GANGUE ROCK	MILLING CAPACITY, *tpd*	TOTAL Cu PRODUCTION, *tpy*	Cu IN CONCENTRATES, *tpy*	% Cu IN CONCENTRATES	TOTAL Cu RECOVERY, %	CEMENT Cu, *tpy*	MoS_2 PRODUCTION, *tpy*	Cu PRODUCT	PRODUCT SHIPPED TO	EMPLOYEES, WAGES	EMPLOYEES, SALARIED	EXPANDED PRODUCTION, *tpy*	EXPANSION COMPLETION
QUARTZ SERICITE KAOLIN	16,000	32,900	30,000	30.0	78.0	3300		BLISTER CAKE	MEXICO CITY	1450	220	46,000	1966
QUARTZ MONZONITE	58,000	129,406	128,600	22 or 23	n.a.	800	350	ANODES	EL PASO	1890[6]	n.a.	139,000	1965
QUARTZ PORPHYRY LIMESTONE	20,000	74,033	58,200[4]	11 or 12	n. a.	5400		ANODES	EL PASO	2350[3,6]	n.a.		
MONZONITE DIORITE RHYOLITE	31,000	70,818	70,689	32.76	n.a.			ANODES	EL PASO	1380[5]	n.a.		
QUARTZ MONZONITE GRANITE PORPHYRY	12,000	32,150	19,000	32.	86.6	13,000[9]		CONCENTRATES PRECIPITATES	INSPIRATION DOUGLAS	468[8]	122		
SCHIST DIABASE PORPHYRY	24,000	58,235	50,200	20 to 22	84%	9040		ANODES	MARYLAND	1003	393		
QUARTZ DIORITE METAMORPHOSED SEDIMENTS	22,000	81,372	56,388	22.25	82	27,421	598	FIRE REFINED BLISTER	MARKET MARYLAND	1140	320	100,000	1965
SCHIST GRANITE	16,500	48,908	19,697	37.5	86.	3807	490	CATHODES BLISTER	MARKET	1305	194	SAME[10]	1965
METAMORPHIC LIMESTONE	4000	12,476	12,476	27.13	89.86			CONCENTRATES	INSPIRATION	362	34	18,000	
SCHIST DIABASE LIMESTONE	1600	17,064	17,356	23.14	96.73			BLISTER	LAUREL HILL, N. Y. EL PASO	984	108		
MONZONITE PORPHYRY QUARTZ MONZONITE	36,000	92,588	94,895	29.91	88.22		2485	ANODES	LAUREL HILL, N. Y. EL PASO	1823	239	100,000	1965
MONZONITE PORPHYRY	6000	19,631	11,878	28.0	75.0	7753	267	CONCENTRATES PRECIPITATES	HAYDEN EL PASO	345	36		
IGNEOUS SEDIMENTARIES	8400	23,600	21,200	31.0	n.a.	2400	400	CONCENTRATES PRECIPITATES	HAYDEN EL PASO	256	50		
HORNFELS ARGILLITES TACTITES	15,000[1]	52,400	52,400	28.6	n.a.		14[2]	CONCENTRATES	HAYDEN EL PASO	479	73		
HORNFELS ARKOSITES	8000	30,000	30,000	25.0	91.0			CONCENTRATES	EL PASO	300	45	35,000	1966
QUARTZ MONZONITE WELDED TUFFS LATITE	12,000	21,000	19,000	25.0	86.0	2000	550	CONCENTRATES PRECIPITATES	HAYDEN EL PASO	250	95		
QUARTZ PORPHYRY QUARTZ MONZONITE SCHIST	14,000	20,000	19,000	22 to 25	85			CONCENTRATES PRECIPITATES	TACOMA EL PASO	230	79		

1 CURRENTLY 20,000 TPD

2 MOLY PLANT STARTED LATE 1964, 600-700 TPY POTENTIAL

3 40% UNDERGROUND ORE IS DIRECT SMELTING

4 INCLUDES CONCENTRATES FROM UNDERGROUND ORE

5 INCLUDES DOUGLAS

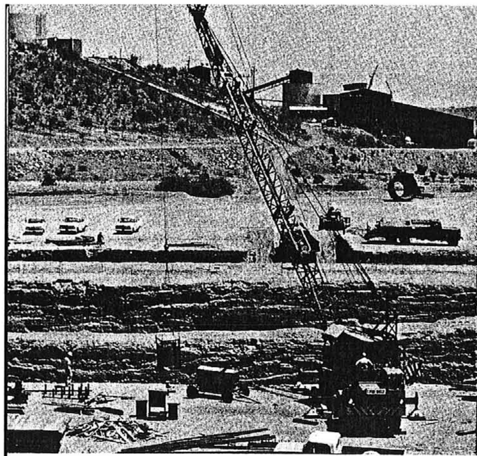
6 WAGES & SALARIED

7 COPPER CITIES

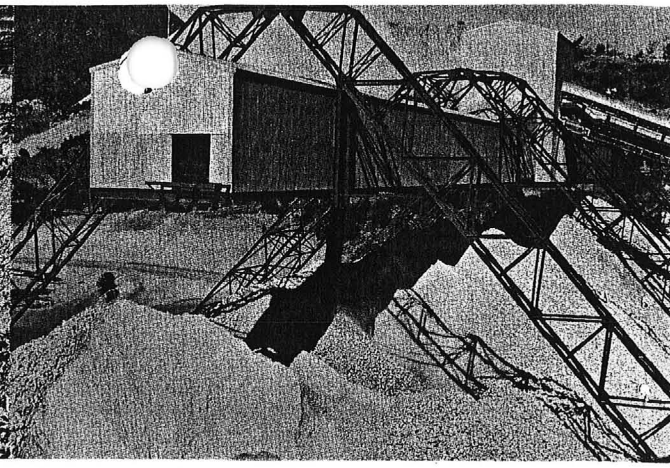
8 INCLUDES MIAMI, CASTLE DOME, COPPER CITIES

9 0.422% CU OXIDE, 0.476% CU SULFIDE

10 TO TREAT LOWER GRADE ORE—NO INCREASE


Expanding at Pima


Digging at Mission


On stream at Mineral Park

Of interest at the mill are the on-stream X-ray analyzer, a computer being tested, and a test of rubber liners, lifters and grates in a ball mill going into nine months continuous operation.

The smelter produces blister and fire refined copper. There is little gold or silver in the ore to be lost by going the fire refined route to market. A new concentrate-precipitate drier is to be installed at the smelter to reduce moisture in charge to reverberatory.

San Manuel

Historically San Manuel goes down in the ranks with Inspiration, Miami and Ray as a great underground blockcaving mine. In present day terms it is a phenomenon which exchanges honors with Climax as world premiere blockcaving mine in rock caved and hoisted, although Climax does not have to hoist ore. In our Southwest copper story, San Manuel is second only to Morenci in copper production but it employs the greatest number of people in a mine-by-mine count. Where Inspiration, Miami and Ray were venturing into the unknown to a larger degree, San Manuel had its neck stuck out somewhat considering the lower grade of ore to be extracted.

Development began in 1948 although the property was optioned in 1944 and the presence of the orebody had been known for a good many years before. It came on stream in 1955. It was a large undertaking involving the development of underground mine plant, building of a reduction works, 30-mile railroad and permanent townsite. But after all the orebody boasted a half billion tons of reserves.

Production based on underground personnel averages 61 tons per man-shift, overall it is rated at 38 tons per man-shift.

San Manuel completed an expansion this year that increases ore production from 35,000 tpd to 40,000 tpd. Two sections have been added to the mill to step up milling capacity from 35,000 tpd to 39,000 tpd. A primary crusher was added at each of the two ore shafts. A new reverberatory furnace has been constructed at the smelter.

Besides blister copper, the Company has several valuable by-products; molybdenum gold and silver. Blister copper is sent to Laurel Hill, N. Y., and El Paso, Texas, for refining.

Magma

Magma's Superior Div. may be reaching the end at the old Magma mine. Begun in 1912, the property has been a substantial high grade mine producing copper and byproduct gold and silver. Square set mining has been supplemented with sand fill in recent years. Extreme temperatures in underground workings necessitated the construction of a system for cooling the air. A large refrigeration plant was built about 20 years ago and was added to later. Engineers come from all over the world to study this operation. Vein mining at depths of 3000 to 4900 ft, naturally high temperature gradient abetted by heat from mineral oxidation and the warm temperatures of desert air at the surface created severe conditions for providing adequate control of humidity and temperature at the working faces. The underground plant is in need of modernization but the Company reports that at present there are insufficient ore reserves to justify this expense.

The reduction works are composed of concentrator and smelter. Blister copper is the end product.

Silver Bell

Interests of the American Smelting and Refining Co. in this area consist of open pit mining and concentrating of copper ores at Silver Bell and Mission near Tucson and a custom smelter at Hayden. The Company has built a new building in Tucson to house its U.S. mining and southwestern administrative offices.

In 1952, stripping was begun on a copper deposit at Silver Bell. Mining was not new to the area, small underground mines having been worked for many years until 1927 when a hiatus began.

Two pits are benched out of the mountain side about four miles apart, the Oxide and El Tiro. The concentrator is adjacent to the Oxide mine. Two types of ore are being extracted, relatively clean disseminated sulfides in igneous rocks with sedimentary inclusions and sulfides in sediments with overlying oxides. The mixed and oxidized material encountered in stripping, containing about 1% Cu or less, is being segregated, pending results of ammonia leaching tests in a 10-ton pilot plant. Content of this material prohibits acid leaching.

The concentrator is being expanded from 9000 tpd to 10,000 tpd by the addition of a sixth ball mill and some new crushing and screening plant.

A well developed dump leaching system has been in operation since 1960, irrigating dumps with water and precipitating on iron scrap. This operation is to be expanded from circulating 1000 gpm to 2000 gpm.

Mission

Mission open pit mine, now four years old, lies in the afternoon shadow of the waste dump of the Pima mine started some 4 years earlier. The two new mines, Mission and Pima, 15 miles south of the center of Tucson, are within sight of older underground mines of Banner Mining Co., now among the groups leased to The Anaconda Co.

The open pit mines in this immediate vicinity are found in alkaline sedimentary rocks, easy grinding hornfels and tougher argillites and tactites. To develop these deposits, it has been necessary to remove about 200 ft of desert alluvium.

Moving 100,000 tons of ore and waste each day puts Mission among the biggest mines in the country. In this Southwest group, it is topped only by Morenci, although Mission is seventh in total copper production. In mining, Mission uses the biggest shovels, having five with 9-cu yd and one with 10-cu yd buckets. Trucks are 55-, 60- and 65-ton load capacity with one 85-ton truck leased for testing. Automatic lubrication is being installed on all shovels. Samples, posted on maps within 24 hr, permit convenient mine control.

When the modern concentrator was constructed, certain automatic controls were not provided but the design was compatible for incorporating additional such devices. The latest addition installed in January and still experimental, is an on-stream X-ray spectroscopic analyzer complex. It consists of a VXQ 25000 six-channel X-ray made by Applied Research Laboratory of Bausch & Lomb to measure copper and molybdenum concentrations and pulp densities. All measurements are made simultaneously. Samples are analyzed from eight locations taken every 15 or 20 minutes. Points sampled are final concentrates, final tailing and scavenger tailing, two locations each and one each of flotation feed and combined scavenger concentrate. Data are programmed to an LPG 21 General Precision computer with a print-out unit. An oscilloscope is used for programming and trouble shooting.

After exhaustive research, a molybdenite by-product plant was put on stream toward the end of 1964. To feed this plant, copper concentrates are combined with a scavenger concentrate which contains Cu, Ag, Zn and MoS_2 values. In the process, concentrates are roasted prior to final flotation. A small tonnage of zinc concentrate is also made as a by-product.

Mission has been operating at slightly better than design capacity since start-up and is currently treating about 20,000 tpd.

Bagdad

Bagdad is no exception to the rule of being the surviving operating company in an old mining district. In 1941 underground blockcaving was expanded and in 1946 underground work was abandoned in favor of open pit mining. The pit today is 800 ft vertically from crest to floor. Shortly after the pit was developed, a system of crushing the ore with a crusher in the pit floor was devised. Feeders removed the reduced rock from a bin to a 1000-ft belt conveyor which travels in a 17½° incline tunnel to surface and lifts the ore a vertical distance of 300 ft to discharge it to the fine crushing plant. As pits go, Bagdad's is a small one but operates with large dimensions; 50-ft benches are carried and loading buckets are up to 9 cu yd.

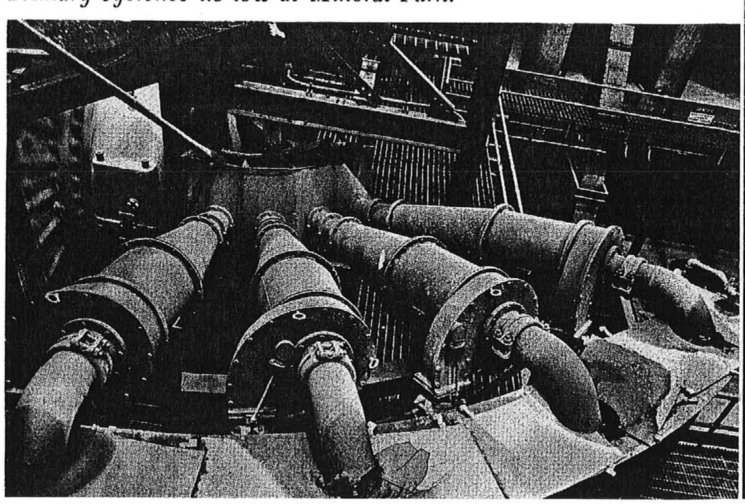
The concentrator mills 6000 tpd and floats the coarsest ore in the Southwest; it is unique in not having a regrind section.

Molybdenite grade, which fluctuates from 0.03% to 0.05% in the ore, is recovered by flotation. A steaming unit has been recently installed to clean copper concentrates of reagents prior to moly flotation. This reduced reagent consumption in the moly plant.

Oxide ores are recovered by heap leaching on dumps. A 200-ton acid plant makes acid from imported sulfur for use in leaching. A long-held ambition of the Bagdad Copper Corp., to produce refined copper at the property is about to be realized. A chemical refining process developed by Chemetals Corp. will be used to convert cement copper to high purity copper metal. The plant, costing $4 million and owned jointly by Bagdad and Chemetals is under construction and is to be completed in 1966. Cement copper will be redisolved in sulfuric acid and precipitated with hydrogen under temperature and pressure. Precipitates will be filtered, sintered and sized. The powder metal is expected to be equivalent to electrolytic copper.

The fact that Bagdad is tucked off by itself in some tough country with poor road connections to the outside would seem to be cause for depression. But quite the opposite appears to be true judging by the jaunty and cheerful appearance of the workers and the camp. There could be several explanations. The nonunion labor force enjoys a 10% par-

Primary cyclones lie low at Mineral Park.



ticipation in the profits. The unique chemical refining plant will bring with it the aura of the Space Age. Then, next to most dwellings is a camper, power boat or both ready to roll when the weekend arrives to more salubrious locals such as nearby Lake Mead.

PIMA

Expansion is a way of life at Pima. The Company is in the course of its third since starting operations in 1957. The mill began life at a capacity of 3000 tpd, was increased to 7500 tpd in 1963 and, by mid-1966, will be milling at the rate of 18,000 tpd. The Company is owned 50% by Cyprus Mines Corp. and 25% each by Utah Construction and Mining Co. and Union Oil Co.

A northeast extension of the pit is being prepared that will nearly connect with the Mission pit of American Smelting & Refining Co. The present mine is now 600 ft below the rim and will reach a depth of 720 ft when it is phased out in 1967. The Company is going to larger haulage units, up to 85-ton capacity, with the acquisition of nine electric-wheel trucks.

New crushing facilities and 4 mill sections similar to 2 existing sections and 2 thickeners are to be added to the concentrator. Portions of the old crushing plant will be incorporated into the new crushing plant which includes a new 54-in. gyratory crusher. Crushing is in three stages. A mill section is composed of 1 rod mill in open circuit with 2 ball mills, each in closed circuit with cyclones. Two stage grinding reflects the harder ores found in the Pima district. At some other mines only one stage of ball milling is needed before rougher flotation. Nearly all plants regrind the pulp before cleaner flotation steps. Each rougher flotation section has 6 banks of 10 cells and the cleaning section has 3 banks of 10 cells which services two rougher sections. Scavenger concentrates from the rougher sections and cleaner tails are reground. At present there is no by-product molybdenite plant although research is in progress.

ESPERANZA

Duval first entered the copper mining industry when it began production at the Esperanza mine in the Twin Buttes District in 1959. It is now readying its second pit at this location to start production by January 1966. Further west, the Company is doing exploration on a new low grade deposit, the Sierrita, which could also be tributary to the Esperanza mill.

The Esperanza deposit is in quartz monzonite porphyry, welded tuffs and latite; ore minerals are chalcopyrite and chalcocite. Mining was contracted to Isbell Construction Co., but on August 1 the equipment was purchased and Duval began conducting its own mining operations. The first drop cut was made recently but prior to this the loaded haul was downhill.

Waste from the pit is stocked for dump leaching. No acid is added to the water irrigating the dumps. An attempt is made to spray the least amount of solution possible and still wet the surface on the theory of minimum flow maximizing concentration in the pregnant solution. Dumps are leached continuously.

The two section concentrator has one rod mill for two ball mills in closed circuit with cyclones in each section. Overflow from the cyclones goes to rougher flotation, regrind, cleaner and recleaner banks. In the moly plant, copper concentrates are steamed and treated in three stages of flotation after which the molybdenite concentrates are roasted to molybdenum trioxide for shipment to market.

√ MINERAL PARK

Newest star in the Arizona showcase of copper mines is the Mineral Park property of Duval. Exploratory work begun in 1959 led to the conclusion that a deposit containing upwards of 60 million tons of 0.54 Cu and 0.045 Mo could be mined by open pit methods at an overall stripping ratio of approximately 1.5 to 1. During the exploration period, drillholes were checked by underground bulk sampling. Airborne work not only speeded mapping but helicopters were used in locating some drill equipment. The precipitous terrain posed many problems in addition to those for drilling; in particular location of access roads and adequate sites for waste disposal. These dispositions were made before the commencement of stripping. Two years of pre-mine stripping, about 18 million tons, were completed to coincide with concentrator construction and mine production began in November 1964.

Cut-off grade for mining is 0.4% Cu equivalent. All rock having a minimum to 0.4% Cu assay is placed on heap leaching locations. The fact that assay records are being kept on leach dumps as they are formed will provide much valuable information on efficiency of leaching not available at many of the older mines. Advantage was taken of mining on the face of Ithaca Peak to provide a downhill haul to the primary crusher throughout the mining of 70% of the orebody.

The 12,000 tpd concentrator is designed for copper and molybdenum recovery. It is the first one in the Southwest to use single stage wet autogenous grinding. Of the four mills in operation, two were operated autogeneously and two were using balls for grinding. While the autogenous mills were performing at rated capacity, the two using balls were at excess capacity. The cyclone classifiers are placed close to the mills in a position approaching horizontal in order to minimize pump head.

The plant is equipped with centralized electrical control and instrument panels. The instrument panels were delivered as complete units to the plant during construction with marked leads for connections accessible from outside the units.

The moly plant is similar to the one at Esperanza. Copper concentrates are sold to Asarco at Hayden. •

DUMP LEACHING—AN EXPANDING SOURCE OF COPPER

On this page and the succeeding two pages of photographs attention is focused on the leaching of low-grade copper ore on mine dumps. This practice is expanding rapidly and may ultimately lead to large scale "chemical mining."

Leaching is still in the "art" stage because there is little precise knowledge of the chemistry. Although the practice is not new, it is only recently that intensive experimentation has begun with a view to lifting the process out of the category of a minor sideline and elevating it to an integral part of copper producing operations. For example, at Chino leaching has been dovetailed into overall mining plans by expanding the leaching operation, putting higher grade material on the leaching dumps, and raising the cut-off grade of ore that is sent to the concentrator.

It is quite possible that as experimental work progresses, dumps will be shattered by explosive charges for controlled percolation of solutions that may be injected under pressure and fortified with catalysts and solvents to achieve greater production in a shorter period of time. It is probable that the future will see more leaching in place than at present.

Current leaching practice is an approximation of natural processes, in which old dumps or low grade ore, considered waste, is irrigated with water, in some cases souped up with acid. The water percolates through the dump dissolving copper as it descends until the solution is trapped at the bottom where it drains to catchment reservoirs and is then delivered to tanks where it replaces iron placed there to precipitate the copper. Operating data given in table below show variations in different orebodies.

For all practical purposes, leaching is performed by sulfuric acid and ferric sulfate by oxidizing copper minerals to soluble copper sulfate. Where there is sufficient pyrite in the waste dump, leaching may be performed with natural water, the acid being formed by reaction with pyrite. The general equations given below approximate the reactions which are thought to take place for the minerals that are amenable to the process. Chalcopyrite, an important ore mineral, is not significantly leached by the solutions. Certain bacteria, utilizing iron and copper in their metabolism, are oxidizing agents which catalyze the leaching process. Other catalysts and solvents are coming on the market which may economically increase the efficiency of leaching. Precipitation of copper from the pregnant solution may see a change in method due to the high cost of iron scrap.

Azurite

$$Cu_3(OH)_2 \cdot (CO_3)_2 + 3H_2SO_4 = 3CuSO_4 + 2CO_2 + 4H_2O$$

Chalcocite

$$Cu_2S + 2Fe_2(SO_4)_3 = 2CuSO_4 + 4FeSO_4 + S$$

Covellite

$$CuS + Fe_2(SO_4)_3 = CuSO_4 + 2FeSO_4 + S$$

Cuprite

$$Cu_2O + H_2SO_4 + Fe_2(SO_4)_3 = 2CuSO_4 + H_2O + 2FeSO_4$$

Chrysocolla

$$CuSiO_3 \cdot 2H_2O + H_2SO_4 = CuSO_4 + SiO_2 + 3H_2O$$

Malachite

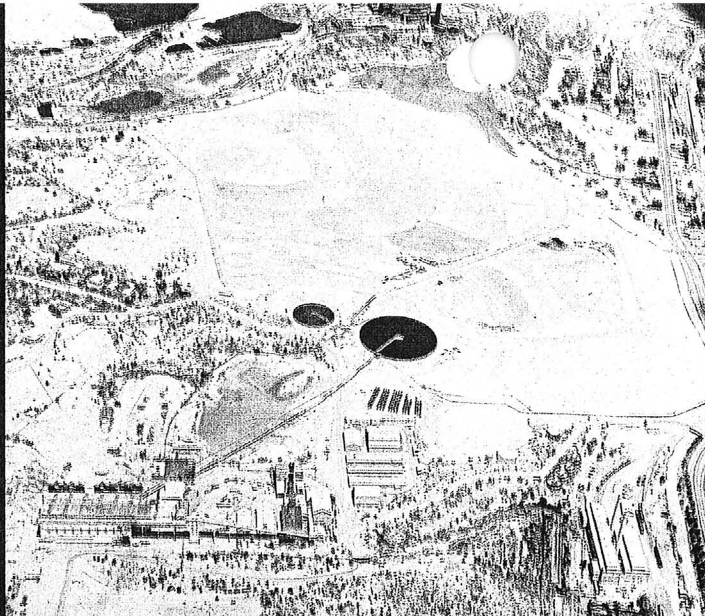
$$Cu_2(OH)_2 \cdot CO_3 + 2H_2SO_4 = 2CuSO_4 + CO_2 + 3H_2O$$

Pyrite

$$2FeS_2 + 2H_2O + 7O_2 = 2FeSO_4 + 2H_2SO_4$$

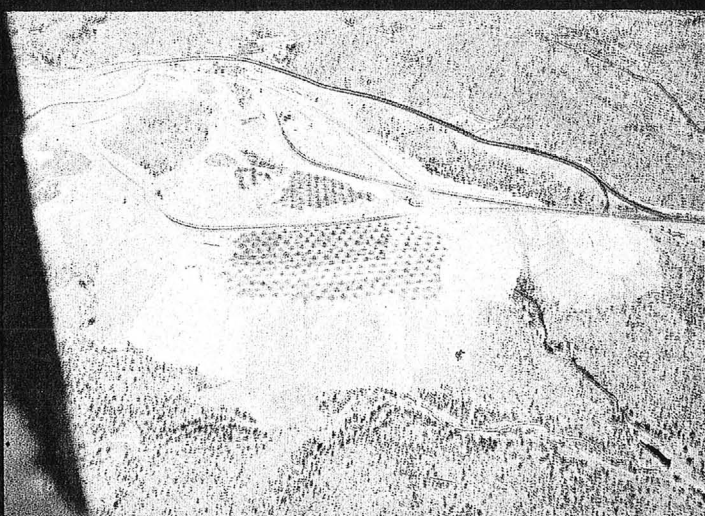
DUMP LEACHING DATA	CANANEA	COPPER QUEEN	RAY	CHINO	INSPIRATION	BAGDAD	ESPERANZA
Qty. of sol. circulating, gpm	1200	2100	5000	11,000	n.a.	3300	1000
% Cu in dump (range)	0.2-0.4	0.3	n.a.	0-0.5	n.a.	0.25-0.75	0.15-0.4
pH of sol. to dump	2.75	3.5	2.1-3.5	3.5	2.64	2.00	4.5
Fe^{++} in sol. to dump, gpl	20.0	10	1.2-2.4	3.6	4.96	3.80-4.20	1.44
Fe^{+++} in sol. to dump, gpl	2.2	nil	0.06	.1	0.50	.10-.20	trace
Cu in sol. to dump, gpl	0.15	nil	trace	.1	0.24	0.02	trace
pH of pregnant sol.	2.0	2.0	2.0-2.5	2.5	1.88	2.3-2.5	2.5
Fe^{++} in pregnant sol., gpl	6.0	3.5	0-0.96	1.0	3.34	.02-.05	trace
Fe^{+++} in pregnant sol., gpl	12.0	3.0	0.24-1.80	1.0	2.73	1.80-2.00	0.24
Cu in pregnant sol., gpl	1.50	1.4	0.24-3.60	1.8	1.877	1.10-1.30	1.2
Quantity of acid additions, lb/ton of sol.	none	none	n.a.	3.3*	9.82	14-16	none
Operng. range of Cu in preg. sol., gpl	1.30-2.50	1.1-2.4	0.60	1.2-2.4	n.a.	1.3-1.10	n.a.
Solution loss, %	5.0	1	n.a.	5-6	6.65	7	25-30
Iron consumption, tons/ton Cu ppt	4	2.5	n.a.	1.5	2.52	1.8	1.35
Length of dump rest, months	6	12	n.a.	4	n.a.	2½	none

*Testing



Iron stains show up Miami's leach areas.

Copper-bearing solu[illegible] collect below Castle Dome terraces.

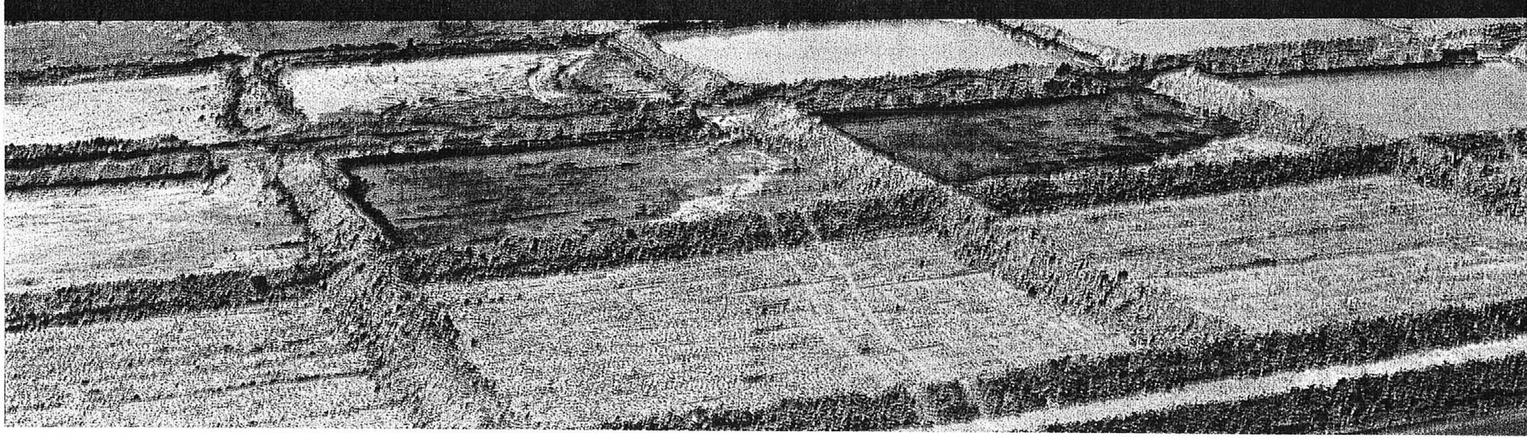


Silver Bell leaching ponds with El Tiro pit behind.

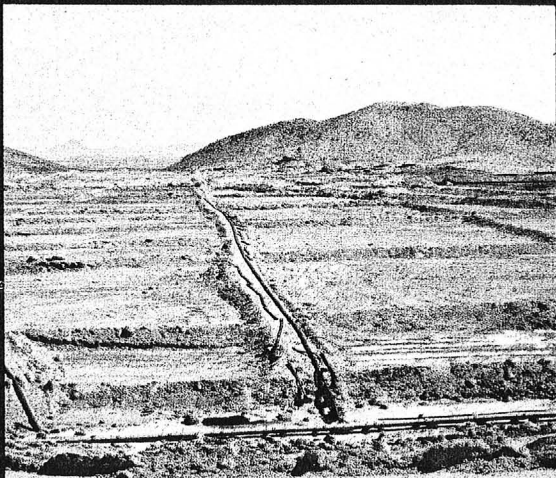
Top: Esperanza ponds show iron salts accumulations.

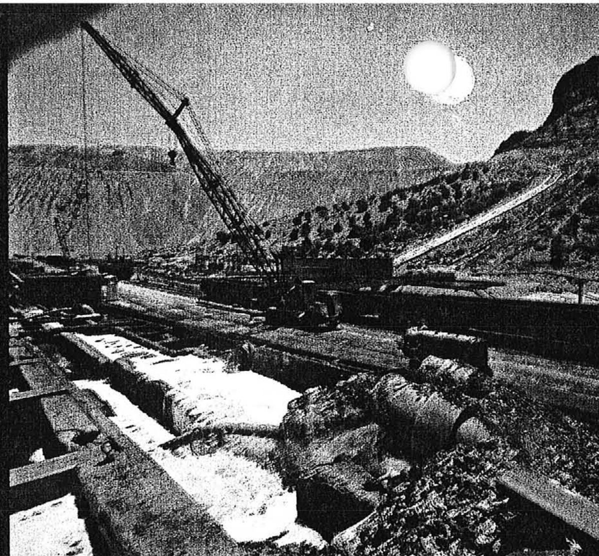
Right: Solution distribution lines feed sprays.

Below: Iron, eventually sealing dumps, must be ripped.



Ponds atop Bisbee dumps in rest period.

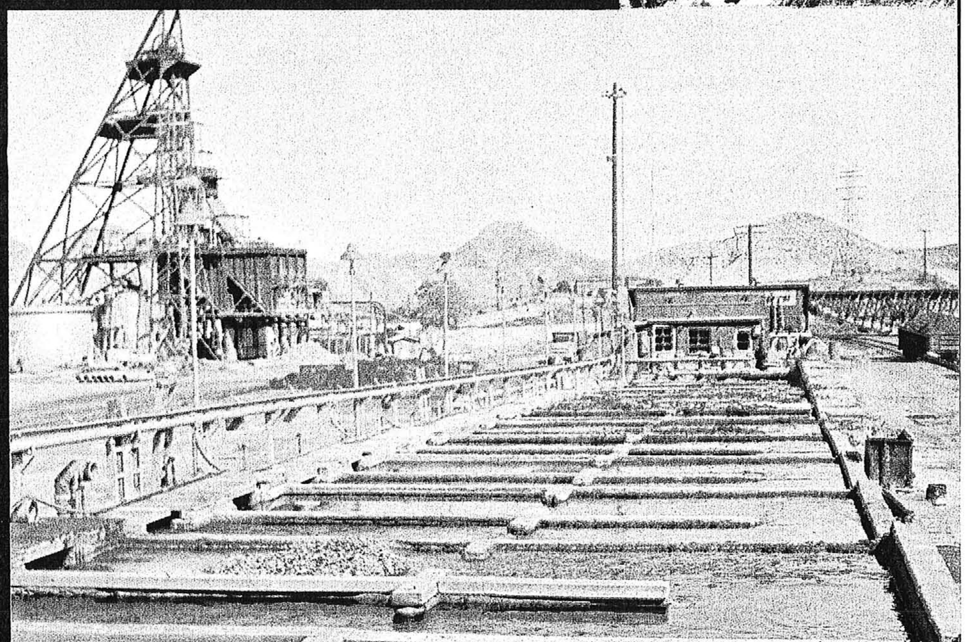




Chino's precipitation and piping to leach areas.

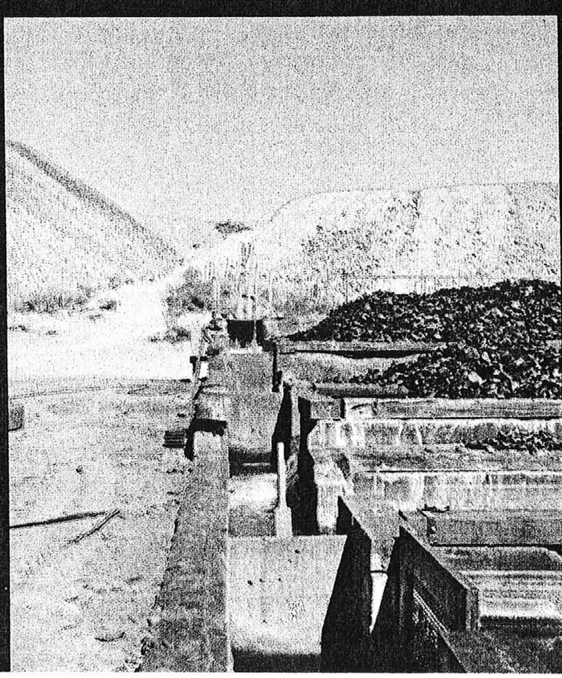
Gathering pond for solutions from dumps.

Gravity flow can reduce pumping costs.

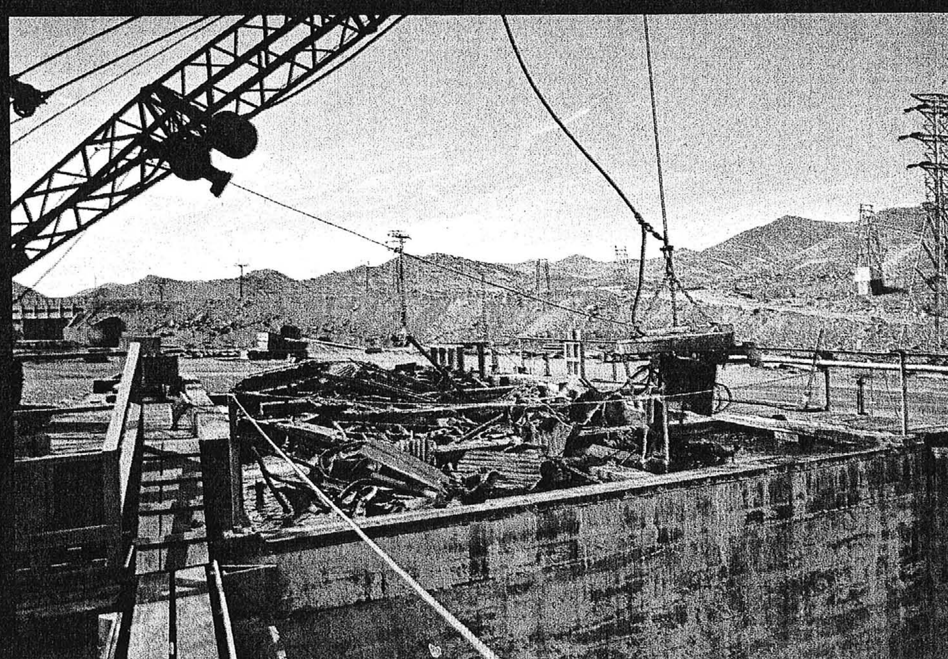


Circulating solutions deposit their copper on iron at Bisbee.

Shredded can supply ahead of ppt/tanks.



Heavy scrap supplements shredded cans in Bisbee's precipitation.



stripped and is ready for mining. Another deposit amenable to open pit exploitation is in reserve. Each of the deposits is a distinct porphyry-volcanic contact zone of disseminated secondary copper mineralization.

The Company is in the throws of a 40% expansion. One feature of the expansion is a new ore pass placed in the bottom of La Cananea pit to eliminate the necessity of an adverse ore haul in a pit that will reach a depth of 700 ft. It was necessary to drive a 2500 ft inclined tunnel under the pit, excavate a station to accommodate a 66- x 84-in. jaw crusher and drive a 600-ft raise to the bottom of the pit. Ore will be removed by belt conveyor. Since the portal of the tunnel is at a lower elevation than the existing crushing plant, the tunnel conveyor discharges to another inclined belt that carries the ore 2500 ft to the secondary and tertiary crushing installations.

The concentrator is being expanded from 16,000 to 22,000 tpd capacity. One rod mill is being added ahead of each pair of ball mills. Cyclones will be used to classify the rod mill discharge, the spigot product going to ball milling and the overflow to flotation. The ball mills are also served by cyclones. Scavenger flotation cells are being added. These plant additions, representing a nominal 40% increase in milling rate are hoped to increase copper production in practice by one half.

There is a well developed dump leaching set-up at Cananea. Ferric sulfate which is naturally present is used for dissolving copper and no acid is added. The concentration of ferric sulfate reaching the precipitation plant must be controlled because it consumes iron. Some solution bleeding is done in an attempt to reduce build-up of iron salts. To more completely prepare the dumps for solution, they are alternately leached and rested.

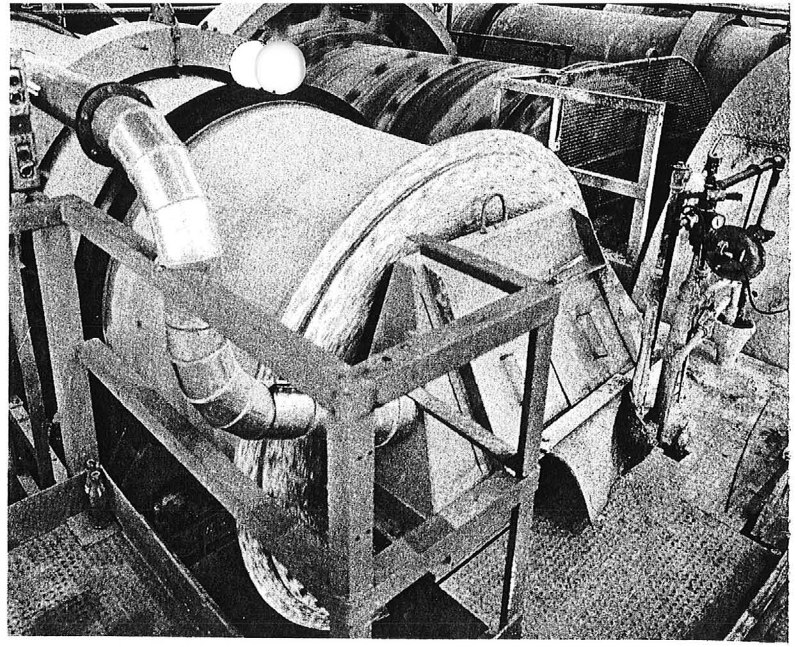
The Cananea product is blister copper cakes that are sent to Mexico City.

As is true at most foreign camps, the Company must operate extensive maintenance shops for rebuilding equipment. Maintenance and motor-pool employees total 360 of the 1670 payroll. Power is generated in the Company's gas-fired steam power plant which has a generating capacity of 38,000 kw.

MORENCI

In the exciting period of copper development that surged in Arizona after the turn of the century, Morenci was the first copper producing district of consequence. Until 1932, production was from underground mining operations and at this time all underground mining was discontinued. Stripping operations on the now famous pit began in 1937 and the new copper concentrator was ready for production in 1942.

Morenci and New Cornelia are the only remaining rail-haulage pits in the Southwest copper industry. At Morenci a double entry ramp system is used with approximately two trains serving each operating shovel. Trains are dispatched according to shovel requirements rather than by assignment to shovels.



New leach-precipitation drum in operation at Morenci.

Ore cars are 80-ton nominal capacity drawn by 1750-hp and 1850-hp locomotives. Some older 1200-hp engines are also in service. Truck haulage is utilized as the need arises for stripping operations above operating rail haulage levels and for making drop cuts. Through 1963, 917 million tons of ore and waste have been removed from the pit of which 607 million tons were ore.

The original concentrator was 25,000 tpd milling capacity, increased to 45,000 tpd two years later or in 1944. Nominal milling capacity today is 58,000 tpd, achieved by 30 parallel ball mills of approximately 2000 tons capacity each operating in closed circuit with a spiral classifier.

During the 30's, when a method for concentration of the projected open pit orebody was being considered, leaching was in the running because of the rapid oxidation characteristics of the chalcocite ore. The decision was made to follow the uncomplicated sulfide-flotation route. Presently, an LPF adjunct to the mill went on stream and is expected to recover an additional 1.25 lb of copper per ton of feed from the oxide copper previously going out in the tailing. As a result, total copper production will be increased from 7% to 10%.

In the process, crushed concentrator feed is leached with sulfuric acid to dissolve copper and then precipitated with a unique sulfide precipitant to convert it to a mixture of cupric sulfide and sulfidized metallic copper particles. Both these reactions proceed almost simultaneously in a revolving drum, one, placed beside each of the 30 ball mills. The precipitated copper continues with the sulfide copper through grinding circuit to flotation where it is recovered. As the total ore emerges from the leaching drum it is neutralized with lime to alkaline flotation range.

The LPF addition necessitated the construction of an acid plant, additional capacity for the lime plant and a precipitant manufacturing plant, which consumes pyrite, lime and coal as raw materials.

A concentrate roasting plant has also been installed at the smelter.

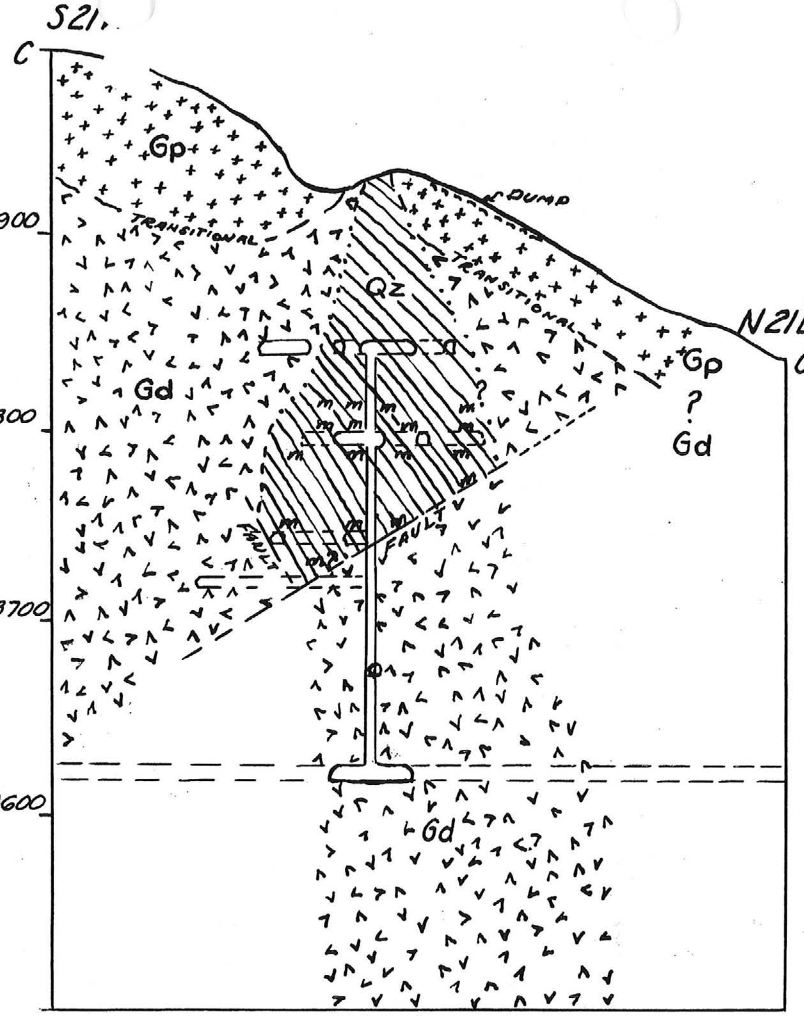


FIG. 4

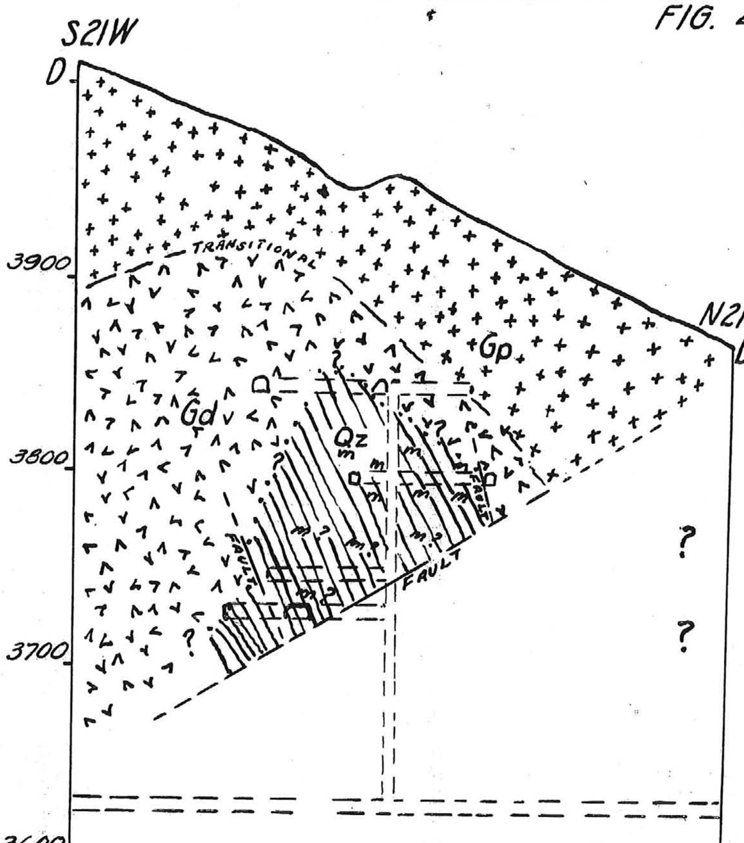


FIG. 5

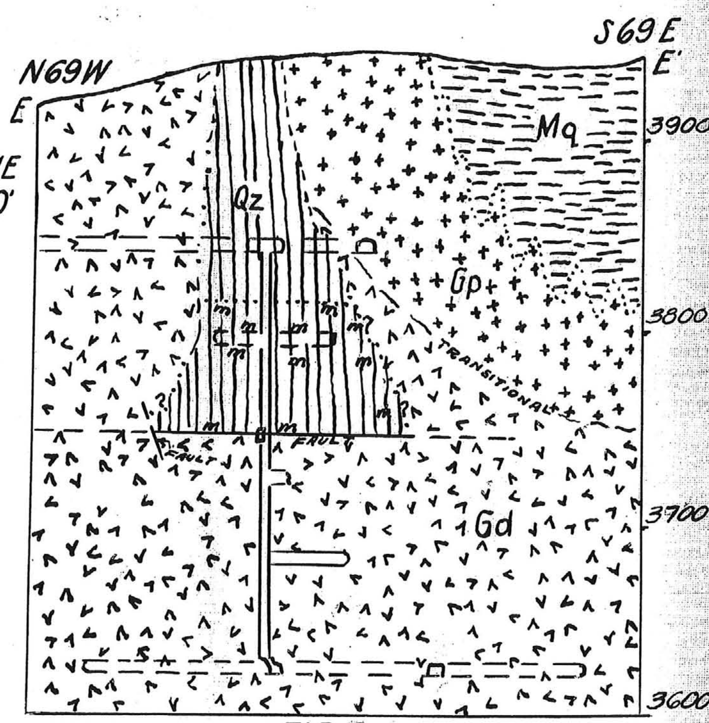
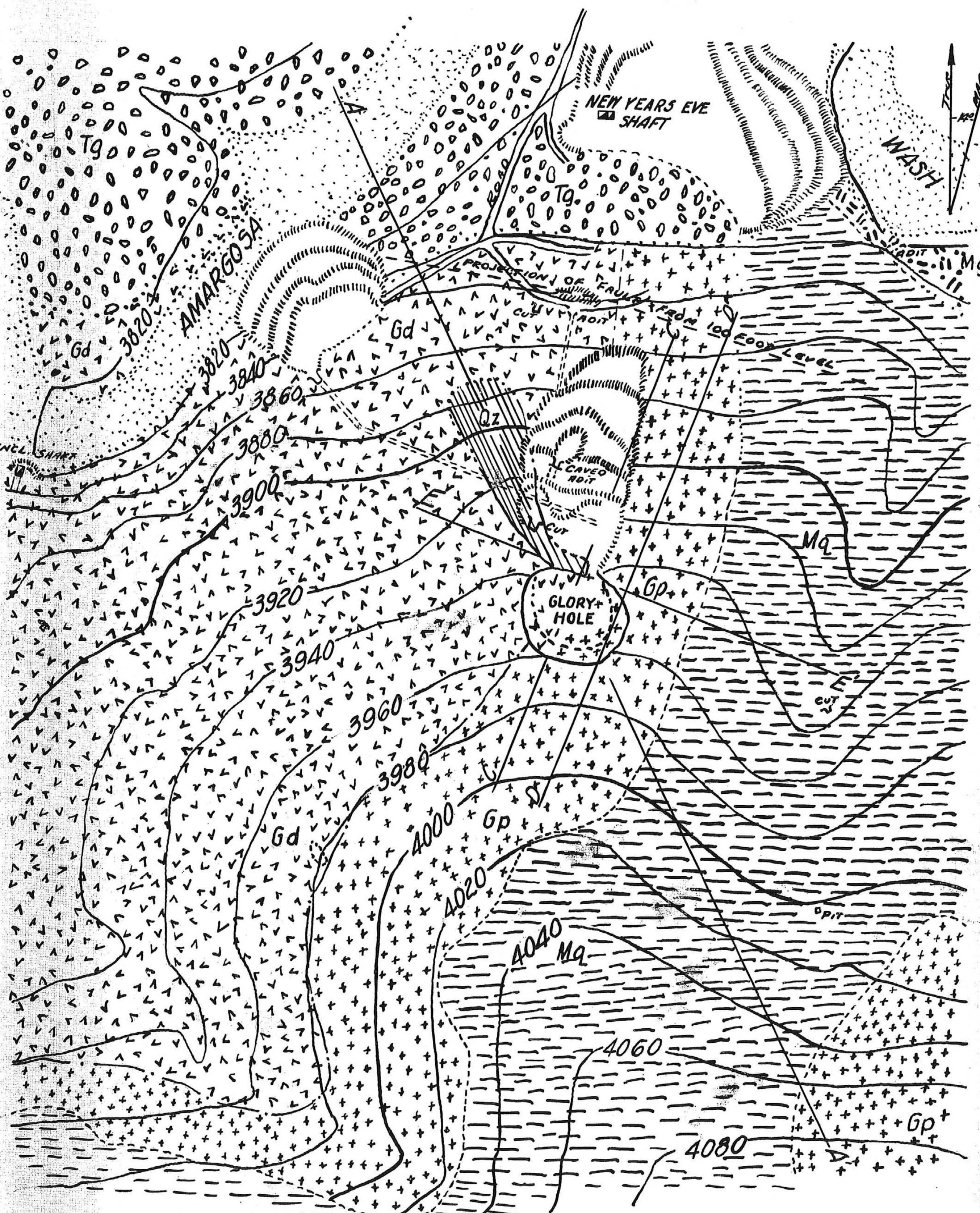


FIG. 6

SECTIONS C-C', D-D', & E-E' - NEW YEARS EVE MINE

100' 0 100' 200'



LEGEND

Note: Geology by U.S.G.S.

Tg — Quaternary terrace gravels	Gp — Granodiorite porphyry	Mg — Gran. Mass. Qtz. Biotite rock
Mq — Quartzite	Gd — Granodiorite	Qz — Quartz

FIG. 2-GEOLOGIC MAP OF NEW YEARS EVE MINE

100' 0 100' 200'

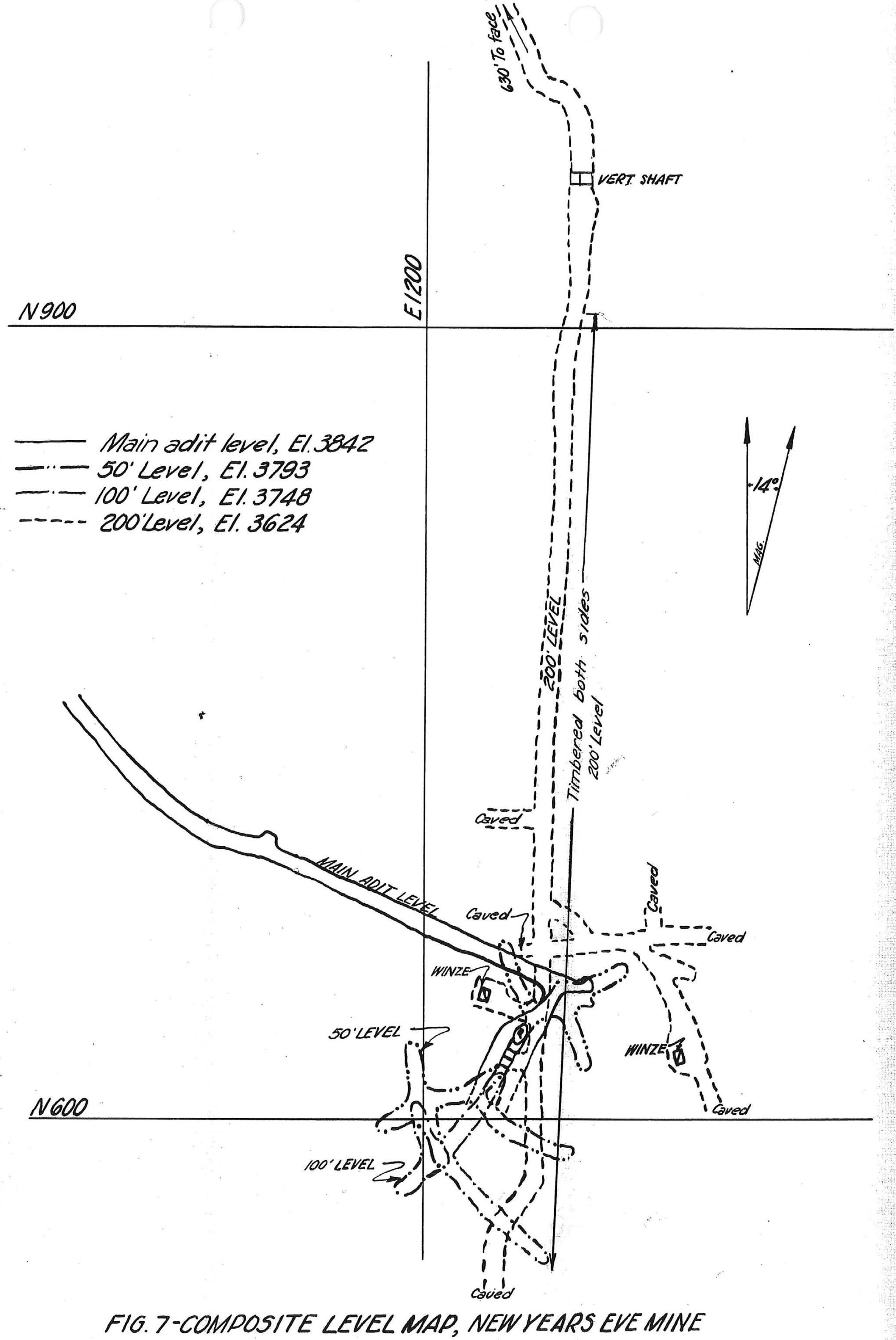


FIG. 7-COMPOSITE LEVEL MAP, NEW YEARS EVE MINE

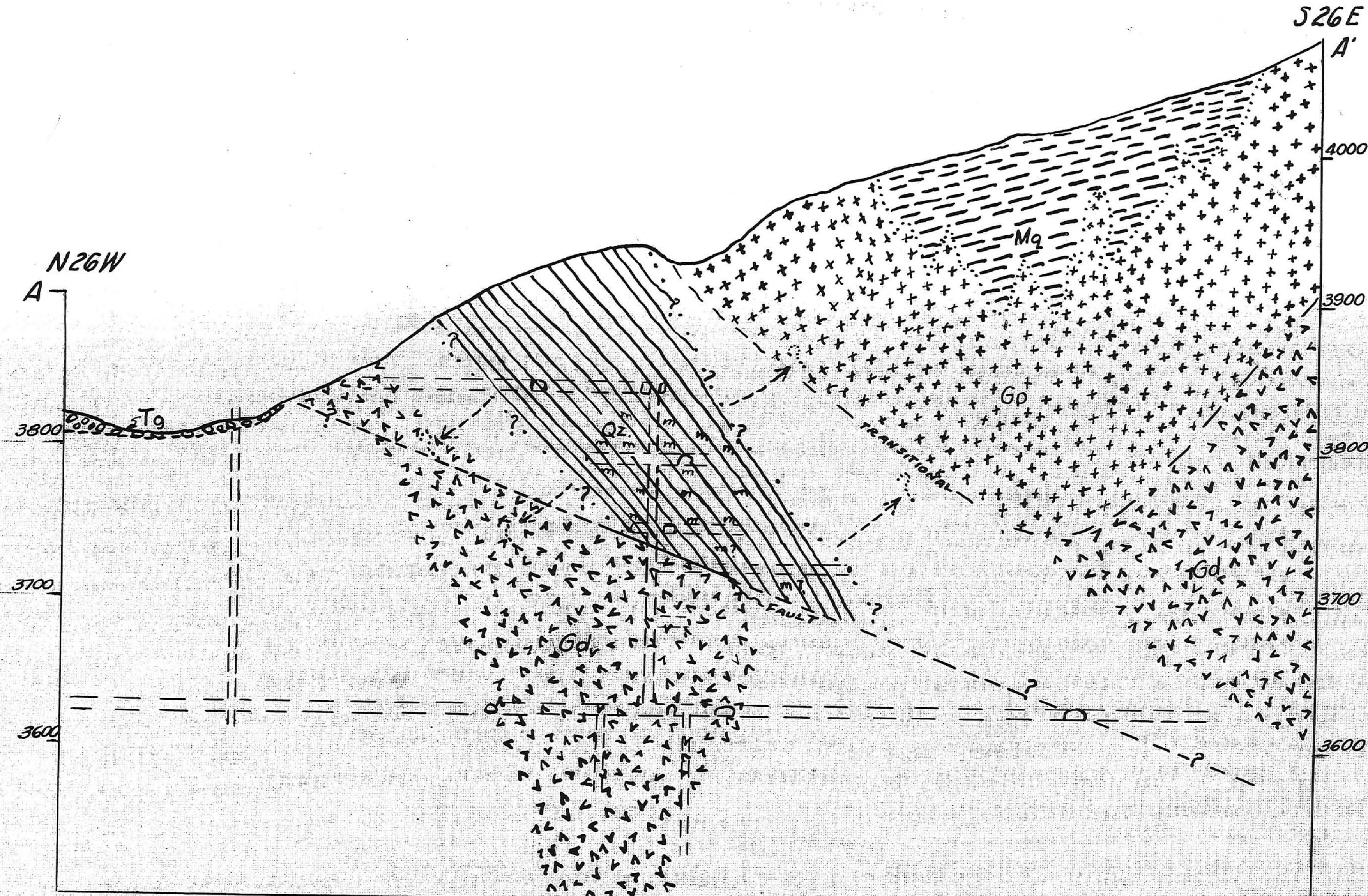
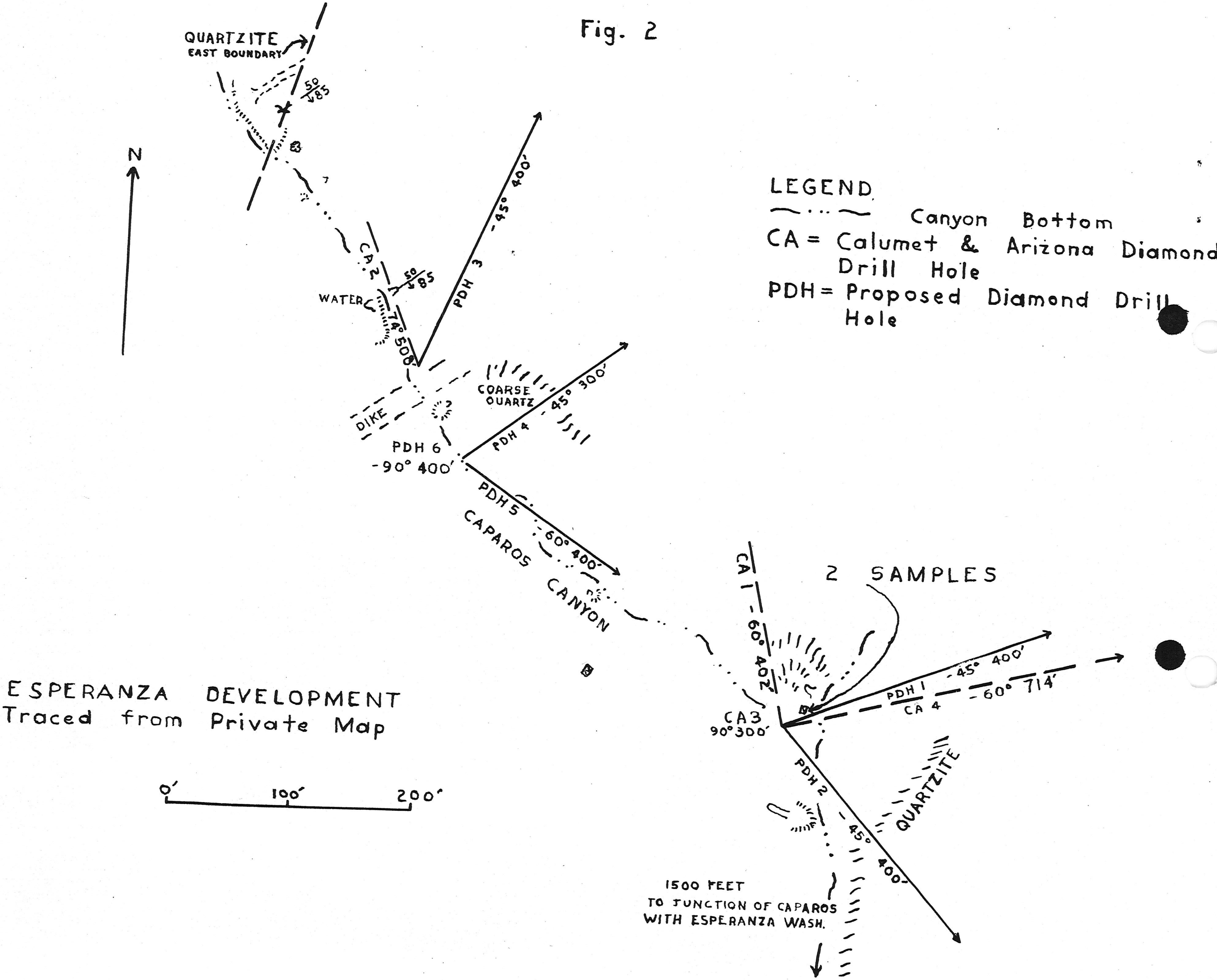
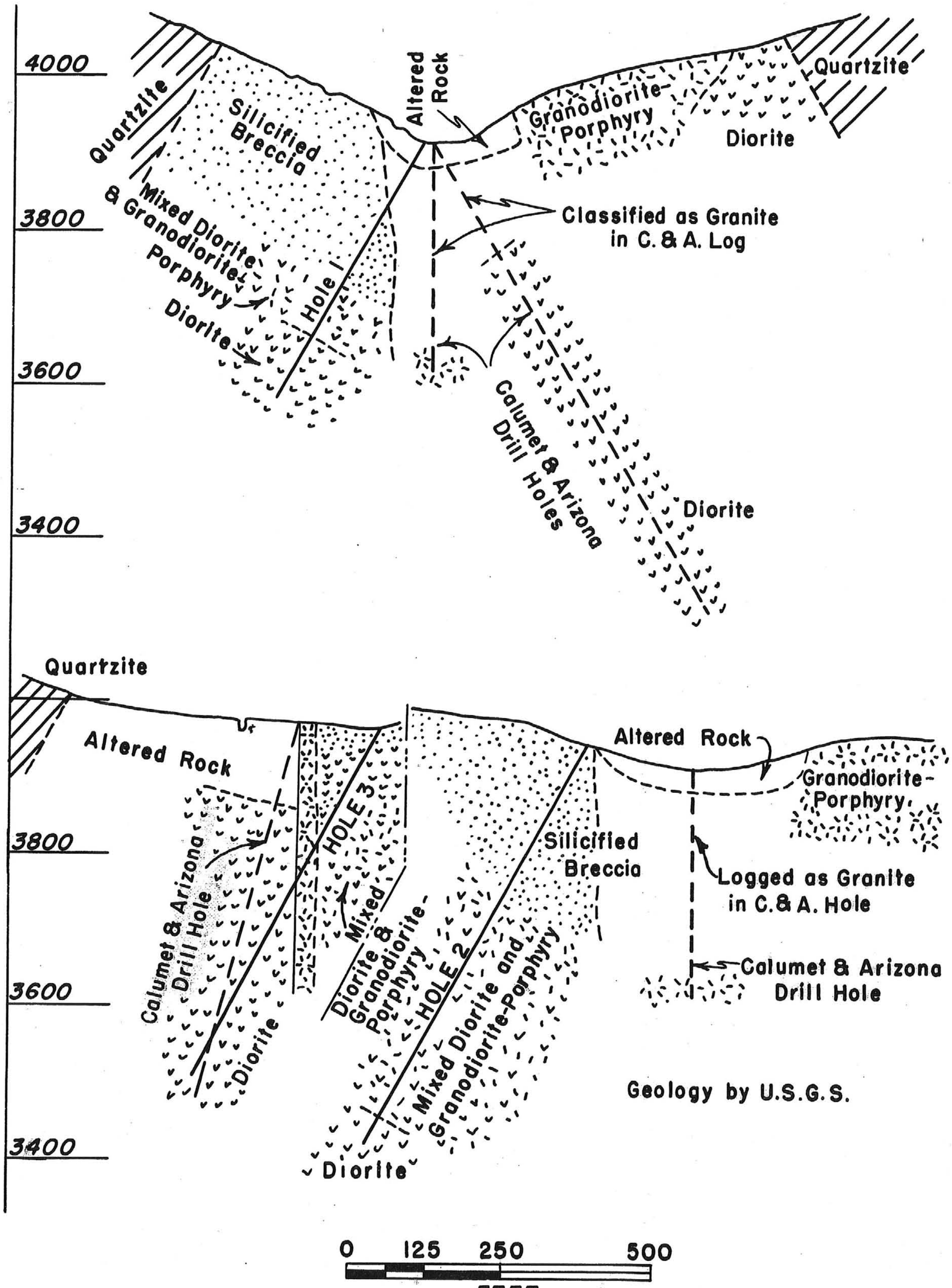


FIG. 3 - SECTION A-A', NEW YEARS EVE MINE

Fig. 2



QUARTZITE
EAST BOUNDARY
50
85
N
LEGEND
Canyon Bottom
CA = Calumet & Arizona Diamond Drill Hole
PDH = Proposed Diamond Drill Hole
PDH 3
-45° 400'
CA 2
50
85
WATER
74° 508'
DIKE
COARSE QUARTZ
PDH 4
-45° 300'
PDH 6
-90° 400'
PDH 5
-60° 400'
CAPAROS CANYON
CA 1
-60° 402'
2 SAMPLES
PDH 1
-45° 400'
CA 4
-60° 714'
CA3
90° 300'
PDH 2
-45° 400'
QUARTZITE
1500 FEET TO JUNCTION OF CAPAROS WITH ESPERANZA WASH.
ESPERANZA DEVELOPMENT
Traced from Private Map
0'
100'
200'



JUNE, 1944

FIG. 3-CROSS SECTIONS THROUGH D.D. HOLES, AMARGOSA PROJ. 1709, PIMA CO., ARIZONA

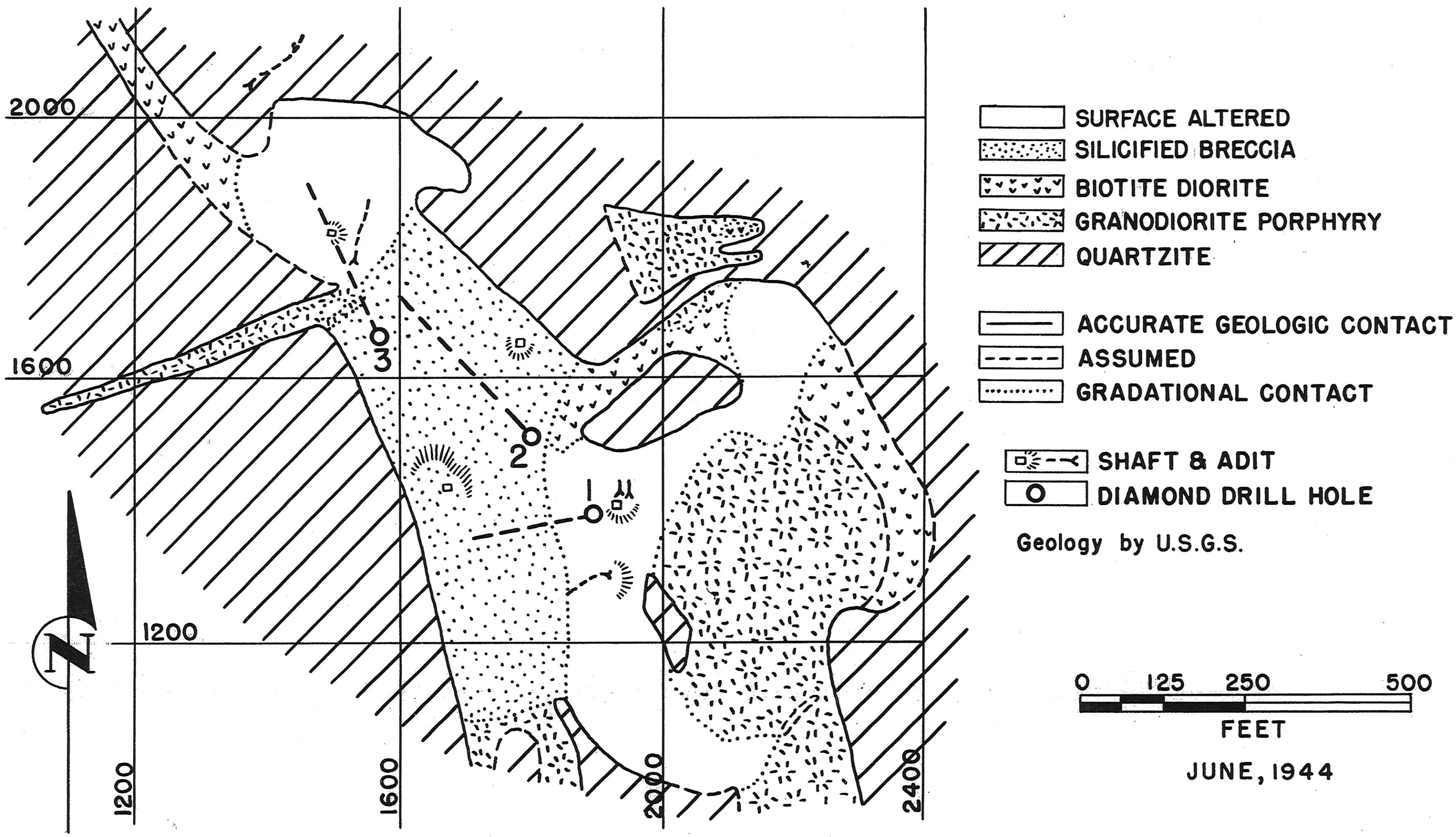


FIG. 2 - GEOLOGIC PLAN OF ESPERANZA DEPOSIT, AMARGOSA PROJ. 1709, PIMA CO., ARIZONA

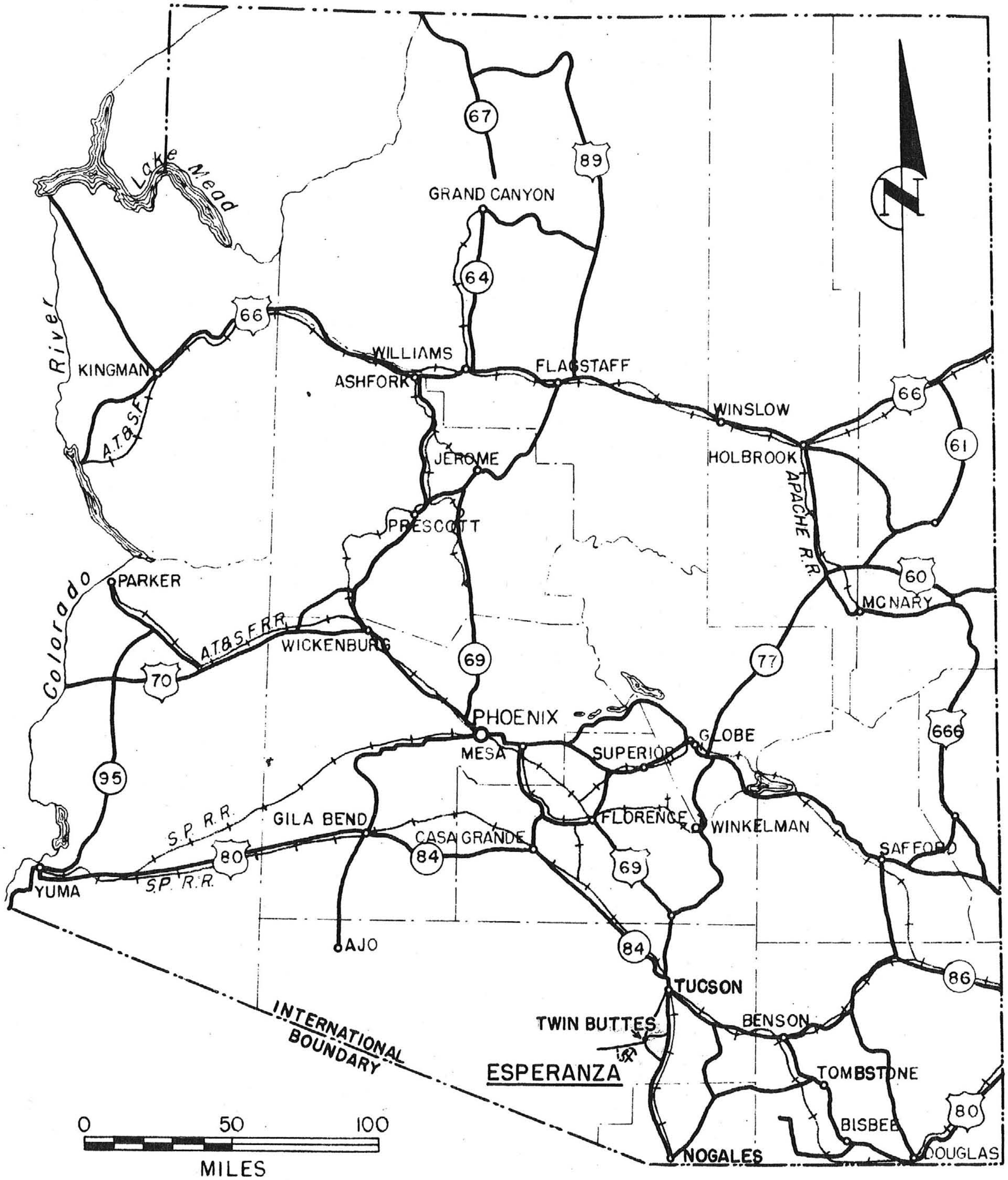
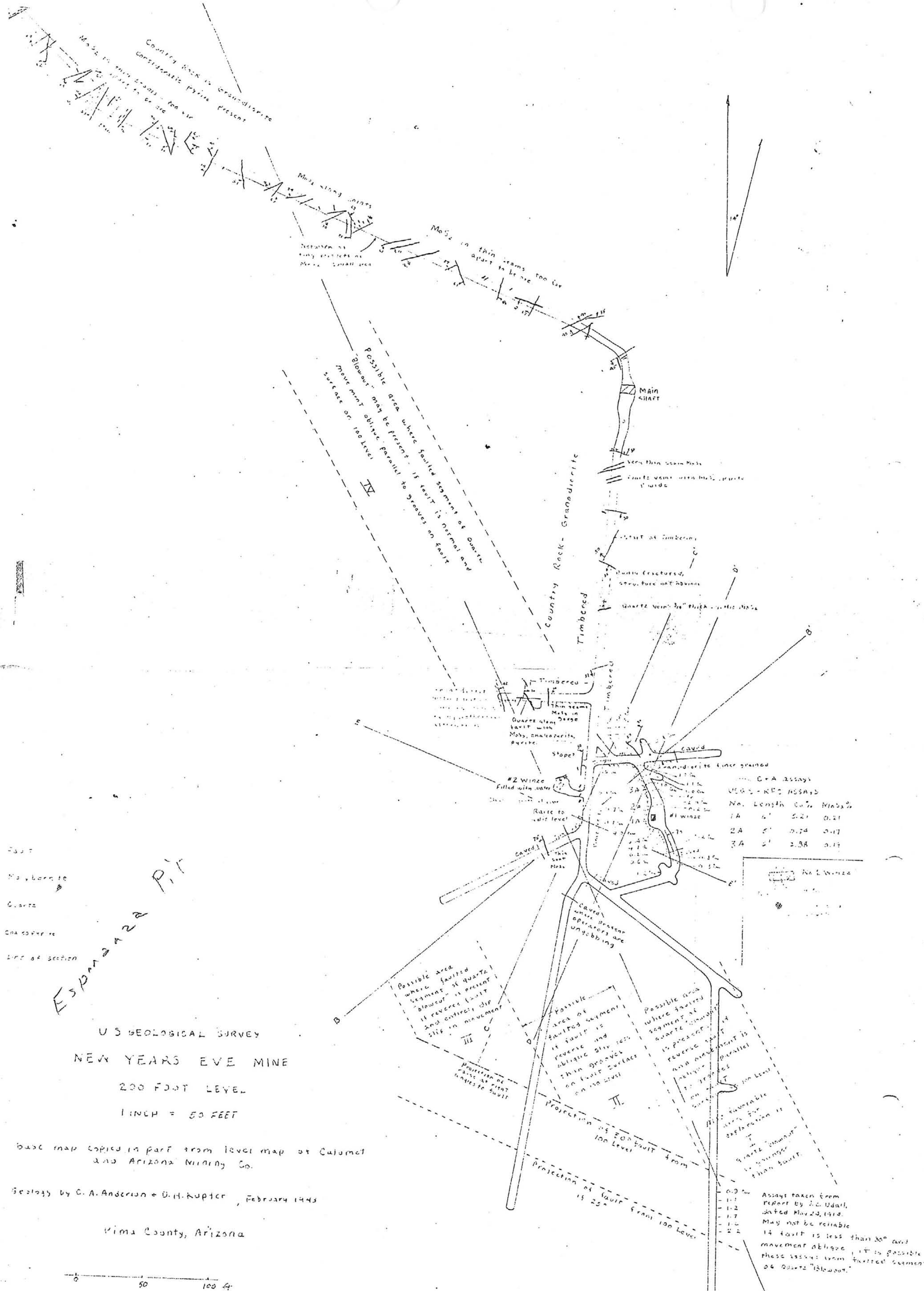
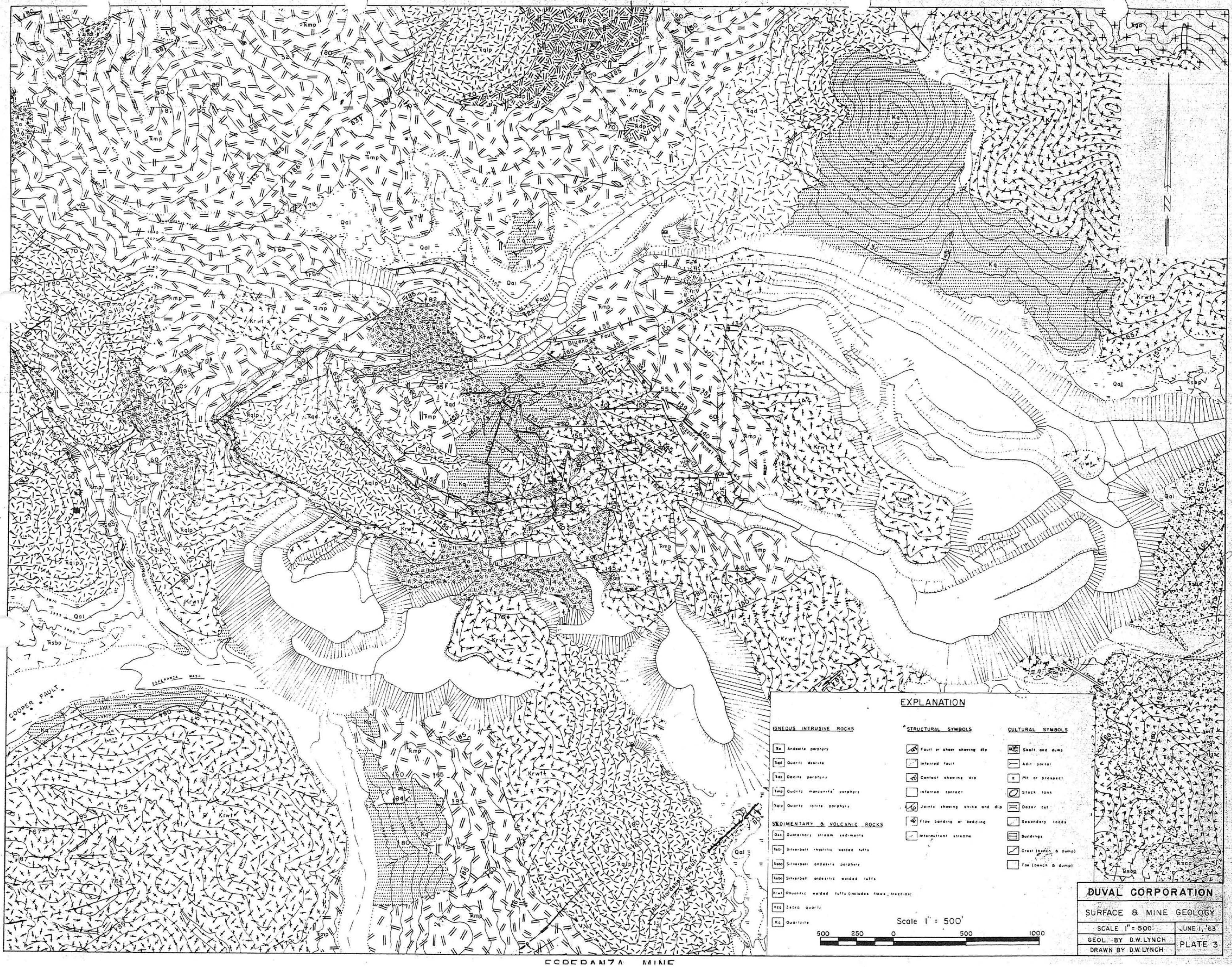


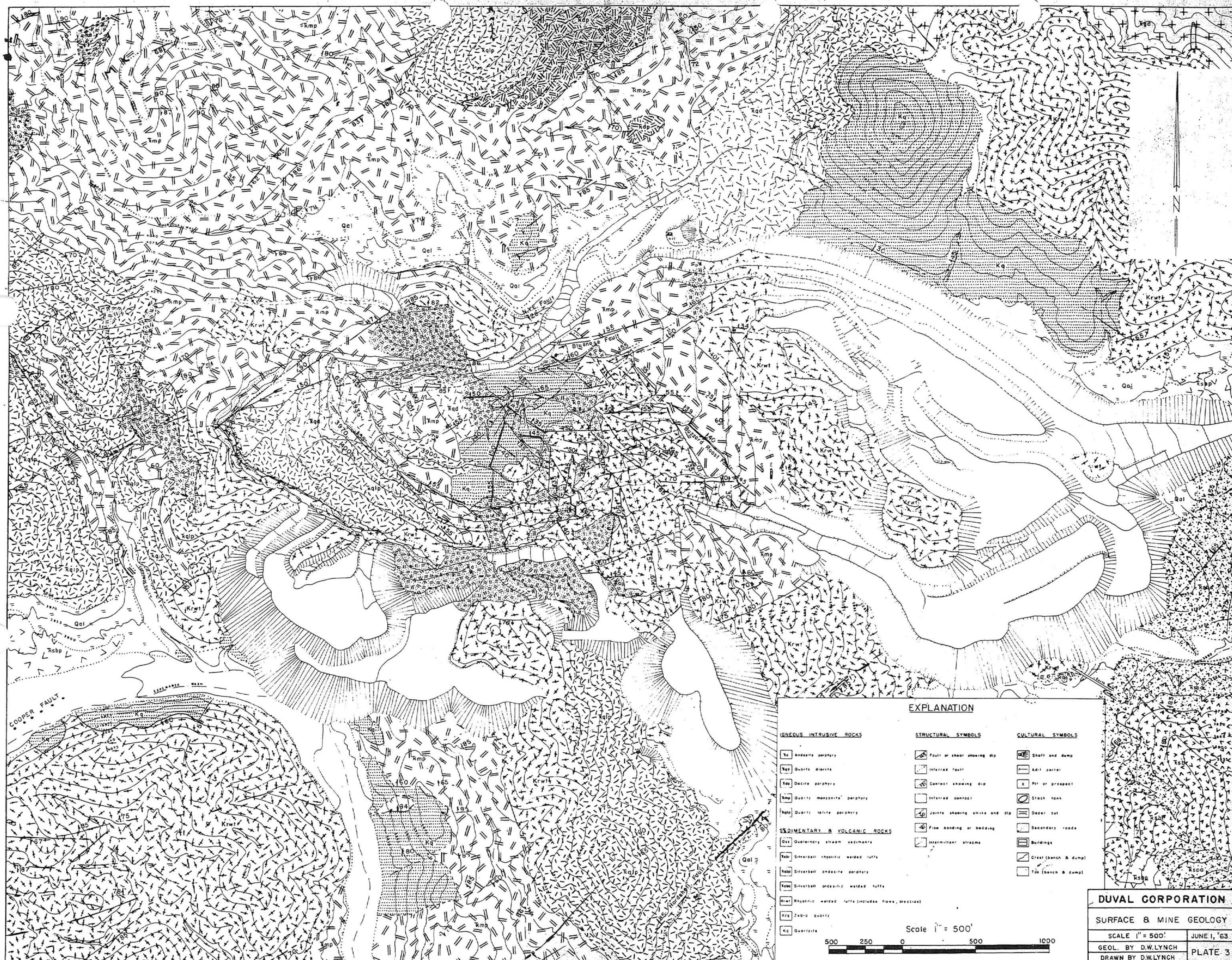
FIG. I-GENERAL LOCATION MAP, ESPERANZA DEPOSIT, AMARGOSA PROJECT 1709, PIMA CO., ARIZ.



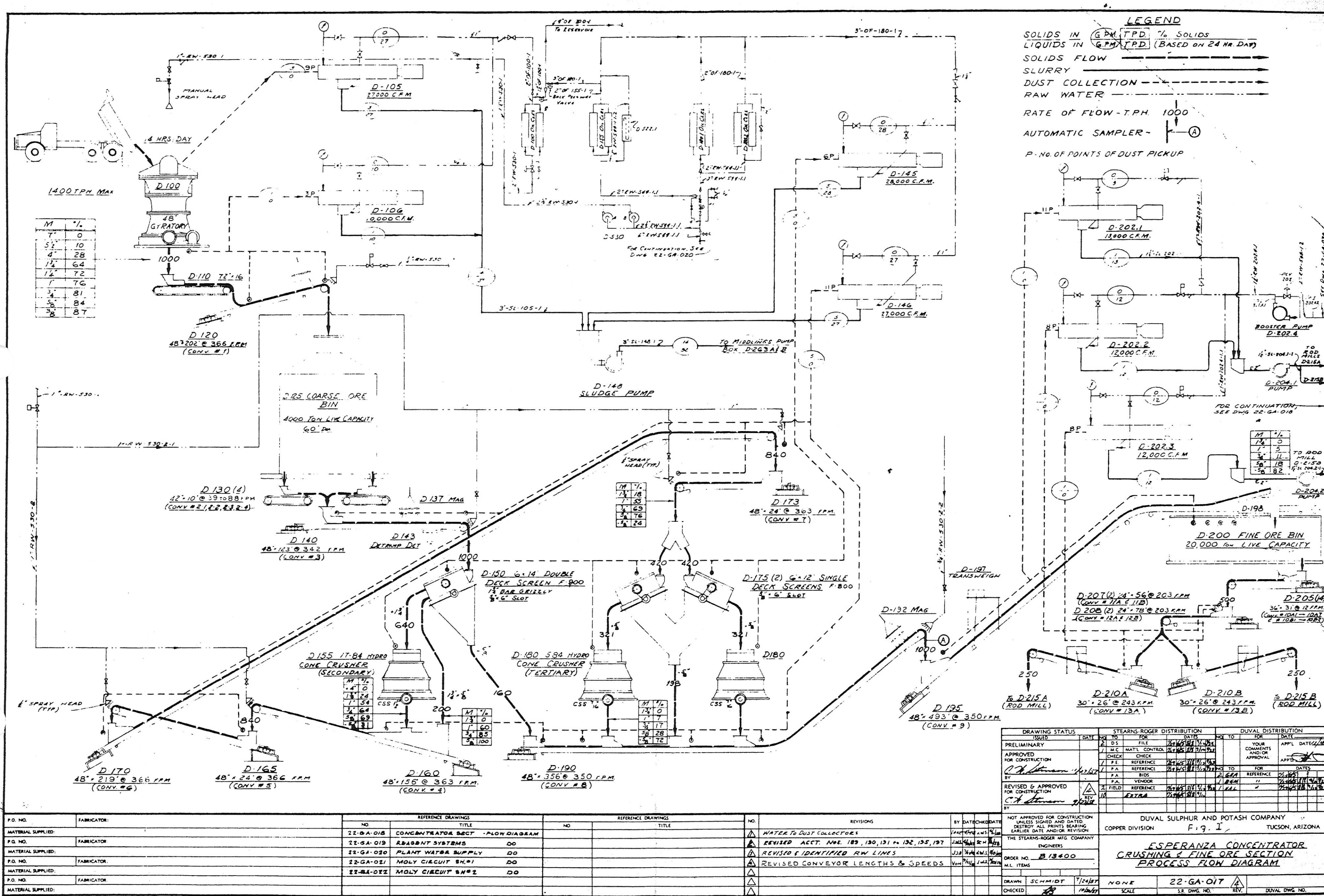
Country Rock is Granodiorite
Considerable Pyrite Present
Mos₂ along joints
Mos₂ in thin seams too far apart to be ore
Main Shaft
Country Rock - Granodiorite
Timbered
Possible area where faulted segment of Quartz "Blowout" may be present, if fault is normal and movement oblique, parallel to grooves on fault surface on 100 Level
IV
Quartz along fault with MoS₂, chalcopyrite, Pyrite
Stopes
#2 Winze Filled with water
Raise to adit level
Caved
#1 Winze
Granodiorite finer grained
C + A assays
USGS - RFC ASSAYS
No. Length Cu% MoS₂%
1A 6' 5.21 0.21
2A 6' 0.74 0.17
3A 2' 2.38 0.13
Caved where present operators are ungobbing
Possible area where faulted segment of quartz "blowout" is present if reverse fault and entirely dip slip in movement
III
Possible area of faulted segment if fault is reverse and oblique slip less than grooves on fault surface on 100 level
II
Possible area where faulted segment of quartz "blowout" is present if reverse fault and movement is parallel to grooves on fault
Most favorable area for exploration is I
Projection of 200 fault from 100 Level
Projection of fault from 100 Level
Assays taken from report by J.C. Udall, dated Mar 24, 1918. May not be reliable. If fault is less than 30° and movement oblique, it is possible these assays from "faulted" segment of quartz "Blowout."
Esperanza Pit
U S GEOLOGICAL SURVEY
NEW YEARS EVE MINE
200 FOOT LEVEL
1 INCH = 50 FEET
base map copied in part from level map of Calumet and Arizona Mining Co.
Geology by C. A. Anderson + D. H. Kupfer, February 1943
Pima County, Arizona
0
50
100 ft

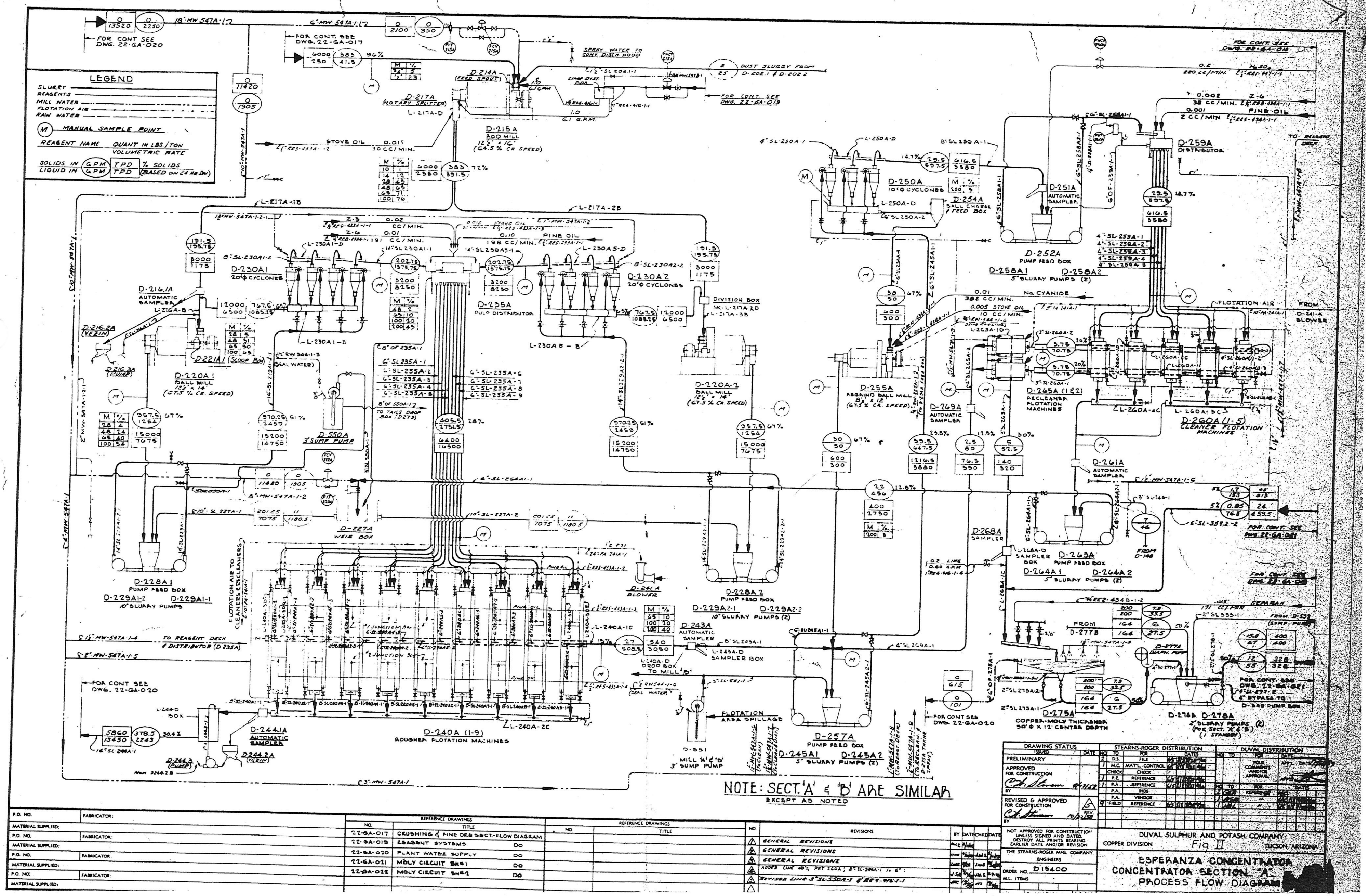


ESPERANZA MINE

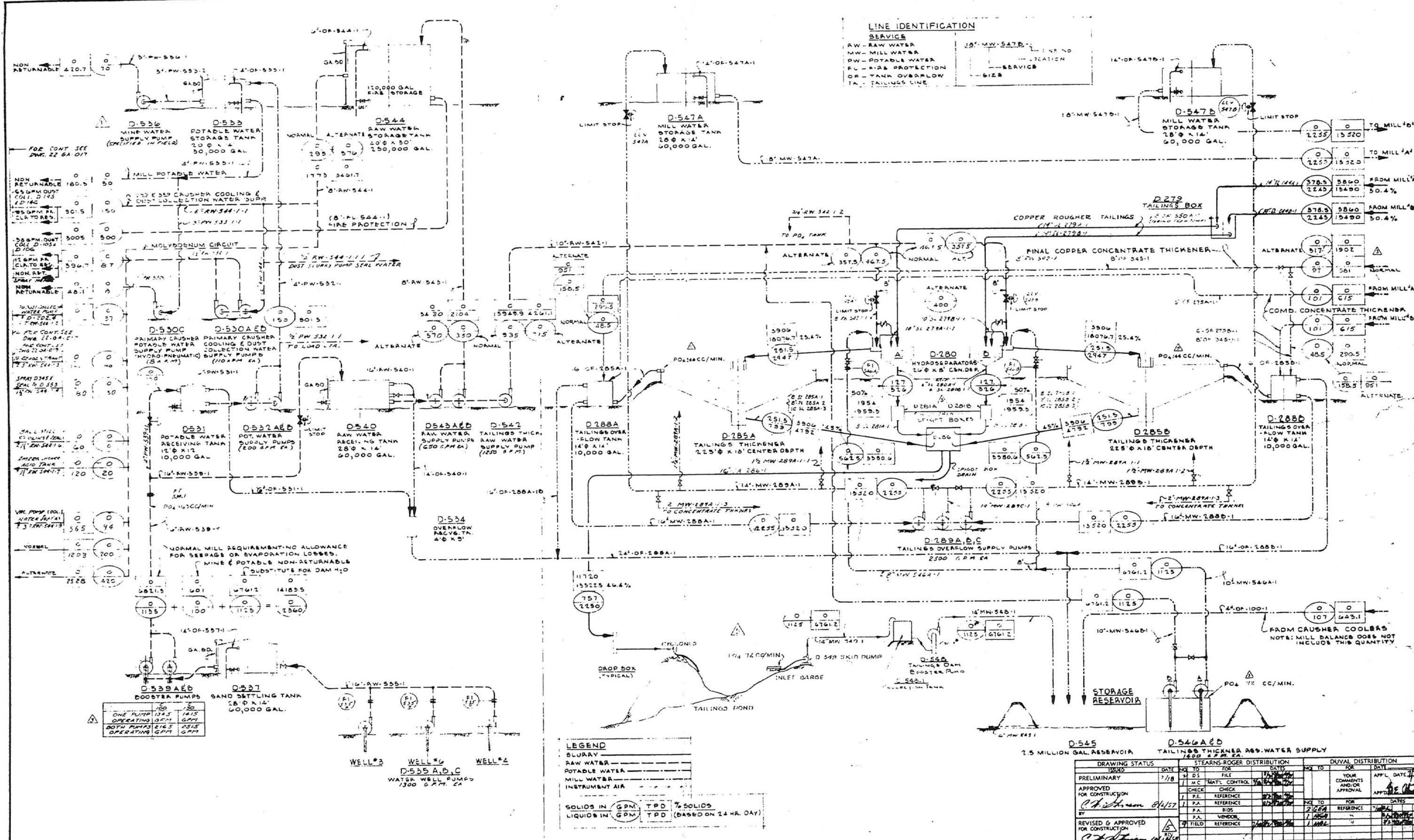


ESPERANZA MINE


LEGEND
SOLIDS IN GPM TPD % SOLIDS
LIQUIDS IN GPM TPD (BASED ON 24 HR. DAY)
SOLIDS FLOW
SLURRY
DUST COLLECTION
RAW WATER
RATE OF FLOW - T.P.H. 1000
AUTOMATIC SAMPLER
P - NO. OF POINTS OF DUST PICKUP
14 HRS. DAY
1400 TPH MAX
D 100
48" GYRATORY
D 110 72" x 16'
D 120
48" x 202' @ 366 F.P.M.
(CONV. # 1)
D-105
27000 C.F.M.
D-106
10,000 C.F.M.
MANUAL SPRAY HEAD
D-145
28,000 C.F.M.
D-146
27,000 C.F.M.
D-148
SLUDGE PUMP
TO MIDDLINGS PUMP BOX D-263 A & B
FOR CONTINUATION, SEE DWG. 22-GA-020
D 125 COARSE ORE BIN
4000 TON LIVE CAPACITY
60' Dia.
D 130 (4)
42" x 10' @ 39 to 88 F.P.M.
(CONV. # 2.1, 2.2, 2.3, 2.4)
D 137 MAG
D 140
48" x 123' @ 342 F.P.M.
(CONV. # 3)
D 143
DETRAMP DET.
D 150 6' x 14' DOUBLE DECK SCREEN F-800
1½" BAR GRIZZLY
⅝" x 6" SLOT
D 155 17-84 HYDRO CONE CRUSHER (SECONDARY)
D 173
48" x 24' @ 363 F.P.M.
(CONV. # 7)
D 175 (2) 6' x 12' SINGLE DECK SCREENS F-800
⅝" x 6" SLOT
D 180 5-84 HYDRO CONE CRUSHER (TERTIARY)
D 180
D 170
48" x 219' @ 366 F.P.M.
(CONV. # 6)
D 165
48" x 24' @ 366 F.P.M.
(CONV. # 5)
D 160
48" x 156' @ 363 F.P.M.
(CONV. # 4)
D 190
48" x 356' @ 350 F.P.M.
(CONV. # 8)
D-132 MAG
D-197
TRANSWEIGH
D 195
48" x 493' @ 350 F.P.M.
(CONV. # 9)
D-202.1
13,000 C.F.M.
D-202.2
12,000 C.F.M.
D-202.3
12,000 C.F.M.
BOOSTER PUMP
D-202.4
C-204.1
PUMP
D-204.2
PUMP
FOR CONTINUATION, SEE DWG. 22-GA-018
TO ROD MILLS
D-198
D-200 FINE ORE BIN
20,000 TON LIVE CAPACITY
D-205 (4)
36" x 31' @ 12 F.P.M.
D-207 (2) 24" x 56' @ 203 F.P.M.
(CONV. # 11A & 11B)
D 208 (2) 24" x 78' @ 203 F.P.M.
(CONV. # 12A & 12B)
D-210A
30" x 26' @ 243 F.P.M.
(CONV. # 13A)
D-210B
30" x 26' @ 243 F.P.M.
(CONV. # 13B)
TO D-215A (ROD MILL)
TO D-215B (ROD MILL)
REFERENCE DRAWINGS
22-GA-018 CONCENTRATOR SECT. FLOW DIAGRAM
22-GA-019 REAGENT SYSTEMS DO
22-GA-020 PLANT WATER SUPPLY DO
22-GA-021 MOLY CIRCUIT SH. #1 DO
22-GA-022 MOLY CIRCUIT SH. #2 DO
REVISIONS
WATER TO DUST COLLECTORS
REVISED ACCT. NOS. 129, 130, 131 to 132, 135, 137
REVISED & IDENTIFIED RW LINES
REVISED CONVEYOR LENGTHS & SPEEDS
NOT APPROVED FOR CONSTRUCTION UNLESS SIGNED AND DATED. DESTROY ALL PRINTS BEARING EARLIER DATE AND/OR REVISION
THE STEARNS-ROGER MFG. COMPANY ENGINEERS
ORDER NO. B 13400
DUVAL SULPHUR AND POTASH COMPANY
COPPER DIVISION
Fig. I
TUCSON, ARIZONA
ESPERANZA CONCENTRATOR
CRUSHING & FINE ORE SECTION
PROCESS FLOW DIAGRAM
DRAWN SCHMIDT
SCALE NONE
22-GA-017
4



LEGEND
SLURRY
REAGENTS
MILL WATER
FLOTATION AIR
RAW WATER
MANUAL SAMPLE POINT
REAGENT NAME QUANT IN LBS/TON VOLUMETRIC RATE
SOLIDS IN GPM TPD % SOLIDS
LIQUID IN GPM TPD (BASED ON 24 HR DAY)
FOR CONT SEE DWG. 22-GA-020
FOR CONT. SEE DWG. 22-GA-017
SPRAY WATER TO CONV DISCH HOOD
DUST SLURRY FROM D-202.1 & D-202.2
FOR CONT SEE DWG. 22-GA-019
D-214A (FEED SPOUT)
D-217A ROTARY SPLITTER
D-215A ROD MILL 12' x 16' (64.5 % CR SPEED)
STOVE OIL 0.015 30 CC/MIN.
D-216.1A AUTOMATIC SAMPLER
D-216.2A (VEZIN)
D-216.3A (PUMP)
D-221A1 (SCOOP BOX)
D-220A1 BALL MILL 12 1/2' x 14' (67.5 % CR. SPEED)
D-230A1 20" CYCLONES
D-230A2 20" CYCLONES
D-235A PULP DISTRIBUTOR
D-220A-2 BALL MILL 12 1/2' x 14' (67.5 % CR SPEED)
D-550A 3" SUMP PUMP
TO TAILS DROP BOX (D273)
D-227A WEIR BOX
D-228A1 PUMP FEED BOX
D-229A1-2 D-229A1-1 10" SLURRY PUMPS
D-228A2 PUMP FEED BOX
D-229A2-1 D-229A2-2 10" SLURRY PUMPS (2)
D-241A BLOWER
FLOTATION AIR TO CLEANERS & RECLEANERS
TO REAGENT DECK & DISTRIBUTOR (D 235A)
D-243A AUTOMATIC SAMPLER
L-243A-D SAMPLER BOX
L-240A-D DROP BOX TO MILL "B"
D-240A (1-9) ROUGHER FLOTATION MACHINES
D-244.1A AUTOMATIC SAMPLER
D-244.2A (VEZIN)
D-244.3 (PUMP)
D-551 MILL "A" & "B" 3" SUMP PUMP
FLOTATION AREA SPILLAGE
D-257A PUMP FEED BOX
D-245A1 D-245A2 5" SLURRY PUMPS (2)
D-250A 10" CYCLONES
D-254A BALL CHARGE & FEED BOX
D-251A AUTOMATIC SAMPLER
D-252A PUMP FEED BOX
D-258A1 D-258A2 5" SLURRY PUMPS (2)
D-259A DISTRIBUTOR
PINE OIL
No CYANIDE
FLOTATION AIR FROM D-241-A BLOWER
D-255A REGRIND BALL MILL 8 1/2' x 12' (67.5 % CR. SPEED)
D-269A AUTOMATIC SAMPLER
D-265A (1 & 2) RECLEANER FLOTATION MACHINES
D-260A (1-5) CLEANER FLOTATION MACHINES
D-261A AUTOMATIC SAMPLER
D-268A SAMPLER
SAMPLER BOX
D-263A PUMP FEED BOX
D-264A1 D-264A2 5" SLURRY PUMPS (2)
FROM D-148
FOR CONT. SEE DWG. 22-GA-021
FOR CONT SEE DWG. 22-GA-022
FROM D-277B
D-277A DIAPH. PUMP
D-275A COPPER-MOLY THICKENER 50' Ø x 12' CENTER DEPTH
D-278B D-278A 2" SLURRY PUMPS (2) (FOR SECT. "A" & "B") (1 STANDBY)
FOR CONT SEE DWG. 22-GA-020
NOTE: SECT. 'A' & 'B' ARE SIMILAR EXCEPT AS NOTED
DRAWING STATUS
PRELIMINARY
APPROVED FOR CONSTRUCTION
REVISED & APPROVED FOR CONSTRUCTION
STEARNS-ROGER DISTRIBUTION
DUVAL DISTRIBUTION
REFERENCE DRAWINGS
22-GA-017 CRUSHING & FINE ORE SECT.-FLOW DIAGRAM
22-GA-019 REAGENT SYSTEMS DO
22-GA-020 PLANT WATER SUPPLY DO
22-GA-021 MOLY CIRCUIT SH#1 DO
22-GA-022 MOLY CIRCUIT SH#2 DO
REVISIONS
GENERAL REVISIONS
GENERAL REVISIONS
GENERAL REVISIONS
NOT APPROVED FOR CONSTRUCTION UNLESS SIGNED AND DATED. DESTROY ALL PRINTS BEARING EARLIER DATE AND/OR REVISION
THE STEARNS-ROGER MFG. COMPANY ENGINEERS
ORDER NO. D 13400
DUVAL SULPHUR AND POTASH COMPANY
COPPER DIVISION
TUCSON, ARIZONA
Fig. II
ESPERANZA CONCENTRATOR
CONCENTRATOR SECTION "A"
PROCESS FLOW DIAGRAM



P.O. NO	FABRICATOR
MATERIAL SUPPLIED	
P.O. NO	FABRICATOR
MATERIAL SUPPLIED	
P.O. NO	FABRICATOR
MATERIAL SUPPLIED	
P.O. NO	FABRICATOR
MATERIAL SUPPLIED	

REFERENCE DRAWINGS

NO.	TITLE
22-GA-017	CRUSHING & FINE ORE SECT. FLOW DIAGRAM
22-GA-018	CONCENTRATOR SECT. DO
22-GA-019	REAGENT SYSTEMS DO
22-GA-021	MOLY CIRCUIT SH#1 DO
22-GA-022	MOLY CIRCUIT SH#2 DO

NO.	REVISIONS	BY	DATE	CHKD	DATE
1	ADDED D-530A,B, & C. DELETED D-536B.	EH	8/16		8/16
2	GENERAL REVISION				
3	ADDED D281A & B. REVISED FLOW QUANTITIES FROM CU THICKENER		10-11	JWS	
▲	ADDED WATER TO SPRAY HEADS & TAILS BOX D-279 - ADDED FLOW TABLE FOR D-533 PUMPS - REMOVED PO4 @ SAND TANK				
▲	REVISED MOLY CIRCUIT RW				
4	ADDED, DELETED & IDENTIFIED MISC. BRANCH LINES			JWS	
▲	CHKD. RECL WATER ARRGT AT TAILS. POND.				
5	Revised PO4 Quantities; Chg'd. Tailings Pond Arrg't				7/63

DRAWING STATUS

ISSUED	DATE
PRELIMINARY	7/18
APPROVED FOR CONSTRUCTION BY C.F. Stinson	8/1/57
REVISED & APPROVED FOR CONSTRUCTION BY C.F. Stinson	REV. 5

STEARNS-ROGER DISTRIBUTION

NO	TO	FOR
2	DS	FILE
1	MC	MAT'L CONTROL
	CHECK	CHECK
1	P.E.	REFERENCE
1	P.A.	REFERENCE
	P.A.	BIDS
	P.A.	VENDOR
9	FIELD	REFERENCE

DUVAL DISTRIBUTION

NO	TO	FOR
		YOUR COMMENTS AND/OR APPROVAL
2	GEA	REFERENCE
1		"
1		"

NOT APPROVED FOR CONSTRUCTION UNLESS SIGNED AND DATED. DESTROY ALL PRINTS BEARING EARLIER DATE AND/OR REVISION

THE STEARNS-ROGER MFG. COMPANY ENGINEERS

ORDER NO. B13400

M.L. ITEMS

DRAWN HUMPHREY 6/18/57

CHECKED 7/11/57

DUVAL SULPHUR AND POTASH COMPANY

COPPER DIVISION — Fig. III — TUCSON, ARIZONA

ESPERANZA CONCENTRATOR PLANT WATER SUPPLY & RECLAMATION SYSTEMS — FLOW DIAGRAM —

SCALE: NONE

S.R. DWG. NO. 22-GA-020 REV. 5

DUVAL DWG. NO.

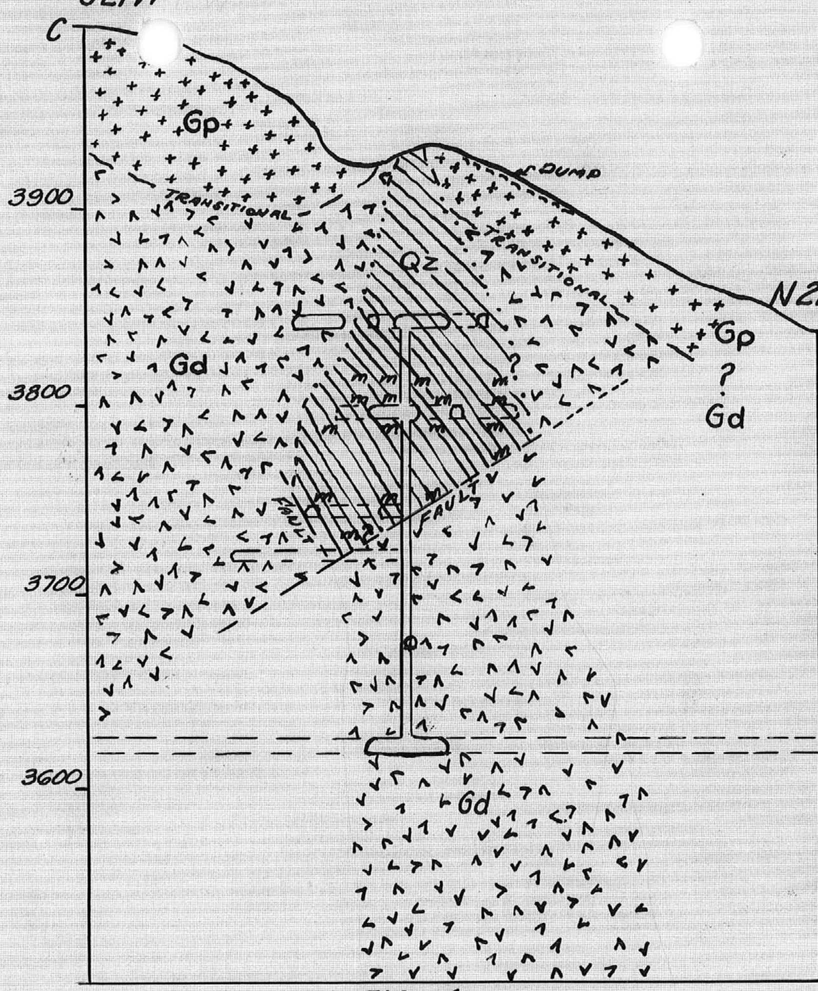


FIG. 4

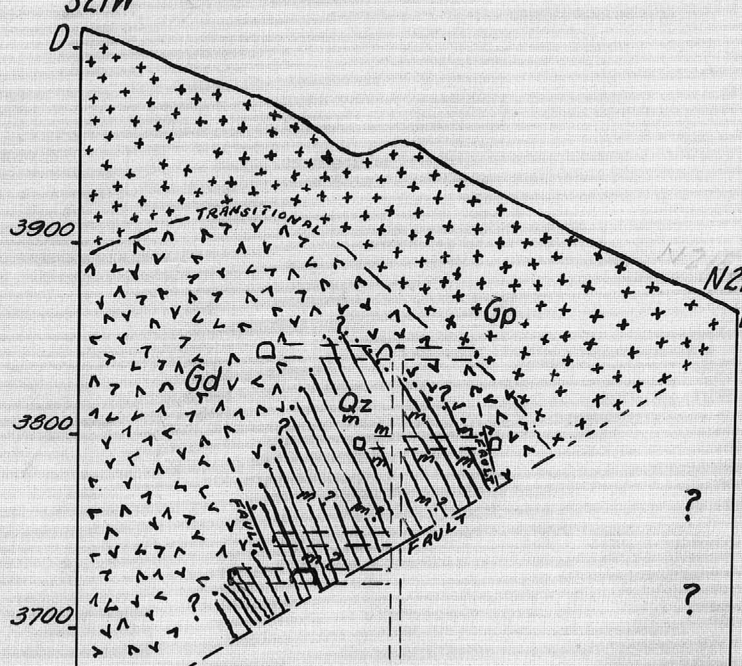


FIG. 5

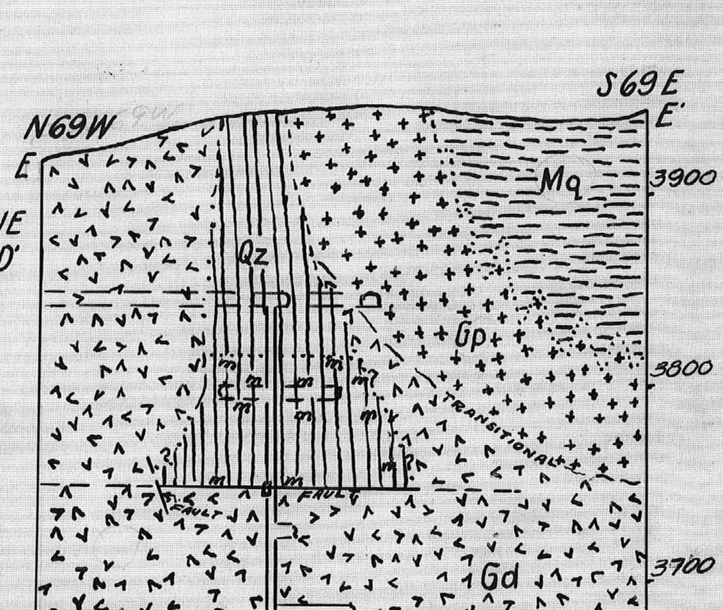


FIG. 6

SECTIONS C-C'; D-D', & E-E' - NEW YEARS EVE MINE

100' 0 100' 200'

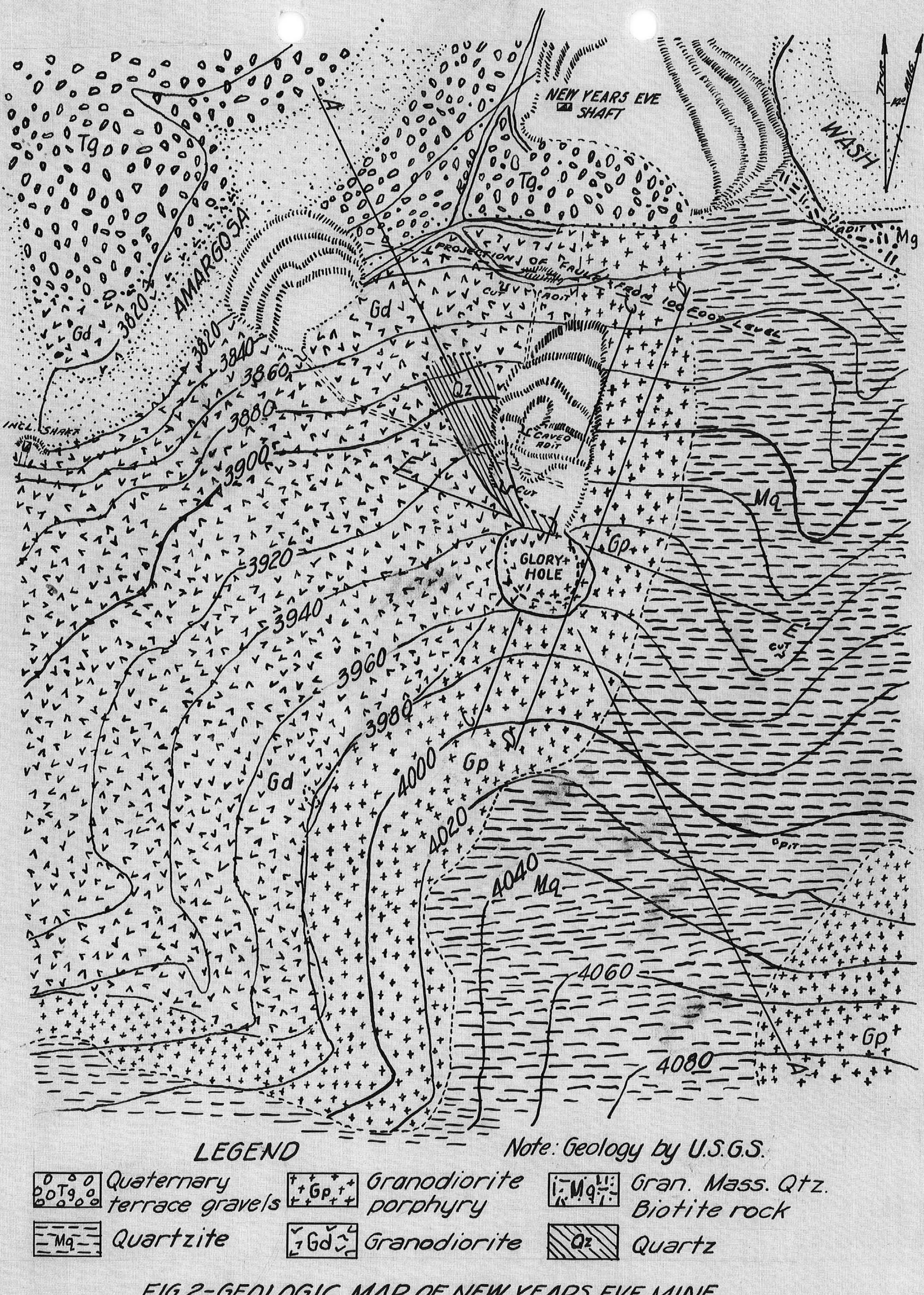


FIG. 2-GEOLOGIC MAP OF NEW YEARS EVE MINE

100' 0 100' 200'

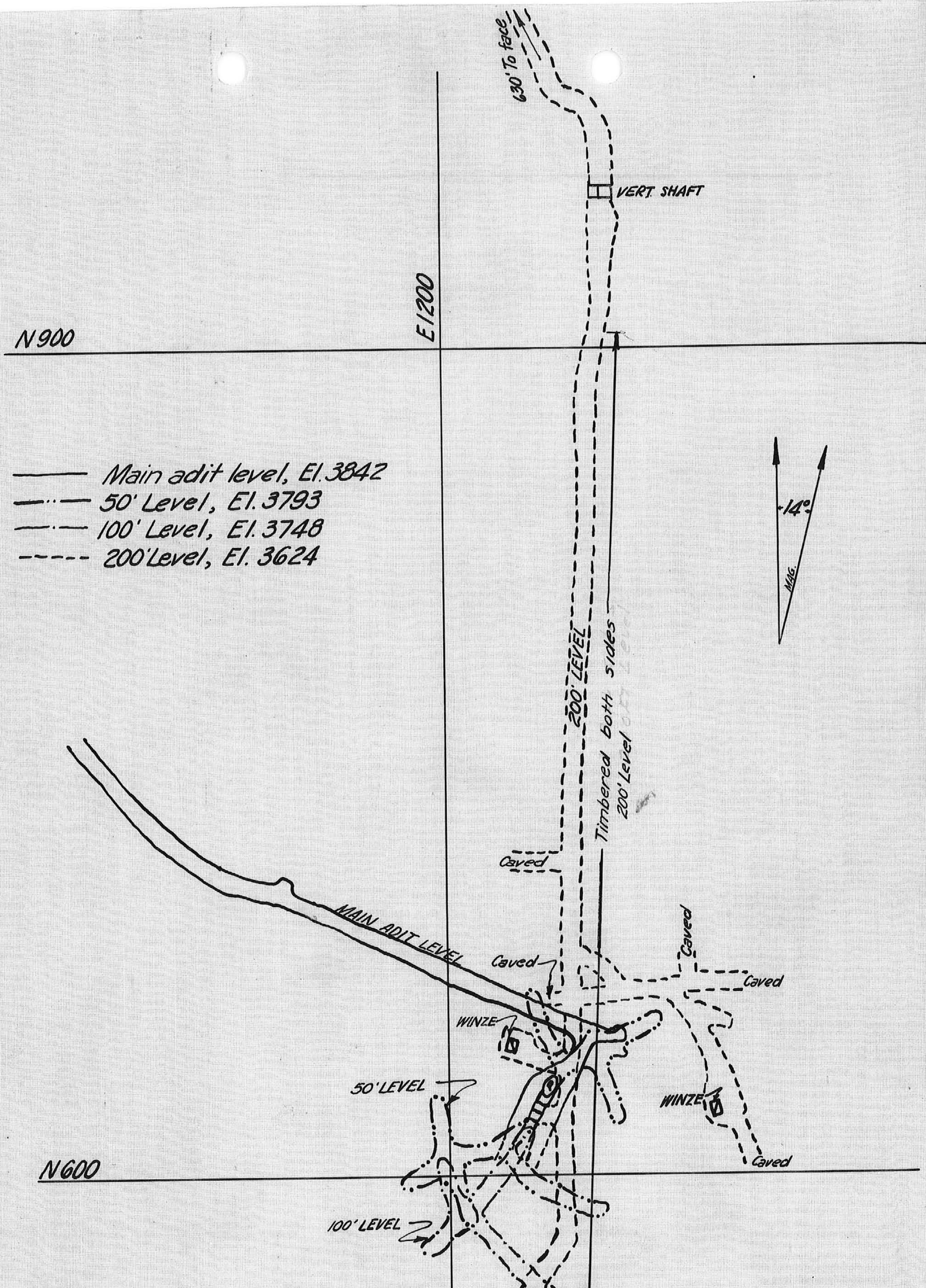


FIG. 7-COMPOSITE LEVEL MAP, NEW YEARS EVE MINE

50' 0 50' 100'

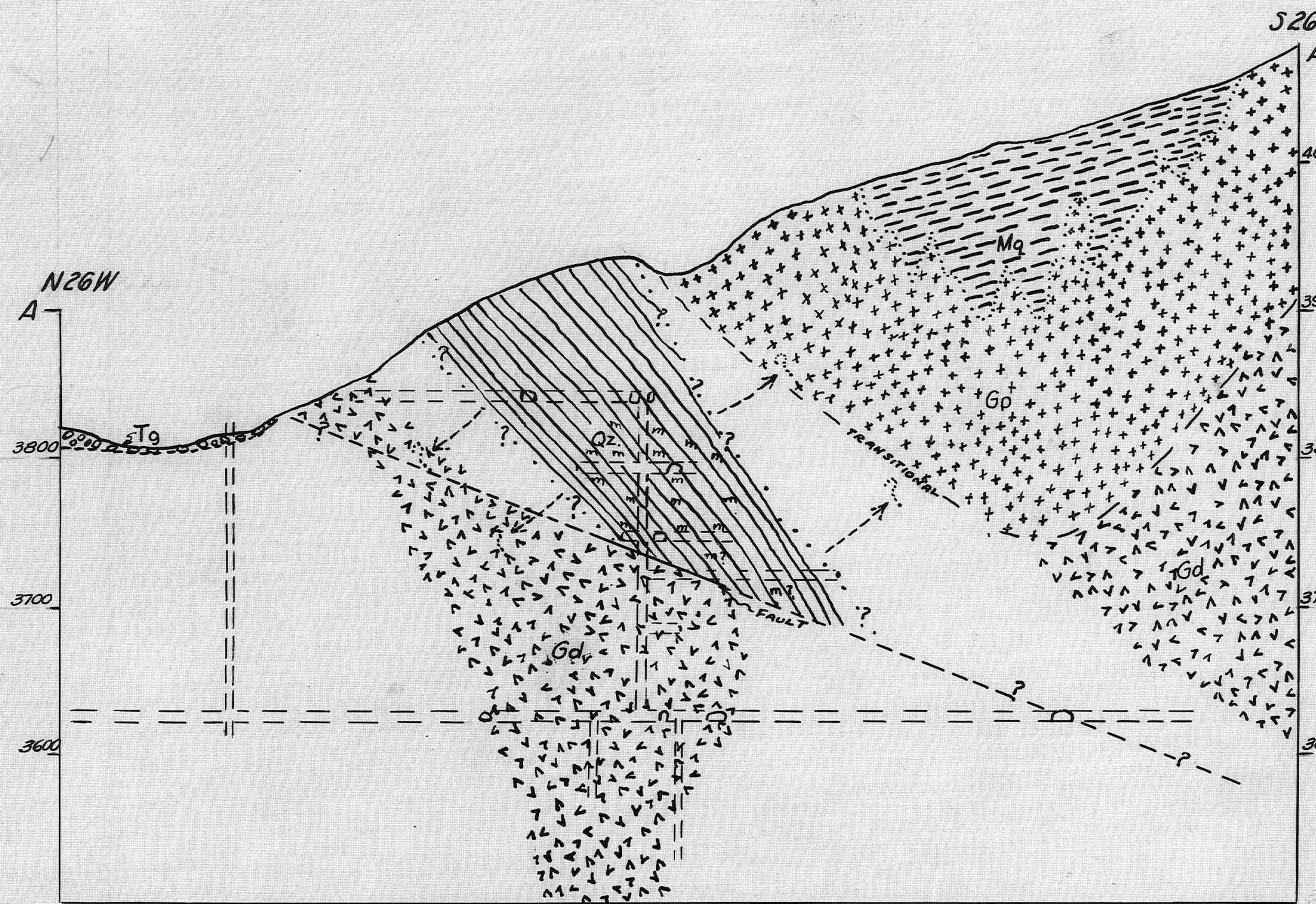
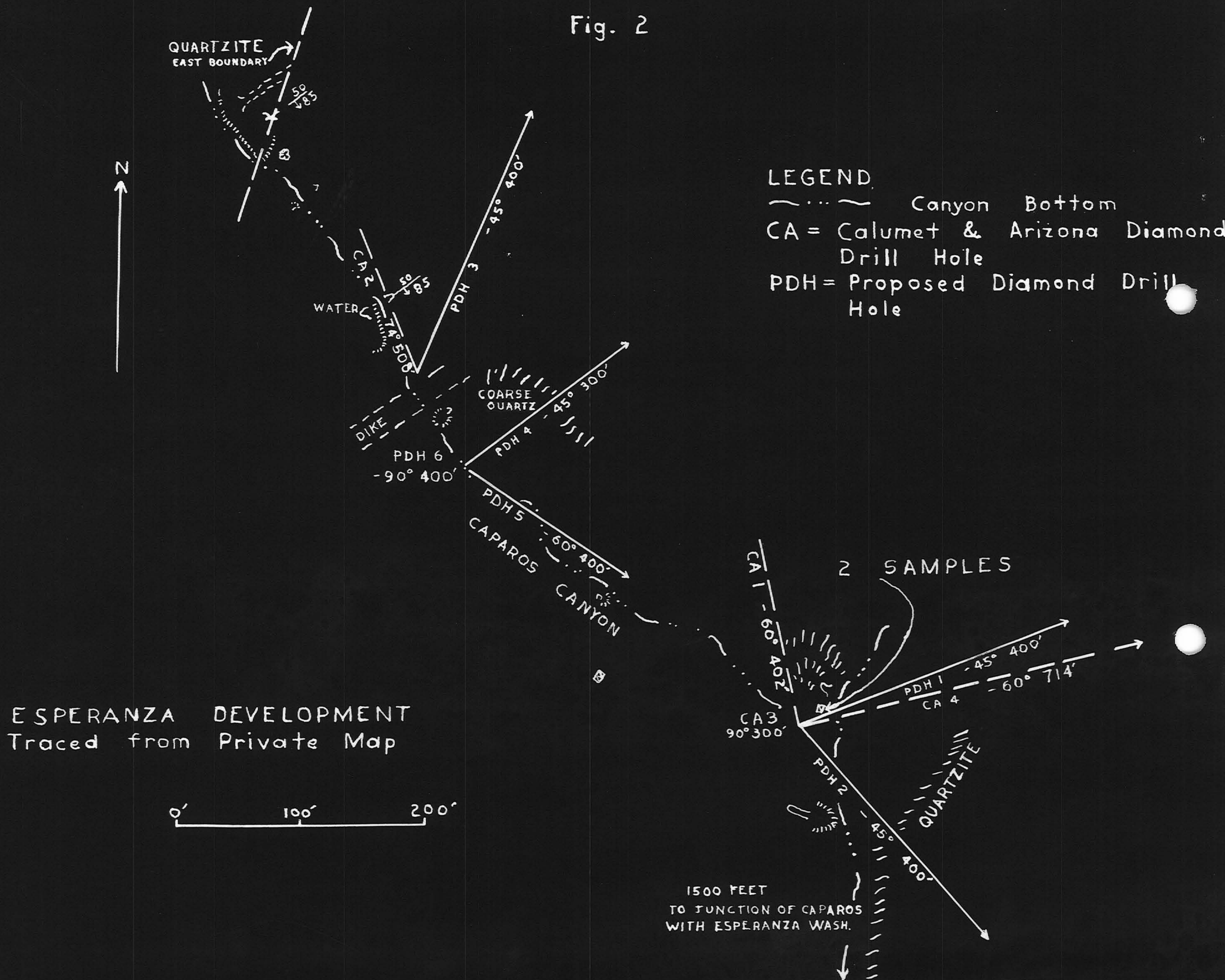


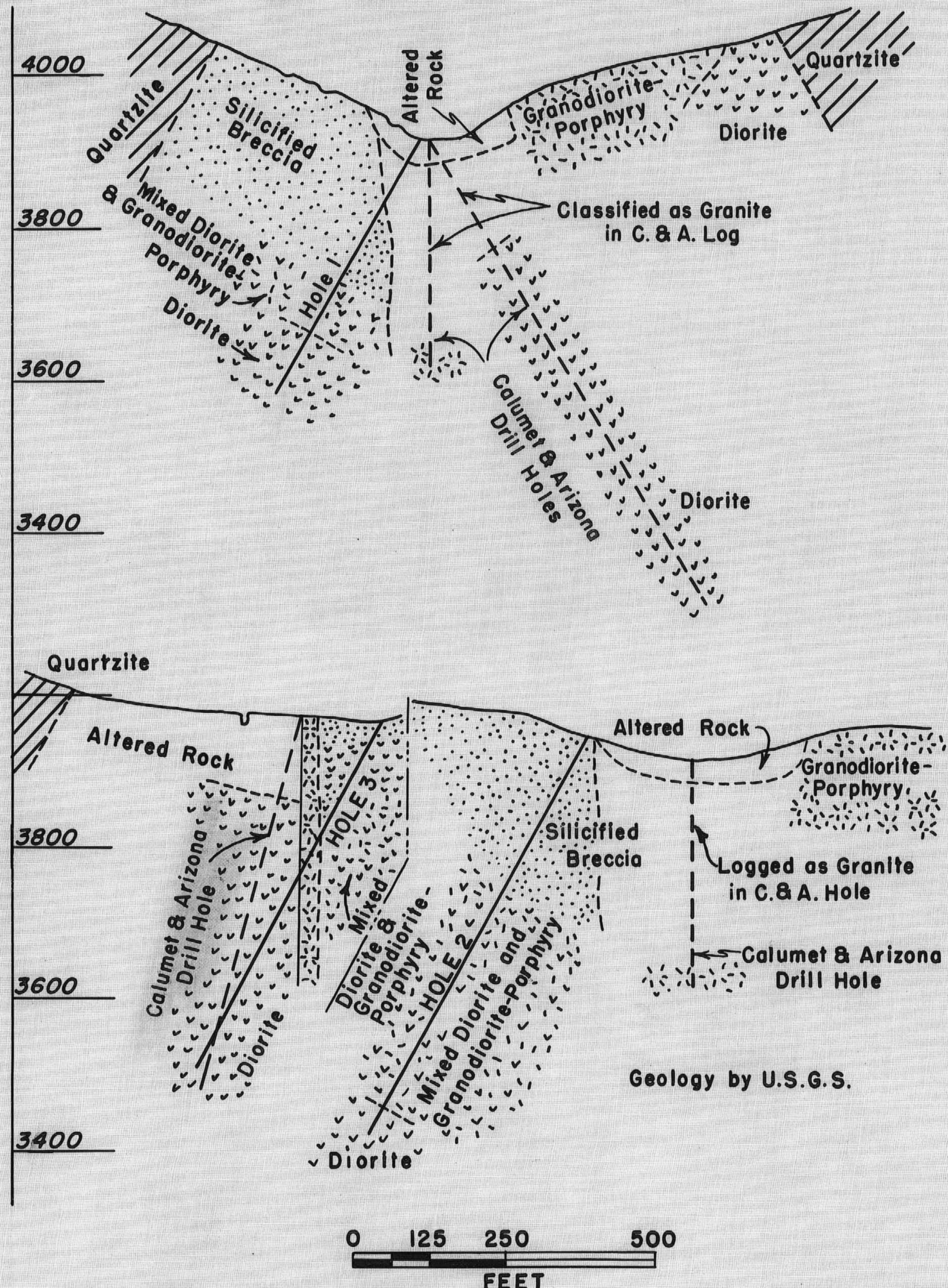
FIG. 3 - SECTION A-A', NEW YEARS EVE MINE

100' 0 100' 200'

Fig. 2



QUARTZITE
EAST BOUNDARY
50
85
N
CA 2
50
85
WATER
74° 500'
PDH 3
-45° 400'
DIKE
COARSE QUARTZ
PDH 4
-45° 300'
PDH 6
-90° 400'
PDH 5
-60° 400'
CAPAROS CANYON
CA 1
-60° 402'
2 SAMPLES
PDH 1
-45° 400'
CA 4
-60° 714'
CA3
90° 300'
PDH 2
-45° 400'
QUARTZITE
1500 FEET
TO JUNCTION OF CAPAROS
WITH ESPERANZA WASH.
LEGEND
Canyon Bottom
CA = Calumet & Arizona Diamond Drill Hole
PDH = Proposed Diamond Drill Hole
ESPERANZA DEVELOPMENT
Traced from Private Map
0'
100'
200'



JUNE, 1944

FIG. 3-CROSS SECTIONS THROUGH D.D. HOLES, AMARGOSA PROJ. 1709, PIMA CO., ARIZONA

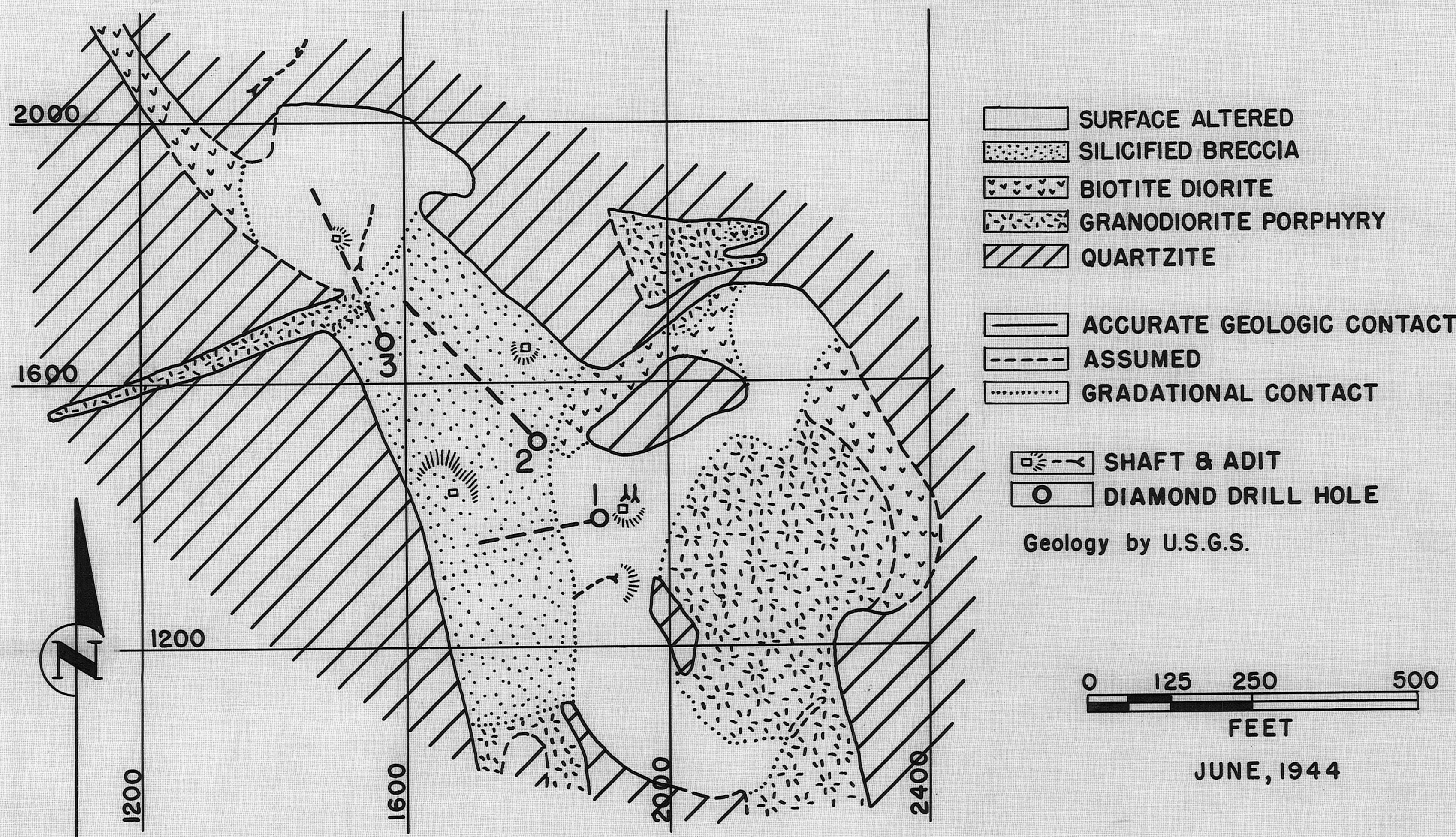


FIG. 2 - GEOLOGIC PLAN OF ESPERANZA DEPOSIT, AMARGOSA PROJ. 1709, PIMA CO., ARIZONA

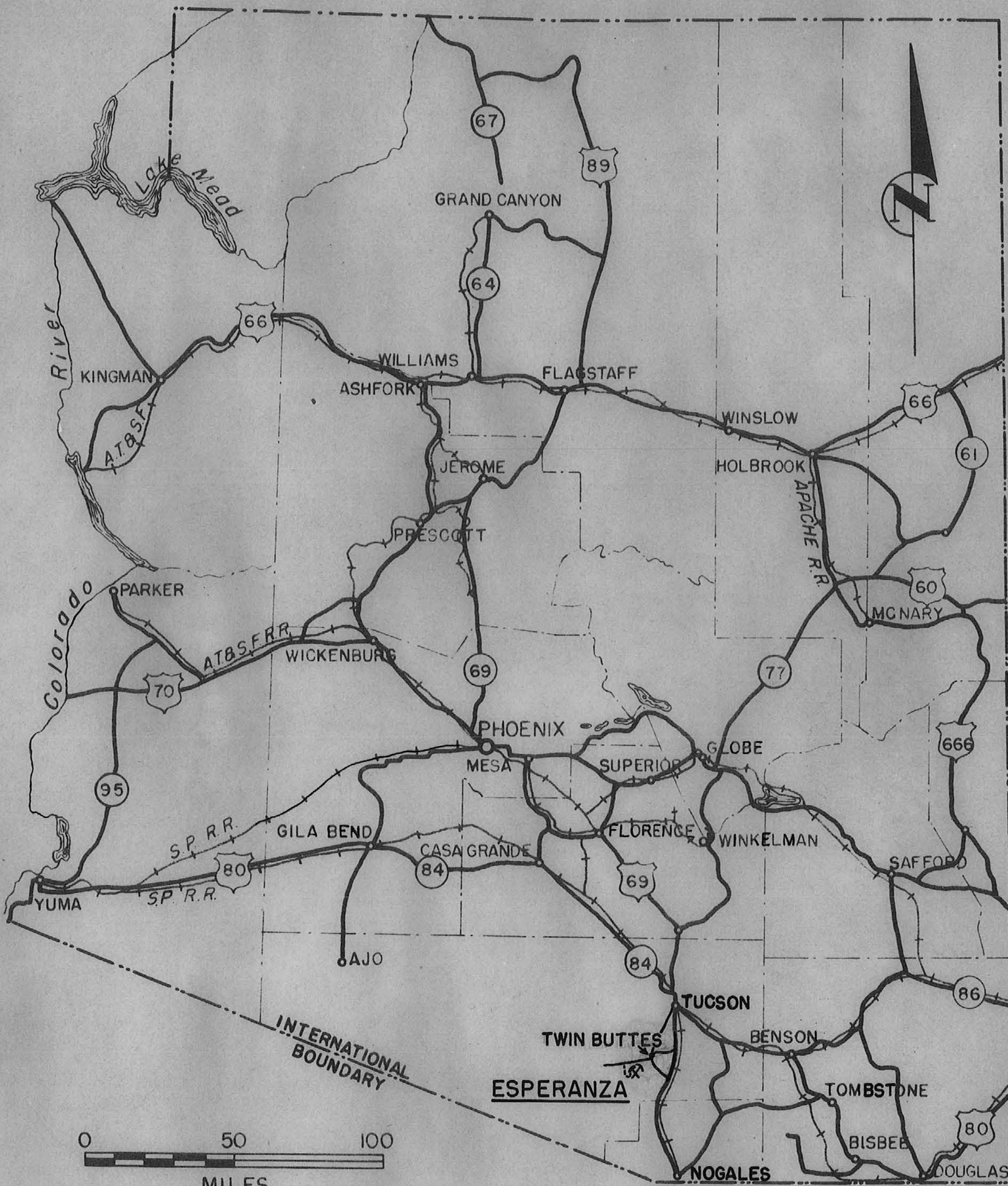
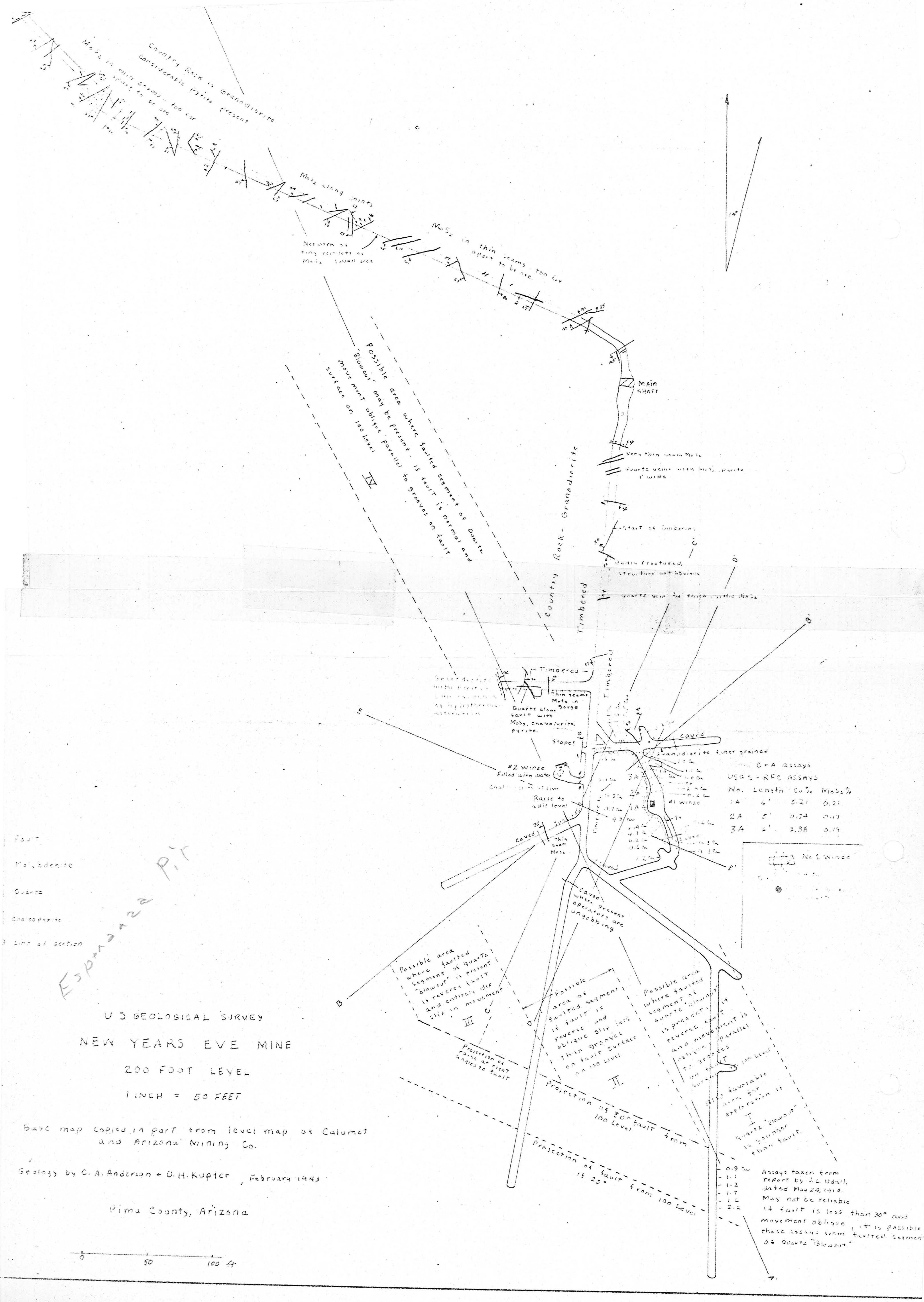
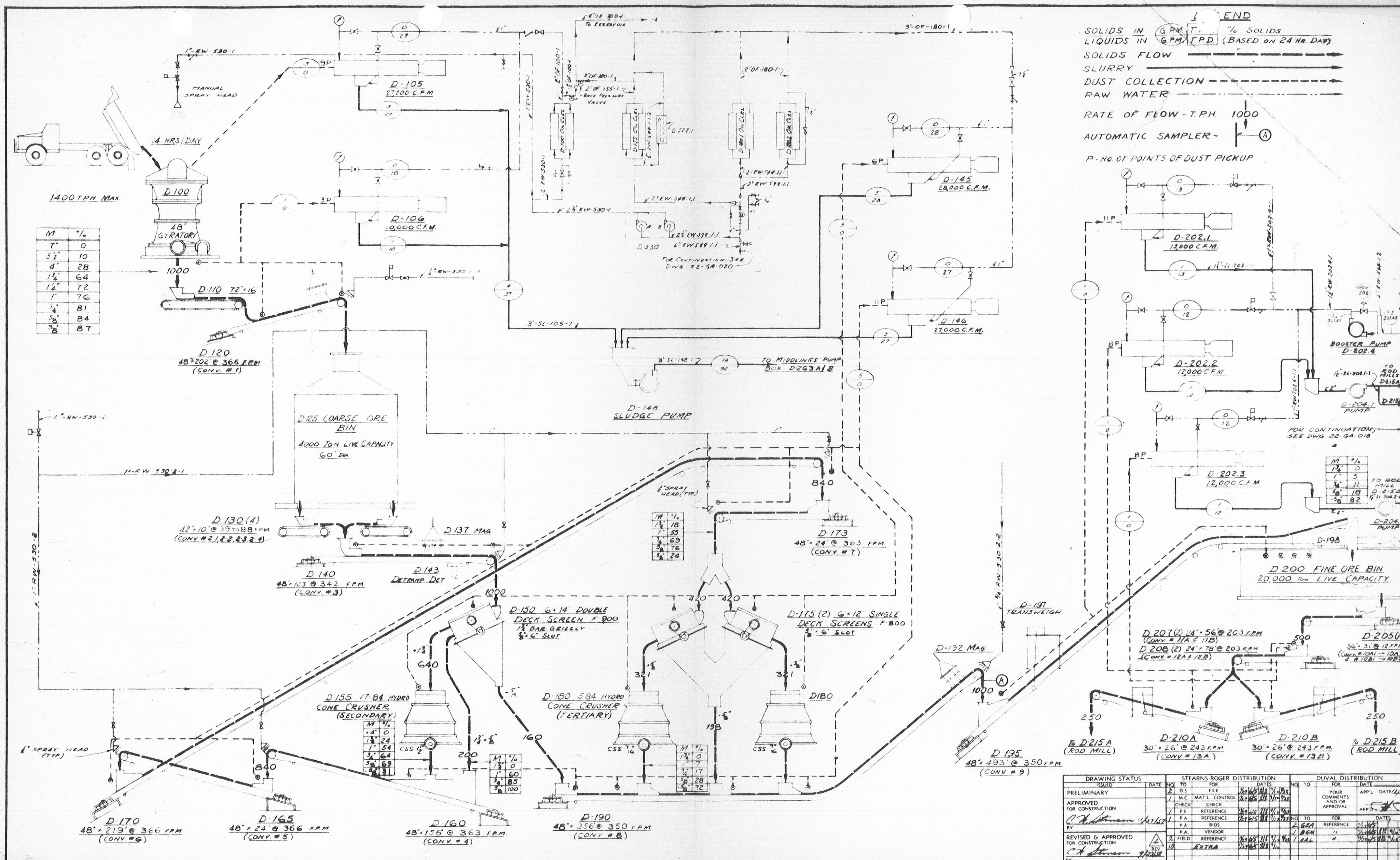


FIG. 1-GENERAL LOCATION MAP, ESPERANZA DEPOSIT, AMARGOSA PROJECT 1709, PIMA CO., ARIZ.



Country Rock is Granodiorite
Considerable Pyrite present
MoS2 in thin seams too far apart to be ore
MoS2 along joints
Network of tiny veinlets of MoS2 Small area
MoS2 in thin seams too far apart to be ore
Main Shaft
Possible area where faulted segment of Quartz "Blowout" may be present. If fault is normal and movement oblique, parallel to grooves on fault surface on 100 Level
IV
Country Rock - Granodiorite
Very thin seam MoS2
Quartz veins with MoS2 pyrite 1" wide
Start of Timbering
Badly fractured, structure not obvious
Timbered
Thin seams MoS2 in gouge
Quartz along fault with MoS2, chalcopyrite, pyrite
Stope?
Caved
Granodiorite finer grained
#2 Winze Filled with water
Raise to adit level
C+A assays
USGS - RFC ASSAYS
No. Length Cu% MoS2%
1A 6' 0.21 0.21
2A 5' 0.74 0.17
3A 5' 1.38 0.19
No 1 Winze
Caved
Thin seam MoS2
Caved where present operators are ungobbing
Fault
Molybdenite
Quartz
Chalcopyrite
Line of section
Esperanza Pit
Possible area where faulted segment of quartz "blowout" is present if reverse fault and entirely dip slip in movement
III
Possible area of faulted segment if fault is reverse and oblique slip less than grooves on fault surface on 100 Level
II
Possible area where faulted segment of quartz "blowout" is present if reverse fault and movement is oblique parallel to grooves on fault surface on 100 Level
Most favorable area for exploration if Quartz "blowout" is stronger than fault.
I
Projection of faults at right angles to fault
Projection of 300 fault from 100 Level
Projection of fault from 100 Level if 25°
Assays taken from report by J.C. Udall dated May 24, 1914. May not be reliable
If fault is less than 30° and movement oblique, it is possible these assays from faulted segment of Quartz "Blowout."
U S GEOLOGICAL SURVEY
NEW YEARS EVE MINE
200 FOOT LEVEL
1 INCH = 50 FEET
Base map copied in part from level map of Calumet and Arizona Mining Co.
Geology by C. A. Anderson & D. H. Kupfer, February 1943
Pima County, Arizona
0 50 100 ft



P.O. NO.	FABRICATOR:
MATERIAL SUPPLIED:	
P.O. NO.	FABRICATOR:
MATERIAL SUPPLIED:	
P.O. NO.	FABRICATOR:
MATERIAL SUPPLIED:	
P.O. NO.	FABRICATOR:
MATERIAL SUPPLIED:	

REFERENCE DRAWINGS

NO.	TITLE
22-GA-018	CONCENTRATOR SECT - FLOW DIAGRAM
22-GA-019	REAGENT SYSTEMS DO
22-GA-020	PLANT WATER SUPPLY DO
22-GA-021	MOLY CIRCUIT SH. #1 DO
22-GA-022	MOLY CIRCUIT SH #2 DO

REFERENCE DRAWINGS

NO.	TITLE

NO.	REVISIONS	BY	DATE	CHKD	DATE
1	WATER TO DUST COLLECTORS	LAKE	4/4/58	J.W.S.	4/11/58
2	REVISED ACCT. NOS. 189, 190, 191 to 192, 195, 197	J.W.S.	6/10/58	SCH	6/58
3	REVISED & IDENTIFIED RW LINES	JSA	7/16/58	J.W.S.	9/10/58
4	REVISED CONVEYOR LENGTHS & SPEEDS	VON	9/22/58	J.W.S.	9/23/58

DRAWING STATUS

ISSUED	DATE
PRELIMINARY	
APPROVED FOR CONSTRUCTION BY C. H. Stinson	11/27/57
REVISED & APPROVED FOR CONSTRUCTION BY C. H. Stinson	9/23/58 REV 4

STEARNS-ROGER DISTRIBUTION

NO.	TO	FOR	DATES
2	D.S.	FILE	11/29 6/5 8/8 9/12 9/23
1	M.C.	MAT'L CONTROL	11/29 6/5 8/8 9/12 9/23
	CHECK	CHECK	
1	P.E.	REFERENCE	11/29 6/5 8/8 9/12 9/23
1	P.A.	REFERENCE	11/29 6/5 8/8 9/12 9/23
	P.A.	BIDS	
	P.A.	VENDOR	
2	FIELD	REFERENCE	11/29 6/5 8/8 9/12 9/23
10		EXTRA	11/29 6/5 8/8 9/12

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		YOUR COMMENTS AND/OR APPROVAL	APP'L DATE 12/18/57 APP'D
2	GEA	REFERENCE	11/29 6/5
1	BGM	"	11/29 6/5 8/8 9/12 9/23
1	HAL	"	11/29 6/5 8/8 9/12 9/23

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THE STEARNS-ROGER MFG. COMPANY
ENGINEERS

ORDER NO. B 13400
M.L. ITEMS

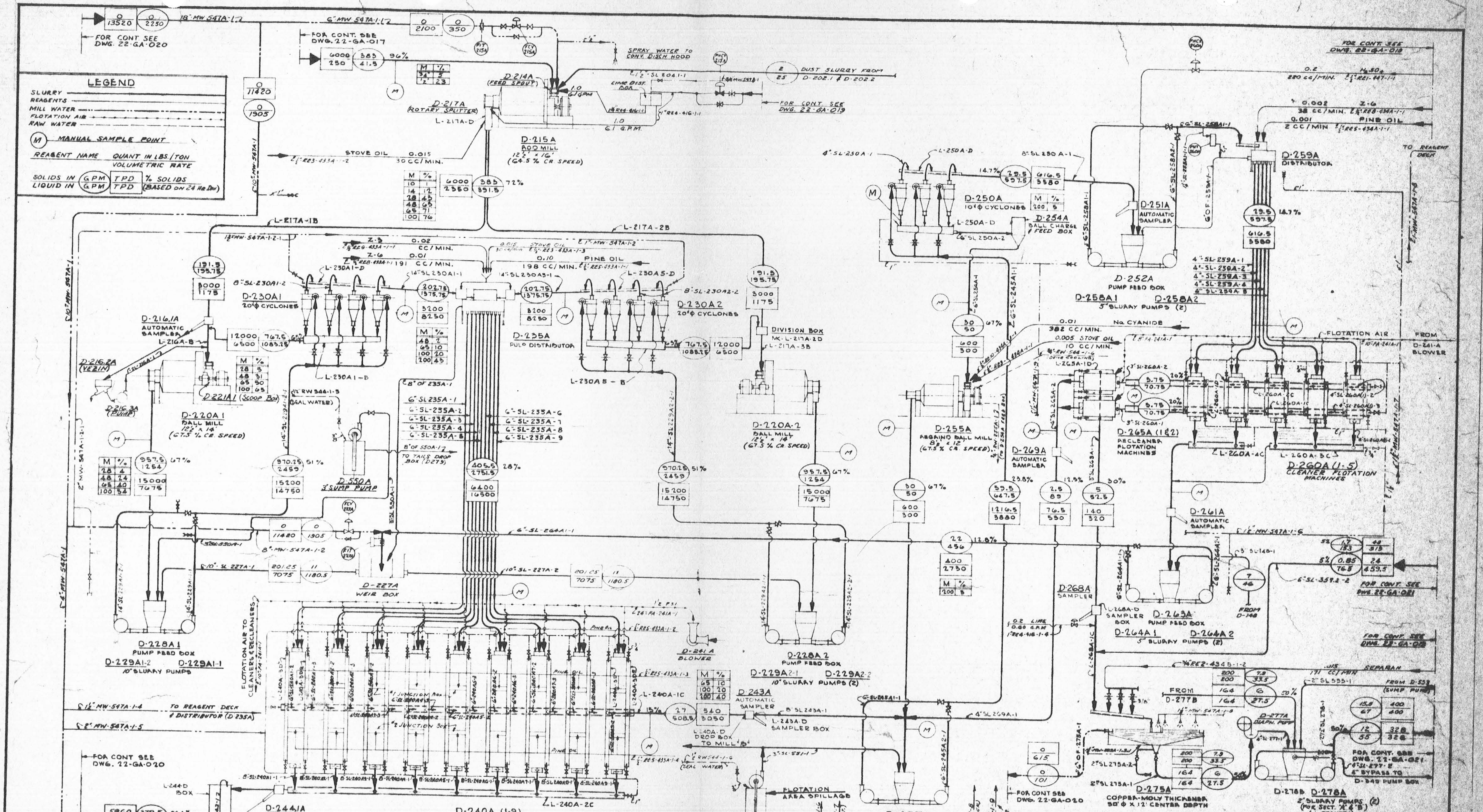
DRAWN SCHMIDT 7/24/57
CHECKED 10/20/57

DUVAL SULPHUR AND POTASH COMPANY
COPPER DIVISION Fig. I TUCSON, ARIZONA

ESPERANZA CONCENTRATOR
CRUSHING & FINE ORE SECTION
PROCESS FLOW DIAGRAM

SCALE: NONE
S.R. DWG. NO. 22-GA-017 REV. 4
DUVAL DWG. NO.

500-2-57 #123 WHITEX



NOTE: SECT.'A' & 'B' ARE SIMILAR
EXCEPT AS NOTED

P.O. NO.	FABRICATOR:
MATERIAL SUPPLIED:	
P.O. NO.	FABRICATOR:
MATERIAL SUPPLIED:	
P.O. NO.	FABRICATOR
MATERIAL SUPPLIED:	
P.O. NO:	FABRICATOR

REFERENCE DRAWINGS

NO.	TITLE	
22-GA-017	CRUSHING & FINE ORE SECT.-FLOW DIAGRAM	
22-GA-019	REAGENT SYSTEMS	DO
22-GA-020	PLANT WATER SUPPLY	DO
22-GA-021	MOLY CIRCUIT SH#1	DO
22-GA-022	MOLY CIRCUIT SH#2	DO

REVISIONS

NO.	REVISIONS	BY	DATE	CHKD	DATE
1	GENERAL REVISIONS				
2	GENERAL REVISIONS				
3	GENERAL REVISIONS				
4	ADDED LINE NO'S; PNT 260A; 8" SL 250A-1 to 6"				
5	REVISED LINE 3" SL-550A-1 & RE4-416-1-1				

DRAWING STATUS

ISSUED	DATE
PRELIMINARY	
APPROVED FOR CONSTRUCTION BY C. A. Stimson	
REVISED & APPROVED FOR CONSTRUCTION BY C. A. Stimson	10/22/58

REV. 5

STEARNS-ROGER DISTRIBUTION

NO	TO	FOR	DATES
2	D.S.	FILE	
1	M.C.	MAT'L. CONTROL	
CHECK		CHECK	
1	P.E.	REFERENCE	
1	P.A.	REFERENCE	
	P.A.	BIDS	
	P.A.	VENDOR	
9	FIELD	REFERENCE	

DUVAL DISTRIBUTION

NO	TO	FOR	DATE
		YOUR COMMENTS AND/OR APPROVAL	APP'L. DATE
2		REFERENCE	
1		"	
1		"	

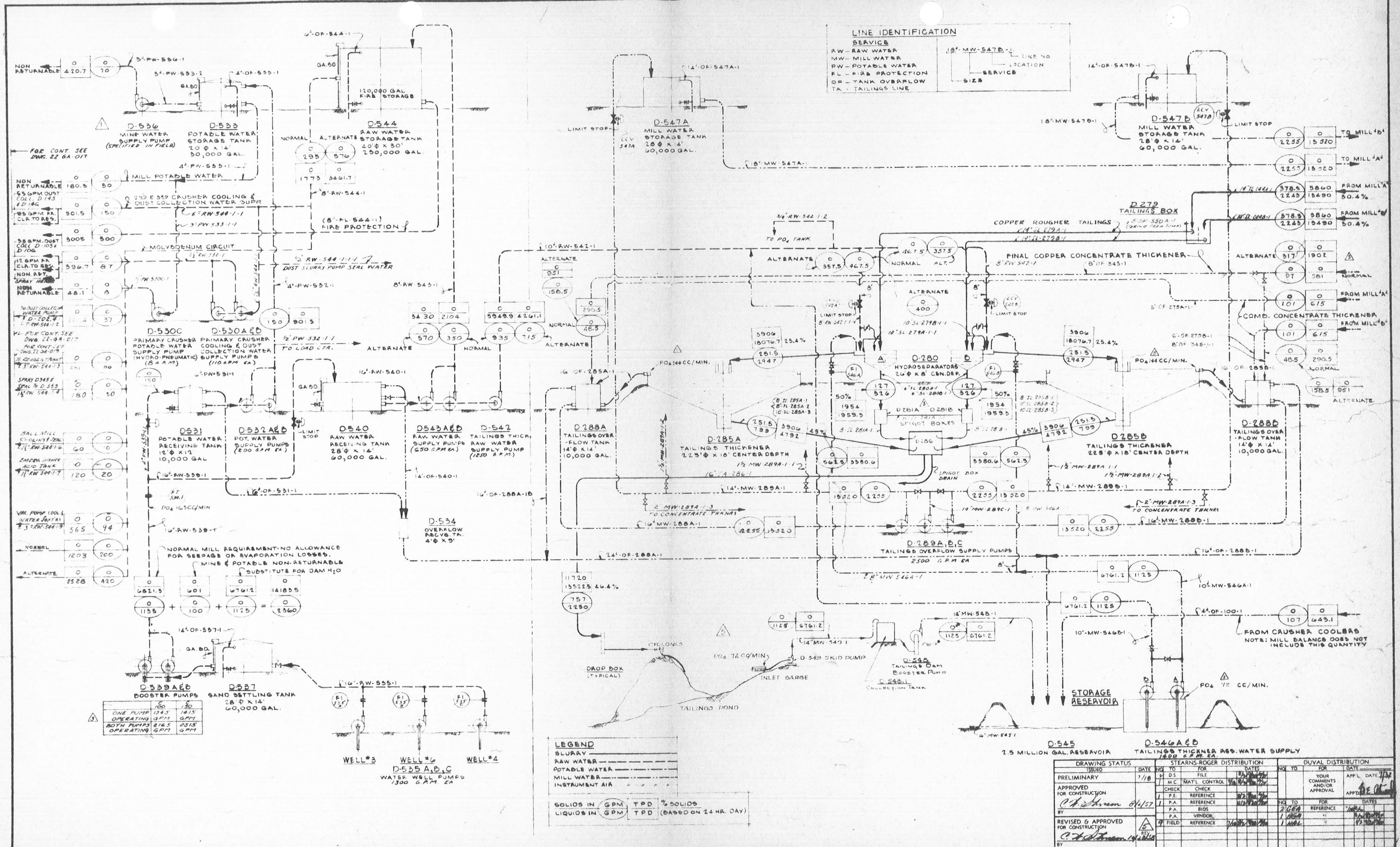
NOT APPROVED FOR CONSTRUCTION UNLESS SIGNED AND DATED. DESTROY ALL PRINTS BEARING EARLIER DATE AND/OR REVISION

THE STEARNS-ROGER MFG. COMPANY
ENGINEERS

ORDER NO. D13400
M.L. ITEMS

DUVAL SULPHUR AND POTASH COMPANY
COPPER DIVISION Fig II TUCSON, ARIZONA

ESPERANZA CONCENTRATOR
CONCENTRATOR SECTION "A"
PROCESS FLOW DIAGRAM



P.O. NO.	FABRICATOR:
MATERIAL SUPPLIED:	
P.O. NO.	FABRICATOR:
MATERIAL SUPPLIED:	
P.O. NO.	FABRICATOR:
MATERIAL SUPPLIED:	
P.O. NO.	FABRICATOR:
MATERIAL SUPPLIED:	

REFERENCE DRAWINGS

NO.	TITLE
22-GA-017	CRUSHING & FINE ORE SECT. FLOW DIAGRAM
22-GA-018	CONCENTRATOR SECT. DO
22-GA-019	REAGENT SYSTEMS DO
22-GA-021	MOLY CIRCUIT SH#1 DO
22-GA-022	MOLY CIRCUIT SH#2 DO

NO.	REVISIONS
1	ADDED D-530A,B,&C. DELETED D-536B.
2	GENERAL REVISION
3	ADDED D281A &B. REVISED FLOW QUANTITIES FROM CU THICKENER
4	ADDED WATER TO SPRAY HEADS (TAILS BOX D-279 - ADDED FLOW TABLE FOR D-539 PUMPS - REMOVED PO4 @ SAND TANK REVISED MOLY CIRCUIT RW
5	ADDED, DELETED & IDENTIFIED MISC. BRANCH LINES
6	CHGD. RECL WATER ARRGT AT TAILS. POND.
7	Revised PO4 Quantities, Chgd. Tailings Pond Arrg't

DRAWING STATUS: PRELIMINARY; APPROVED FOR CONSTRUCTION; REVISED & APPROVED FOR CONSTRUCTION

NOT APPROVED FOR CONSTRUCTION UNLESS SIGNED AND DATED. DESTROY ALL PRINTS BEARING EARLIER DATE AND/OR REVISION

THE STEARNS-ROGER MFG. COMPANY ENGINEERS

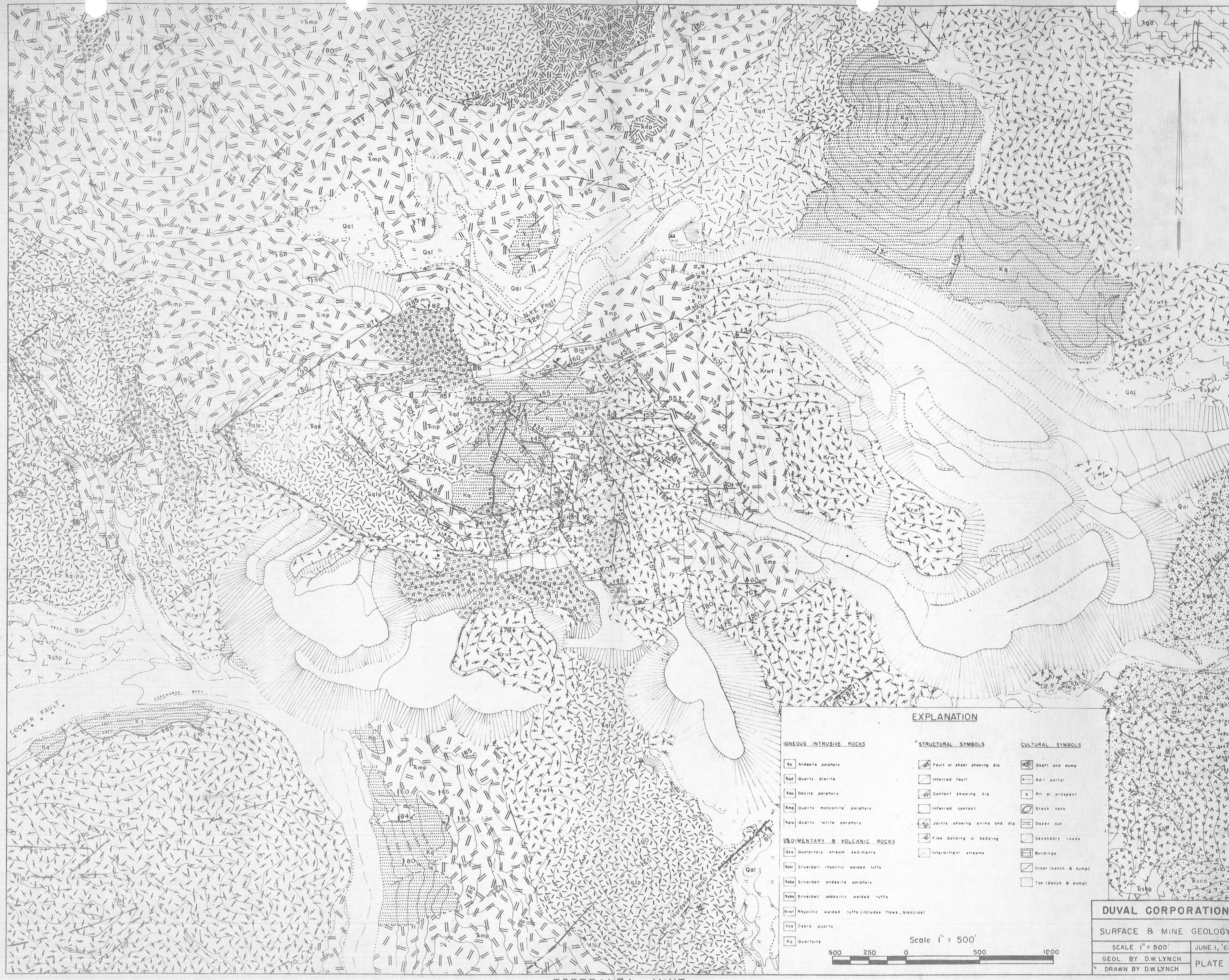
ORDER NO. 813400

DRAWN HUMPHREY 6/28/57 — CHECKED 7/11/57 — SCALE NONE

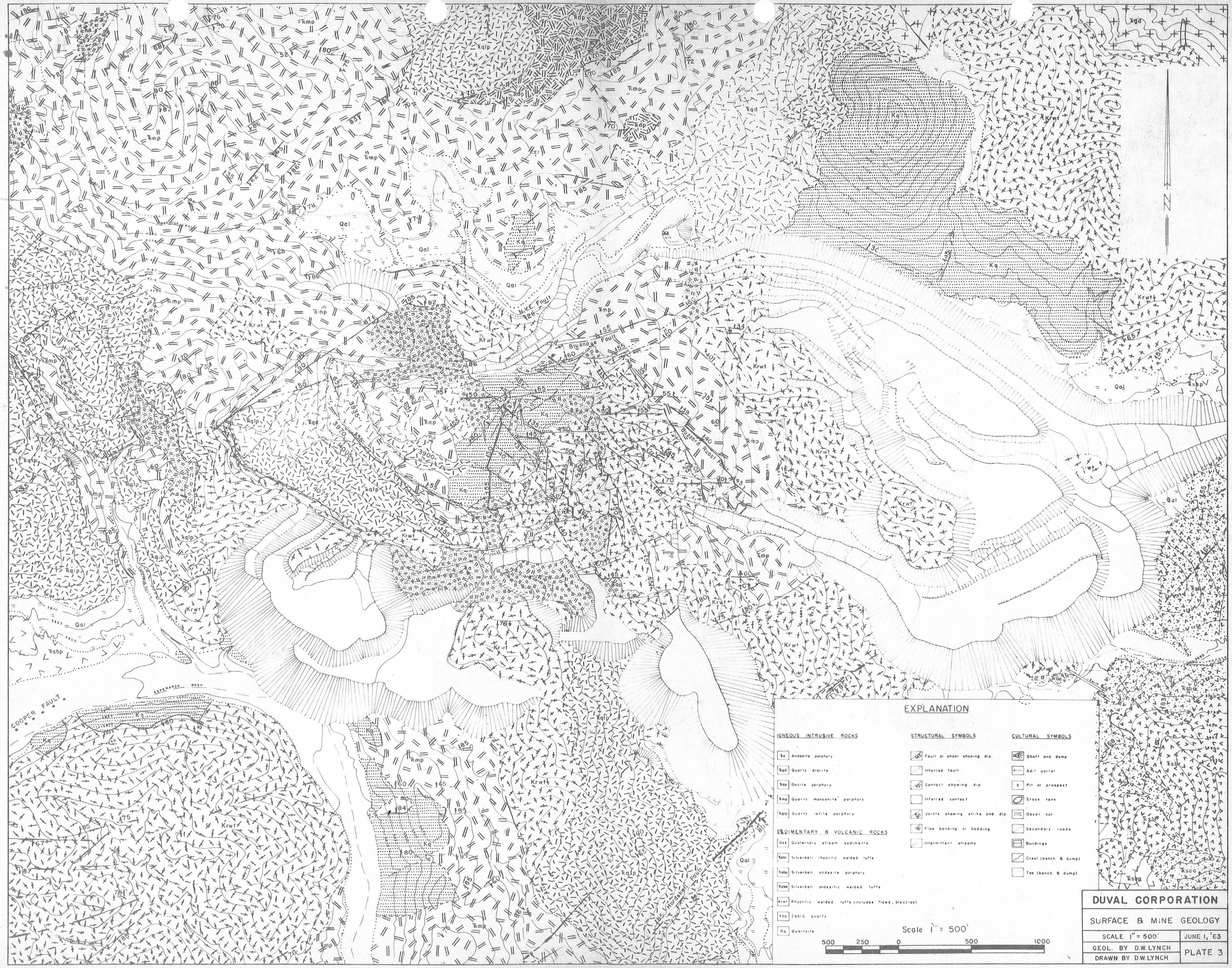
DUVAL SULPHUR AND POTASH COMPANY — COPPER DIVISION — Fig. III — TUCSON, ARIZONA

ESPERANZA CONCENTRATOR PLANT WATER SUPPLY & RECLAMATION SYSTEMS —FLOW DIAGRAM—

22-GA-020

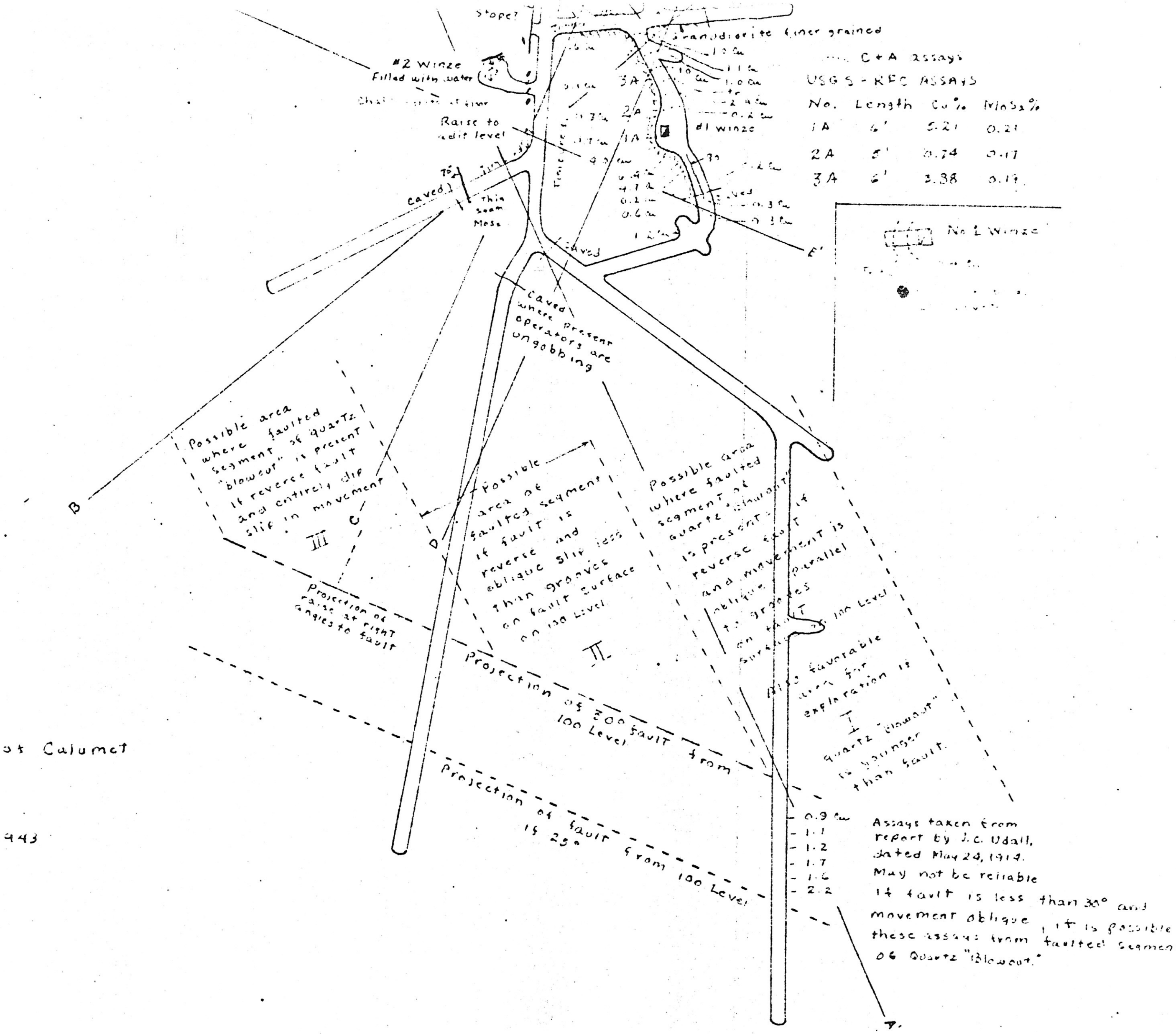


ESPERANZA MINE



ESPERANZA MINE

Esperanza Pit



U S GEOLOGICAL SURVEY

NEW YEARS EVE MINE

200 FOOT LEVEL

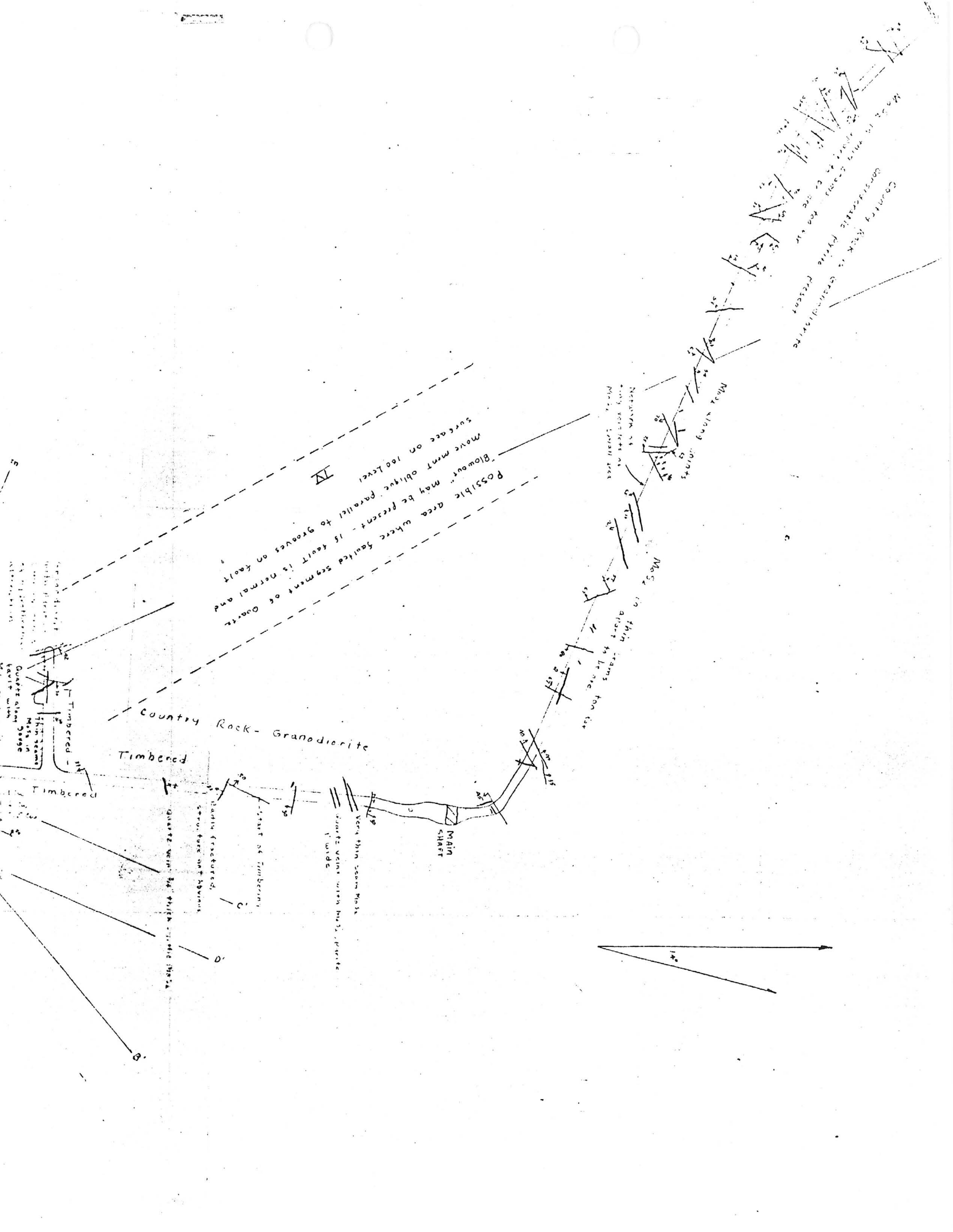
1 INCH = 50 FEET

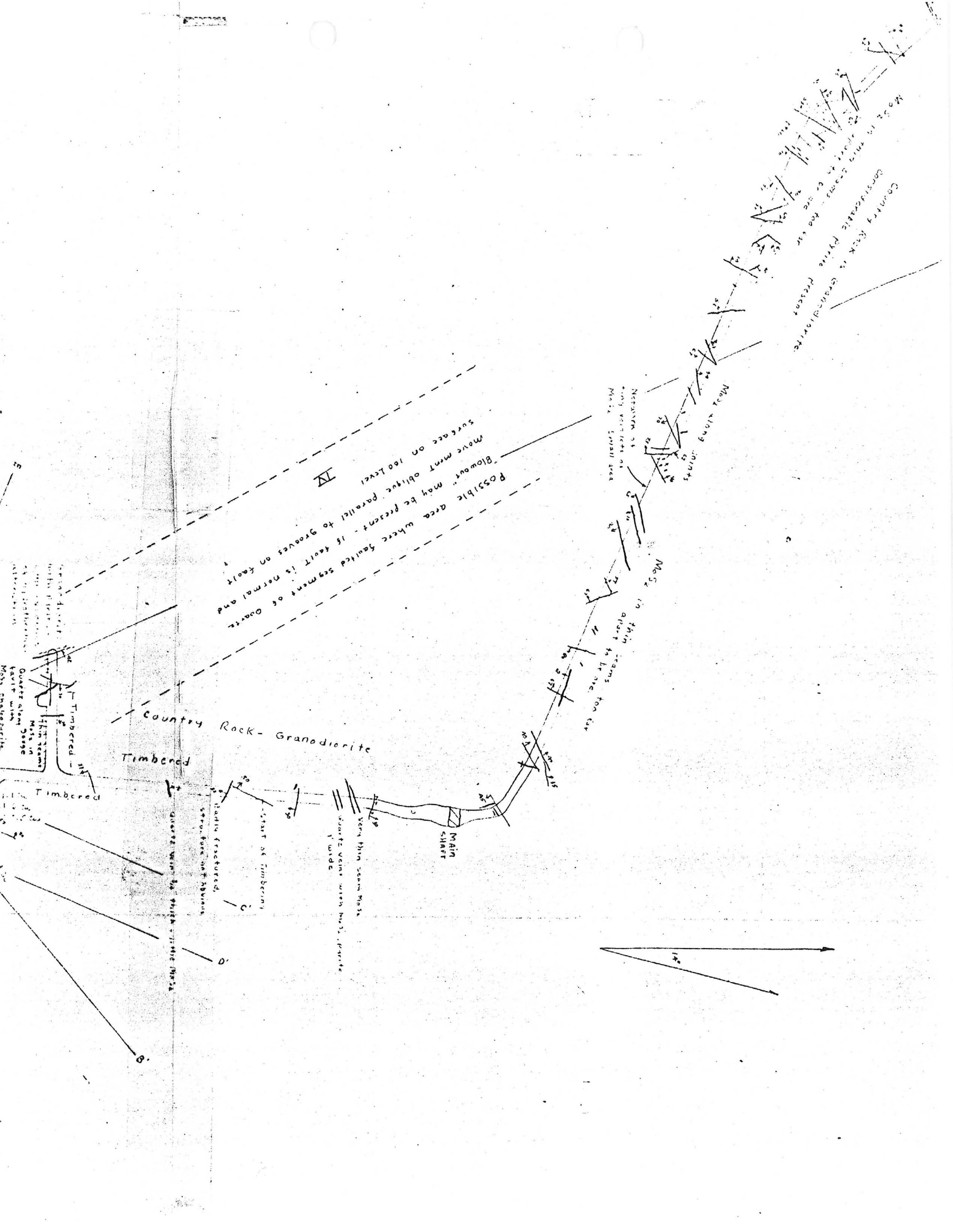
Base map copied in part from level map of Calumet and Arizona Mining Co.

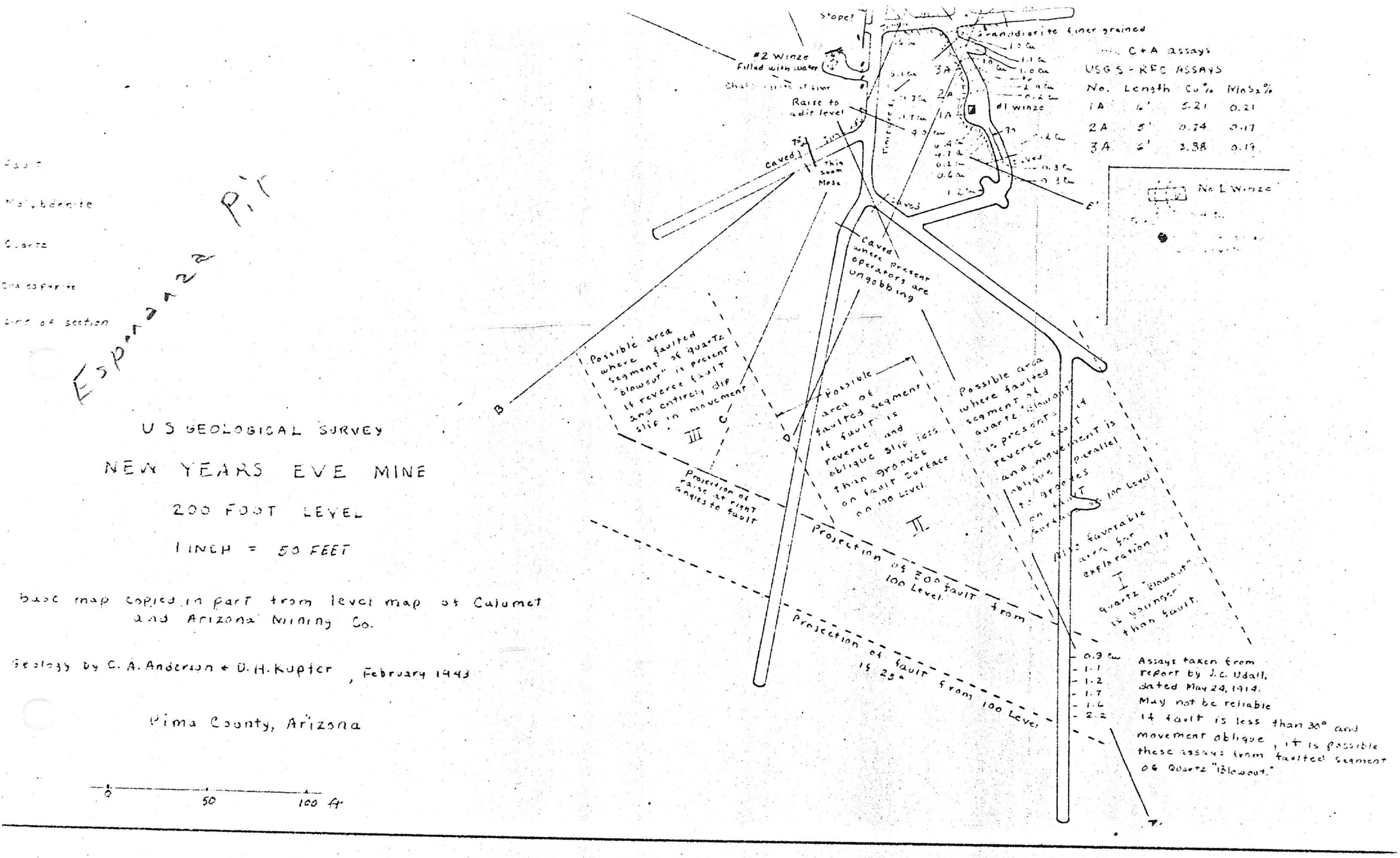
Geology by C. A. Anderson + D. H. Kupfer, February 1943

Pima County, Arizona

0 50 100 ft


IV
Possible area where faulted segment of Quartz
"Blowout" may be present - if fault is normal and
movement oblique parallel to grooves on fault
surface on 100 Level
Country Rock - Granodiorite
Timbered
Timbered
Timbered
Main Shaft
Start of Timbering
Badly fractured, structure not obvious
Very thin seam MoS2
MoS2 along joints
Country Rock is Granodiorite
Considerable pyrite present
C'
D'
B'


Country Rock - Granodiorite
Timbered
Timbered -
Timbered
Main Shaft
IV
Possible area where faulted segment of Quartz "Blowout" may be present - If fault is normal and movement oblique, parallel to grooves on fault surface on 100 Level
Start of timbering
Badly fractured, structure not obvious
Very thin seam Moly
Quartz veins with Moly, pyrite 1" wide
Moly in thin seams too far apart to be ore
Moly along joints
Network of tiny veinlets of Moly. Small area
Country Rock is Granodiorite
Considerable pyrite present
C'
D'
B'
14°



Esperanza Pit
U S GEOLOGICAL SURVEY
NEW YEARS EVE MINE
200 FOOT LEVEL
1 INCH = 50 FEET
base map copied in part from level map of Calumet and Arizona Mining Co.
Geology by C. A. Anderson + D. H. Kupfer, February 1943
Pima County, Arizona
0
50
100 ft
Fault
Molybdenite
Quartz
Line of section
C+A assays
USGS - RFC ASSAYS
No. Length Cu% MoS2%
1A 6' 5.21 0.21
2A 5' 0.74 0.17
3A 6' 3.38 0.19
No. 1 Winze
#2 Winze Filled with water
Stope?
Granodiorite finer grained
Raise to adit level
Caved
Thin seam Moly
#1 winze
Caved where present operators are gobbing
Possible area where faulted segment of quartz "blowout" is present if reverse fault and entirely dip slip in movement
III
Possible area of faulted segment if fault is reverse and oblique slip less than grooves on fault surface on 100 Level
II
Possible area where faulted segment of quartz "blowout" is present if reverse fault and movement is parallel oblique to grooves on fault surface on 100 Level
Also favorable area for exploration if quartz "blowout" is younger than fault.
I
Projection of raise at right angles to fault
Projection of 200 fault from 100 Level
Projection of fault from 100 Level if 25°
Assays taken from report by J. C. Udall, dated May 24, 1914. May not be reliable
If fault is less than 30° and movement oblique, it is possible these assays from faulted segment of Quartz "Blowout."
0.9 Cu
1.1
1.2
1.7
1.6
2.2
B
C
D
E'