (S) (Ox/Phy)	3,291,000	0.92	4,064,000	1.84
365 LEVEL, NORTH OXIDE (S)			4,259,000	1.30
365 LEVEL, NORTH OXIDE (N)			4,877,000	1.40
200 LEVEL, SOUTH PHY.	6,295,000	0.68		
200 LEVEL, CENTRAL PHY.	13,557,000	0.84		
200 LEVEL, NORTH OXIDE (S) (Ox/Phy)	1,674,000	0.82	1,408,000	1.11
200 LEVEL, NORTH PHY.	3,877,000	0.99		
200 LEVEL, NORTH OXIDE (N)			2,043,000	0.86
-50 LEVEL, PORPHYRY	31,443,000	0.74		
-400 LEVEL, PORPHYRY	14,245,000	0.69		
-625 LEVEL, PORPHYRY	4,819,000	0.82		
-50/-625 L., CHALCOCITE (W. of C FAULT)	19,062,000	1.41		
TOTAL RESERVES:	138,179,000	0.93	25,374,000	1.47

COLOR CODE

- 1100 LEVEL
- 900 LEVEL
- 500 LEVEL
- 365 LEVEL
- 200 LEVEL
- -50 ELEVATION
- -200 ELEVATION
- -400 ELEVATION
- -625 ELEVATION
- OXIDfover PORPHYRY

ARIZ. STATE GRID

PROPOSED No.2 OXIDE SHAFT

1100/900 RAMP

950/1100 RAMP

NORTH DECLINE

SOUTH DECLINE

500 DECLINE STATION

500/250 ACCESS RAMP

500 N. OXIDE

500 N. OXIDE Ox. over N. PHY.

1100 LEVEL

900 LEVEL

365 S. & CENTRAL PORPHYRY

365 N. OXIDE (S) Ox. over N. PHY.

200 N. PORPHYRY

365 N. OXIDE (S)

200 CENTRAL PHY.

200 S. PHY.

200 N. OXIDE (S) Ox. over PHY.

200 N. PHY.

-50 LEVEL PHY.

-400 LEVEL PHY.

365 N. OXIDE (N)

No.1 OXIDE SHAFT

200 N. OXIDE (N)

PHY. -625 LEVEL

CHALCOCITE ORE -50,-200,-400,-625 LEVELS

TACTITE PANEL No.3 500 LEVEL

TACTITE PANEL No.1 500 LEVEL

TACTITE PANEL No.3 365 LEVEL

TACTITE PANEL No.2 SUBLEVEL 365 LEVEL

TACTITE PANEL No.3 200 LEVEL

TACTITE PANEL No.2 266 LEVEL

CRUSHER

500 S. PHY.

500 S.W. PHY.

-50 LEVEL PHY.

505,000 E

504,000 E

503,000 E

502,000 E

557,000 N

556,000 N

555,000 N

554,000 N

553,000 N

552,000 N

100' 50' 0 100' 250' 500'

SCALE

Fig. 1

NUMBER	BY	DATE	DESCRIPTION
			REVISION DATA

DESCRIPTION: APRIL, '78 IN SITU ORE RESERVES

LOCATION: COMPOSITE ORE RESERVE PLAN

HECLA MINING COMPANY

LAKESHORE MINE
PINAL COUNTY, ARIZONA

DWN. BY:	APPROVED:	DATE:	CHECKED
M. Blachowski		4/1/78	

SCALE:	DWG. No.	PLATE	REVISION:
1" = 200'	230-M-5100	1 OF 1	

FOLD LINE 8.5x11.0

G.M.B. 22x33 MYLAR "POST AUTOMATTE" 18-JD, 3MIL

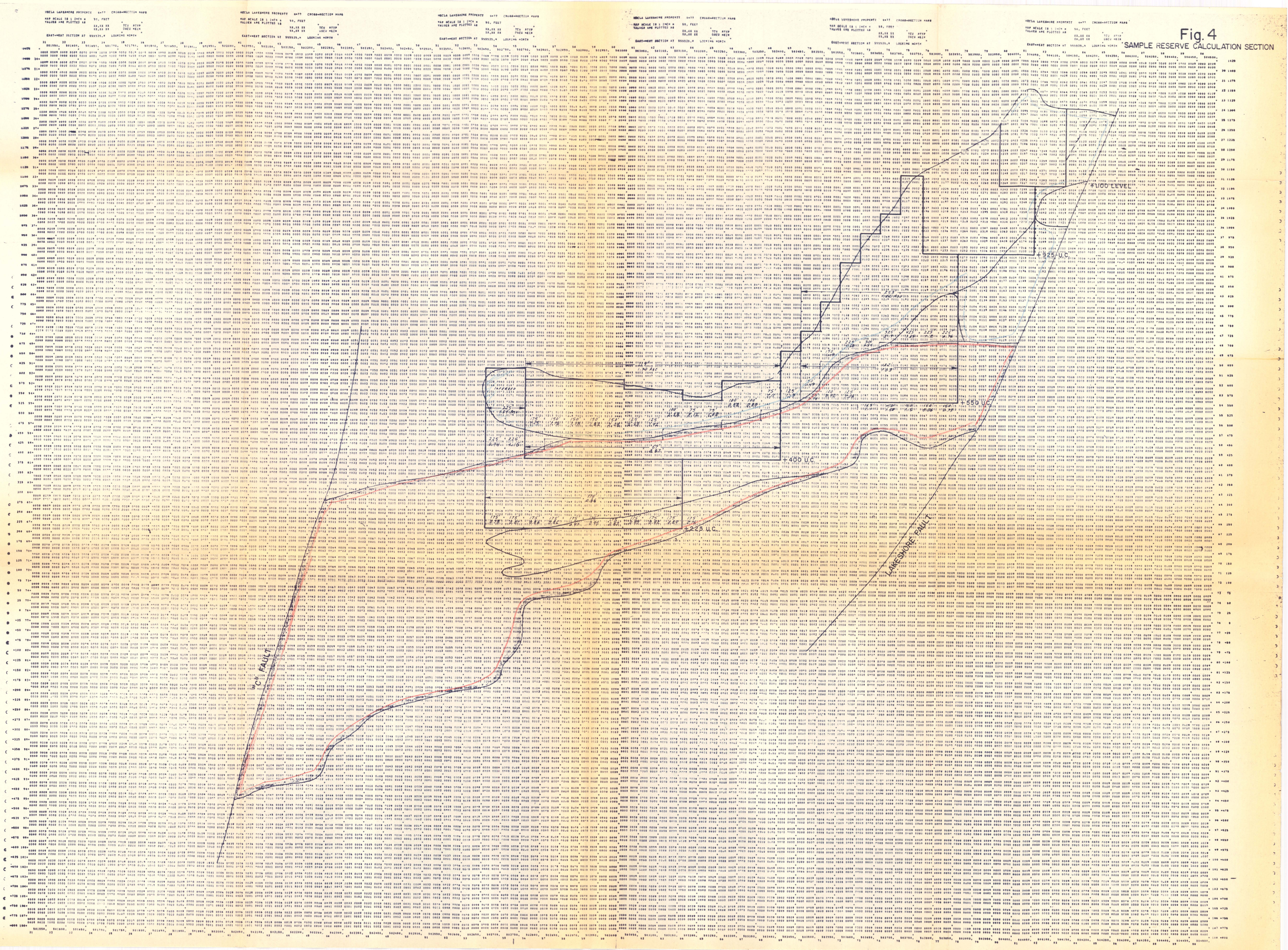


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Fig. 1

NUMBER	BY	DATE	DESCRIPTION

REVISION DATA

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LOCATION: COMPOSITE ORE RESERVE PLAN

HECLA MINING COMPANY

LAKESHORE MINE
PINAL COUNTY, ARIZONA

DWN. BY: G. M. Blacharski | APPROVED | DATE: 4/1/78 | CHECKED

SCALE: 1" = 200' | DWG. No. 230-M-5100 | PLATE 1 OF 1 | REVISION

FOLD LINE 8.5x11.0

G.M.B. 22x33 MYLAR POST AUTOMATTE 18-JD, 3MIL