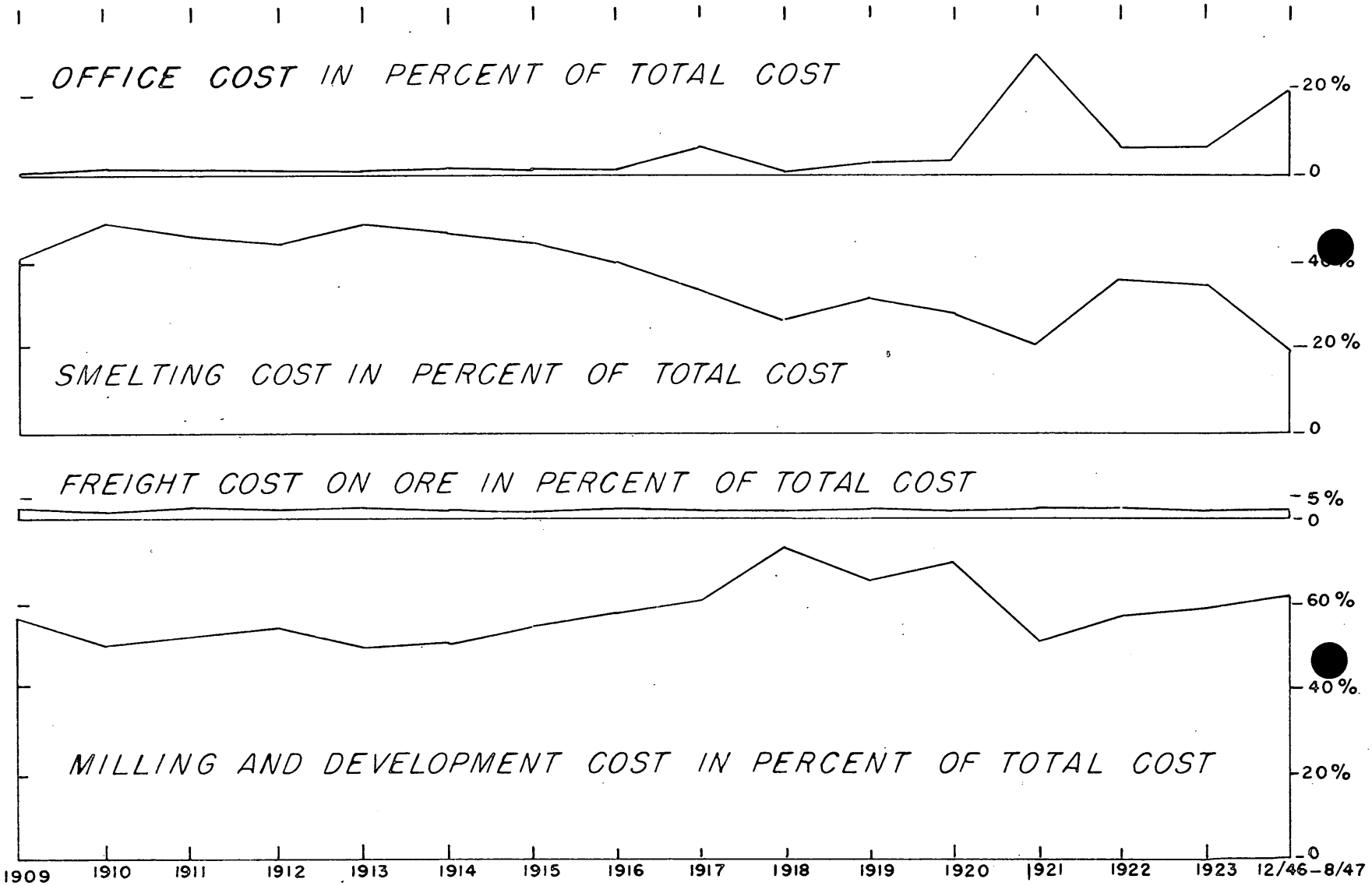


FIG 18 — SUMMARY OF COSTS IN PERCENT — 1909 — 1923 AND 12 — '46 TO 8 — '47

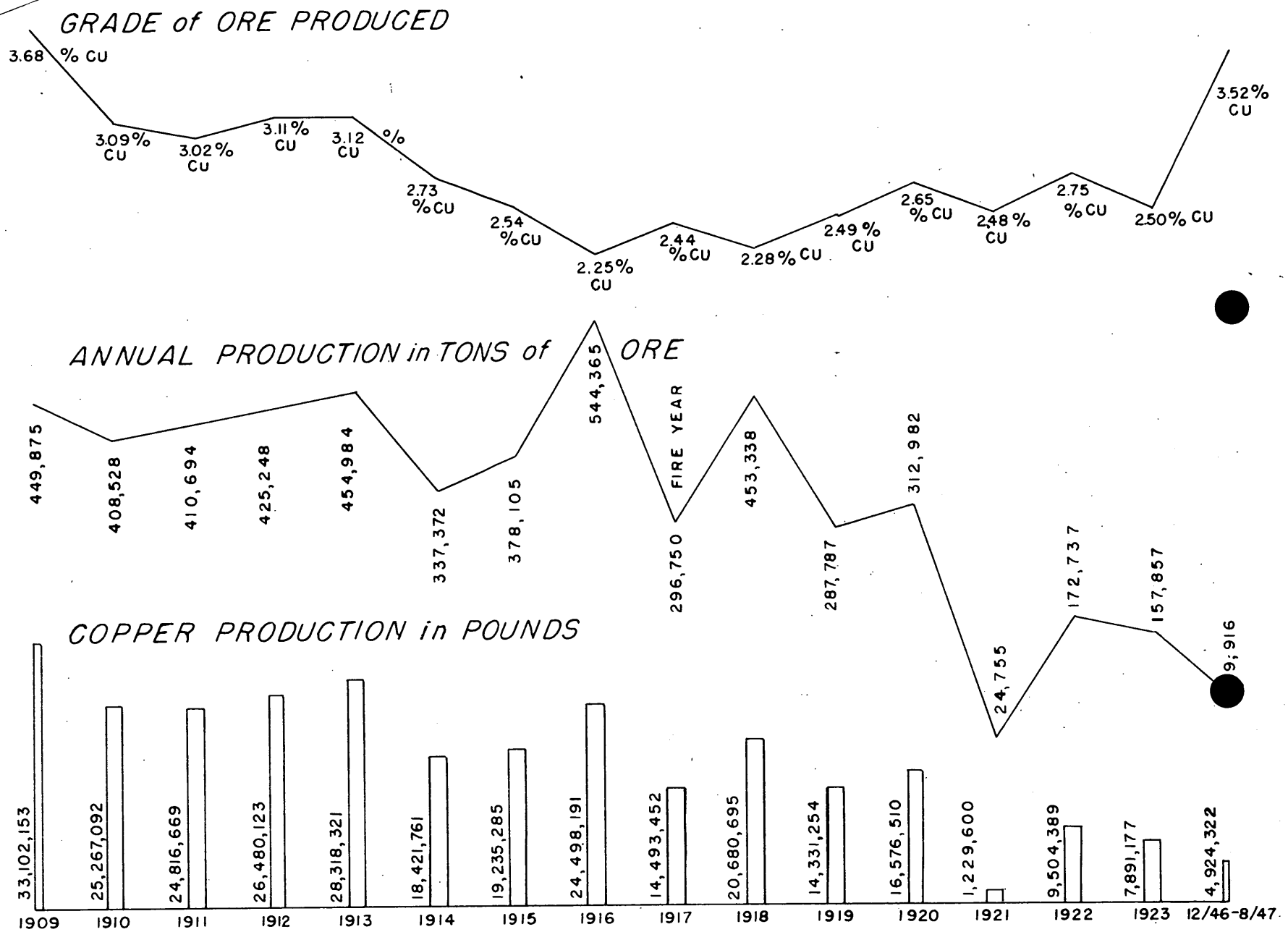


FIG. 15 – TONAGE AND GRADE OF ORE PRODUCED. 1909–1923 & 12/46–8/47

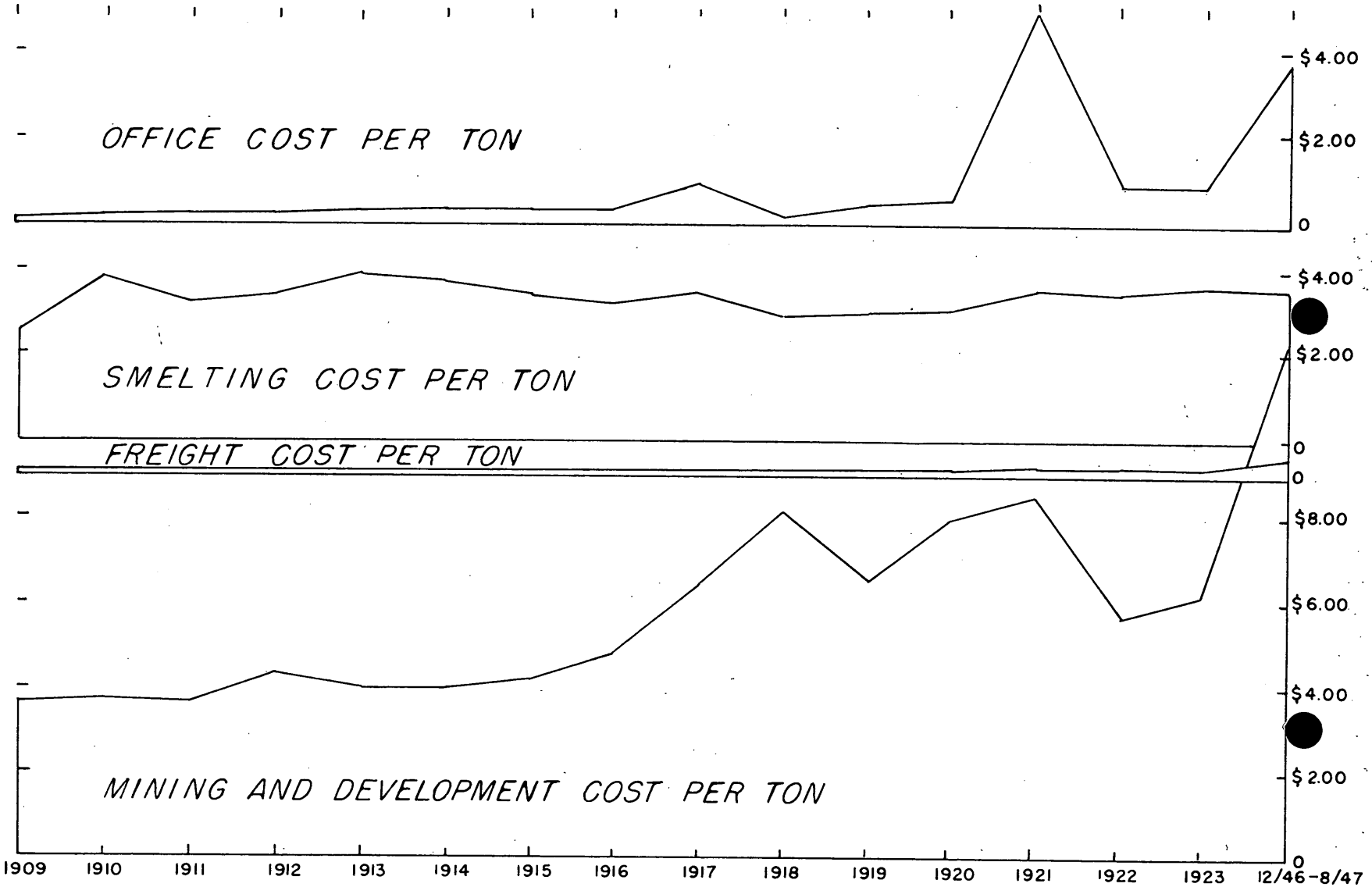


FIG: 16 — SUMMARY OF COST PER TON. 1909 TO 1923 AND 12-'46 TO 8-'47

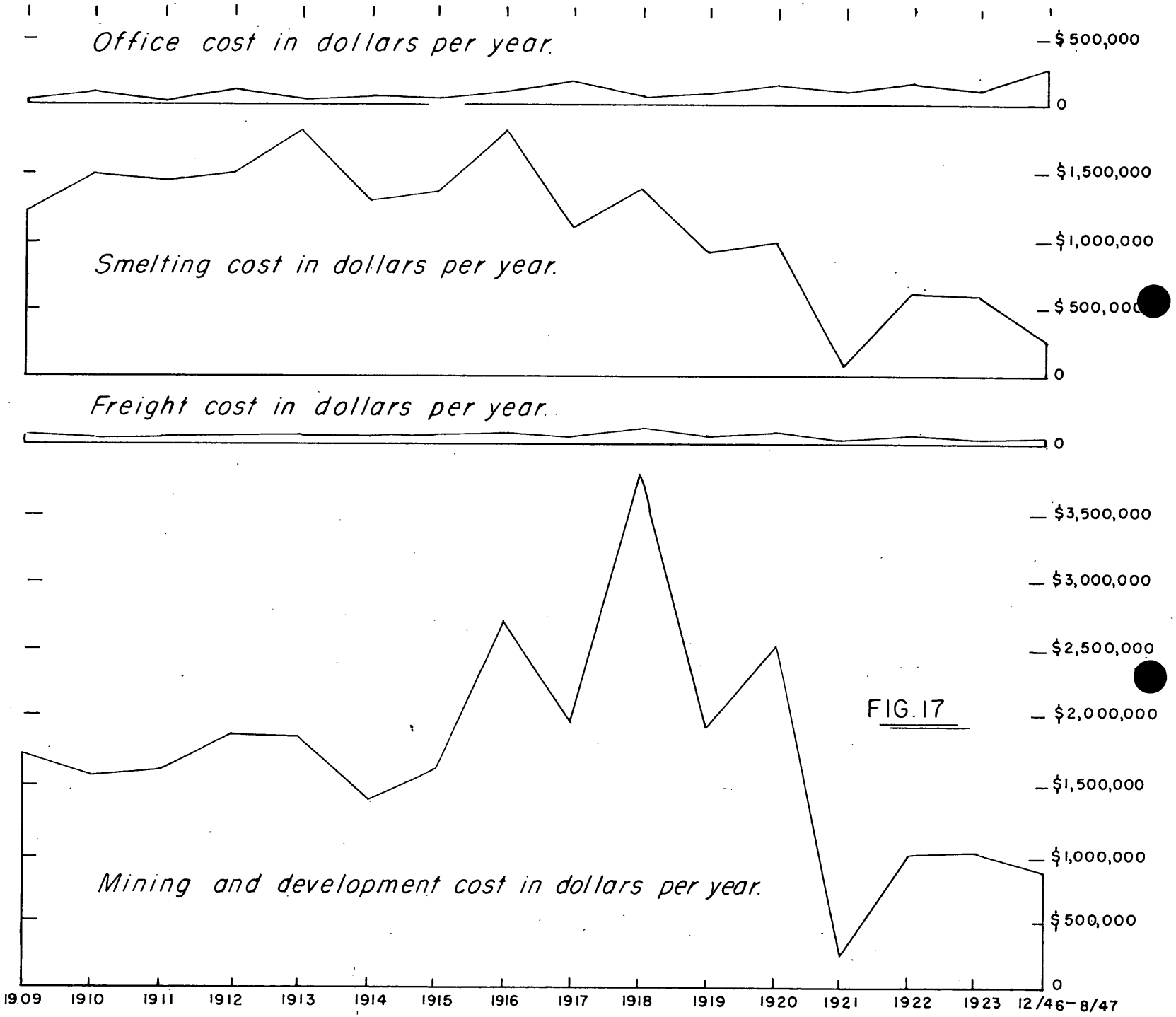

Office cost in dollars per year.
$500,000
0
Smelting cost in dollars per year.
$1,500,000
$1,000,000
$500,000
0
Freight cost in dollars per year.
0
Mining and development cost in dollars per year.
$3,500,000
$3,000,000
$2,500,000
$2,000,000
$1,500,000
$1,000,000
$500,000
0
1909
1910
1911
1912
1913
1914
1915
1916
1917
1918
1919
1920
1921
1922
1923
12/46-8/47

FIG. 17

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

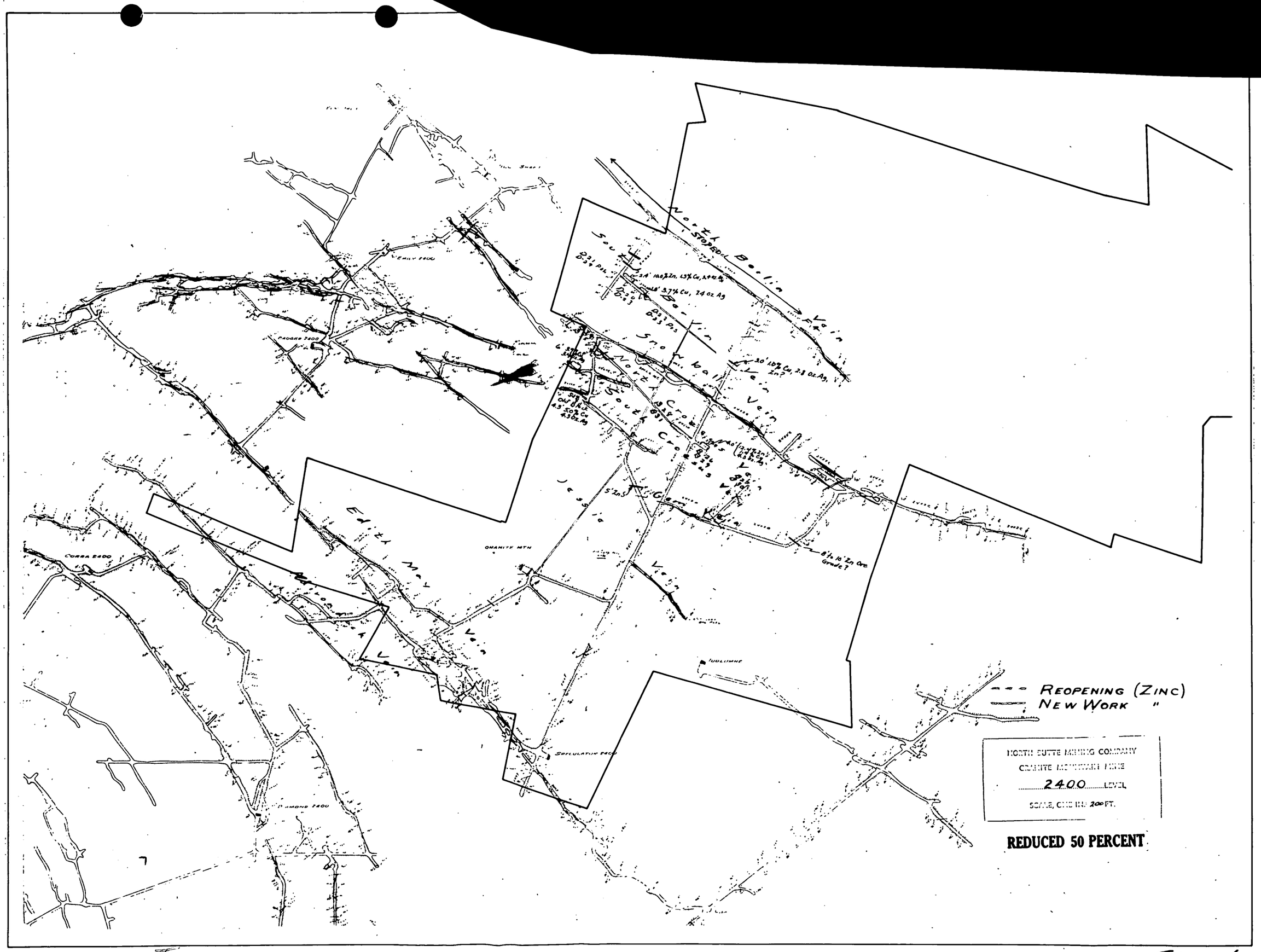


Fig 11

GEOLOGIC AND ASSAY PLAN OF 2400 LEVEL, GRANITE MOUNTAIN MINE, SILVER BOW COUNTY, MONTANA

Scale - 1 inch = 200 feet

Fig 11

Fig 11

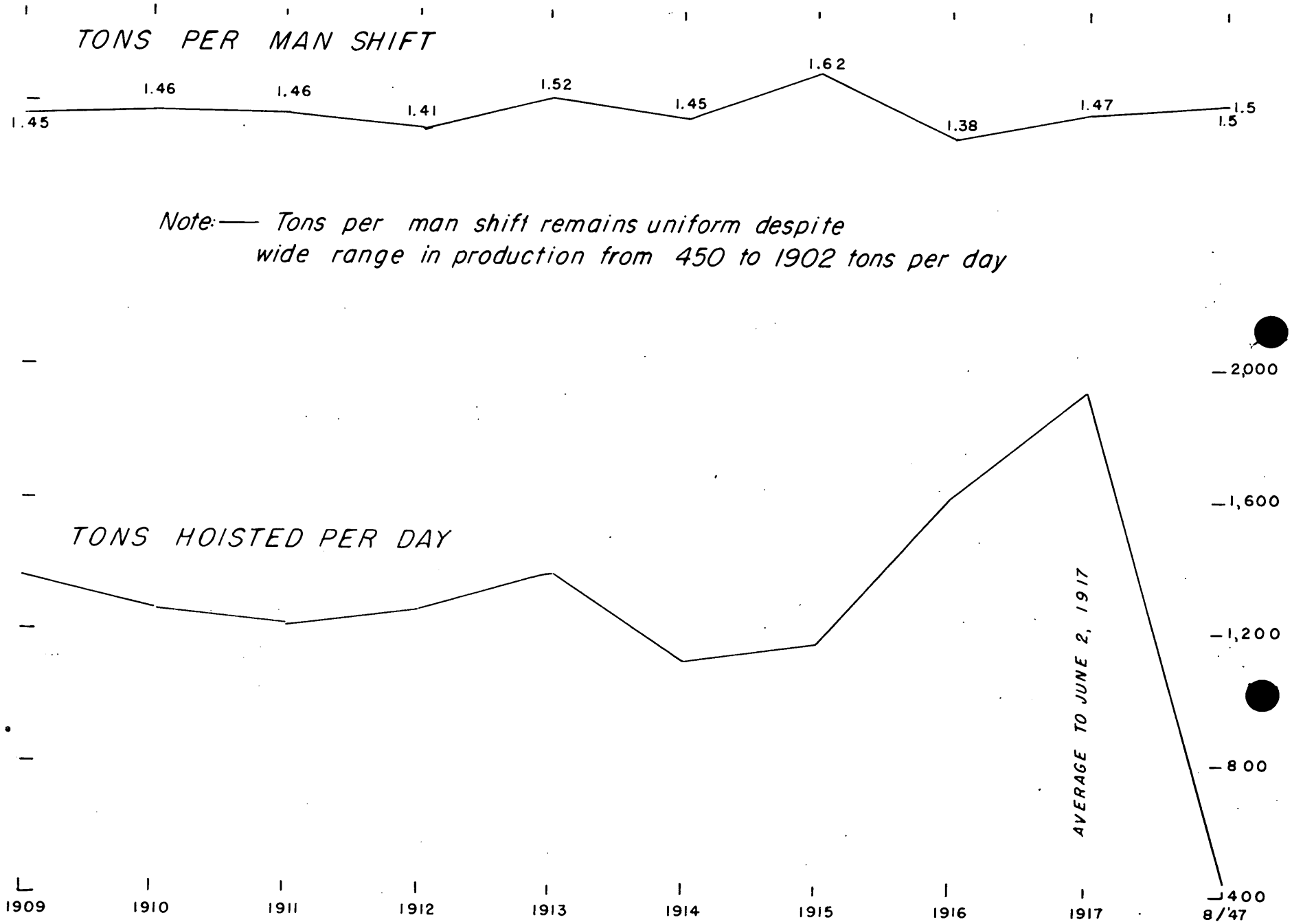


FIG. 20 - GRAPH COMPARING TONS HOISTED WITH TONS PER MAN SHIFT.

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

Fig. 12

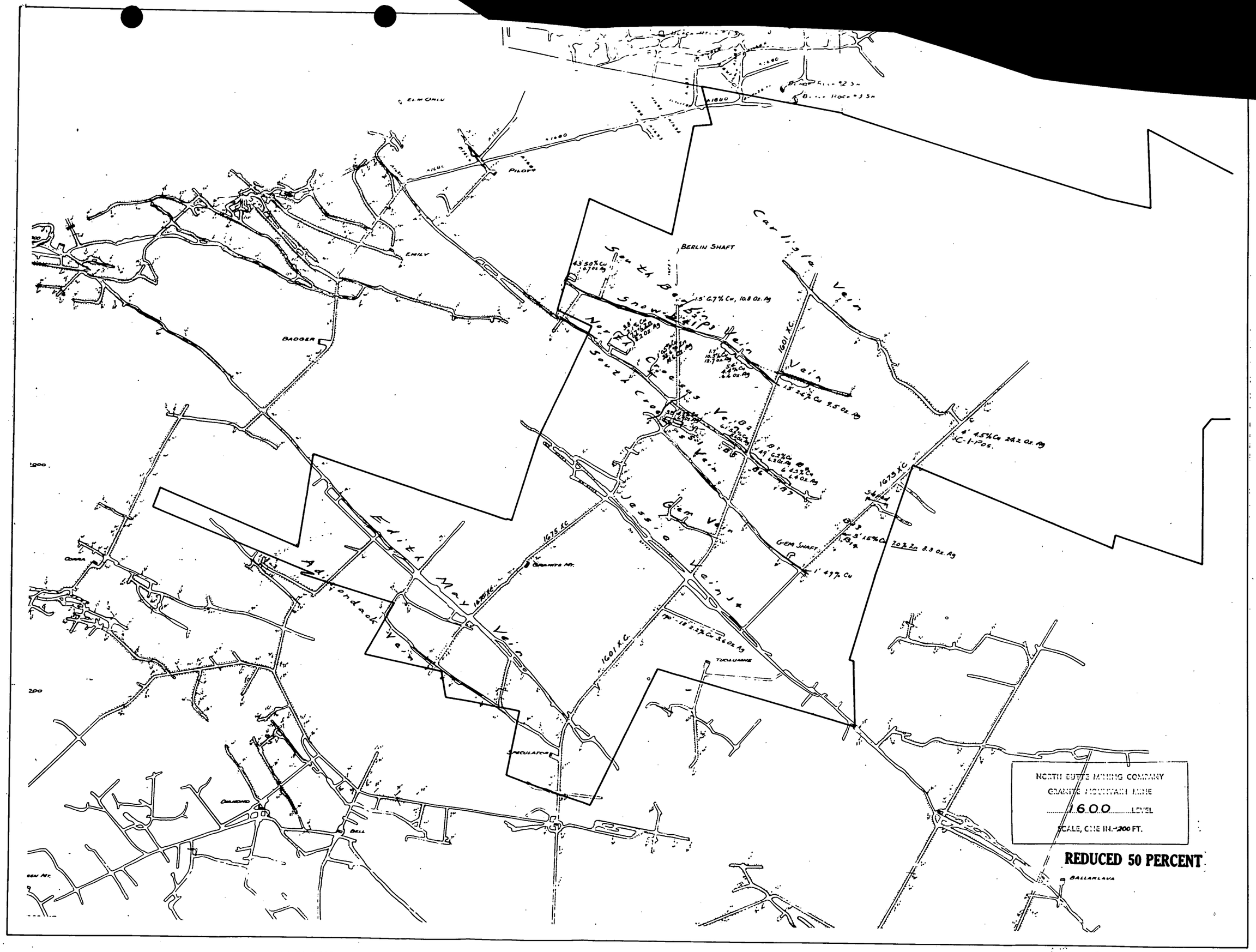
GEOLOGIC AND ASSAY PLAN OF 2800 LEVEL, GRANITE MOUNTAIN MINE, SILVER BOW COUNTY, MONTANA

Scale 1 inch = 200 feet

Fig 12

Fig 12

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY



GEOLOGIC AND ASSAY PLAN OF 1600 LEVEL, GRANITE MOUNTAIN MINE, SILVER BOW COUNTY, MONTANA

Fig 9

Scale 1 inch = 200 feet

Fig 9

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

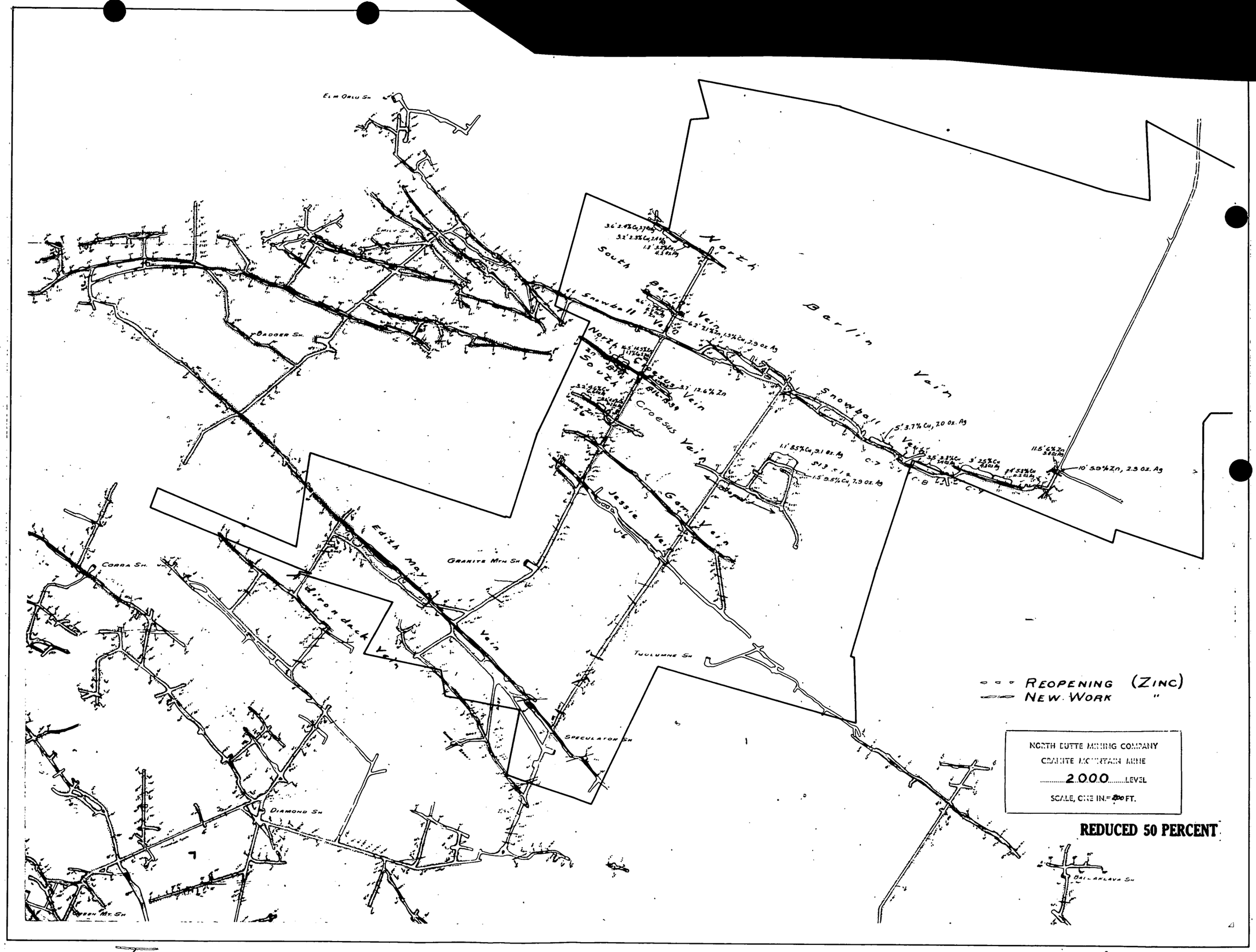


Fig 10

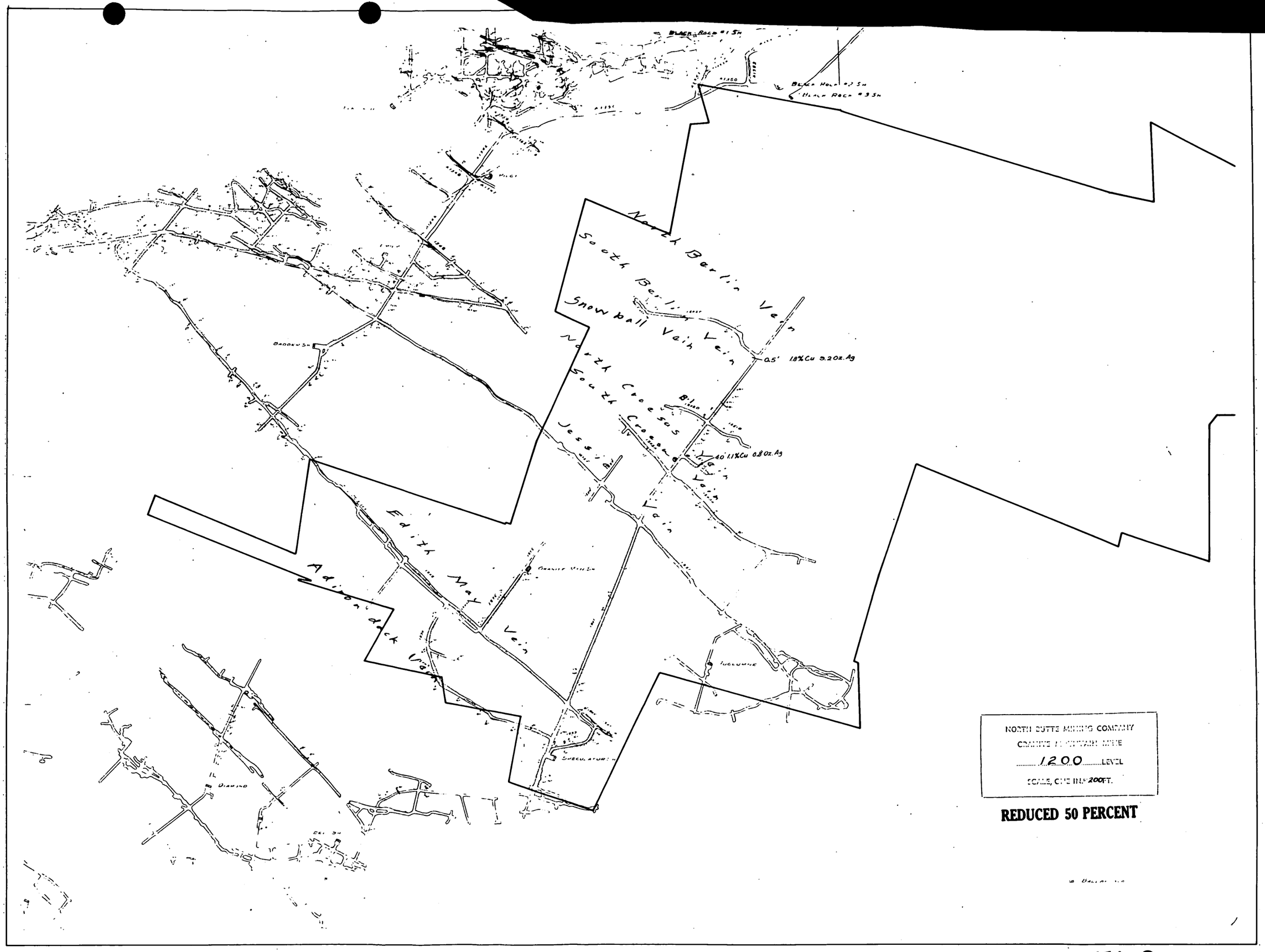
GEOLOGIC AND ASSAY PLAN OF 2000 LEVEL, GRANITE MOUNTAIN MINE, SILVER BOW COUNTY, MONTANA

Scale : 1 inch = 200 feet

Fig 10

Fig 10

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY



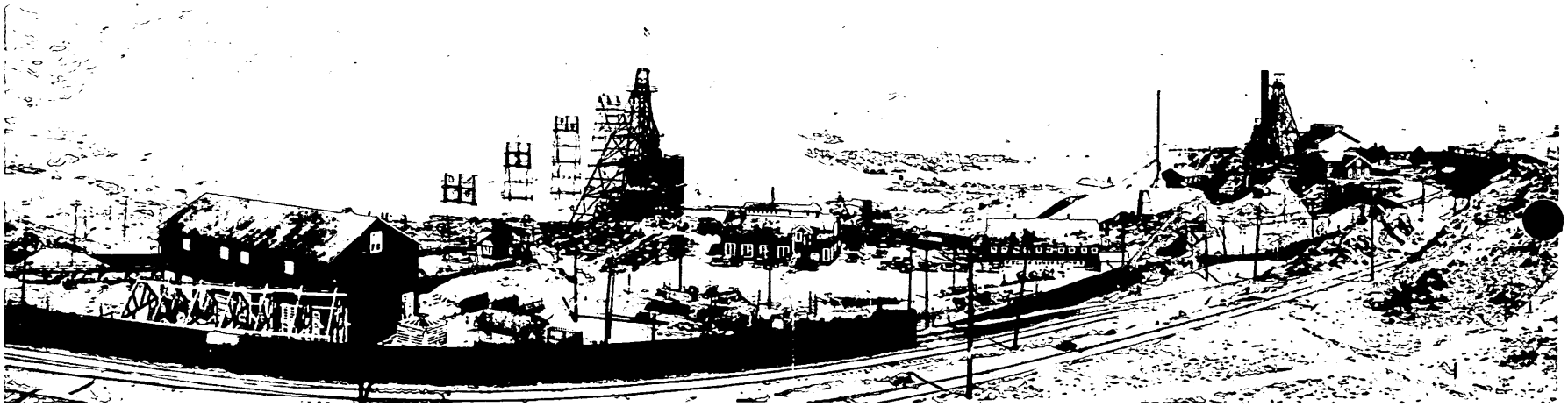
REDUCED 50 PERCENT

GEOLOGIC AND ASSAY PLAN OF 1200 LEVEL, GRANITE MOUNTAIN MINE, SILVER BOW COUNTY, MONTANA

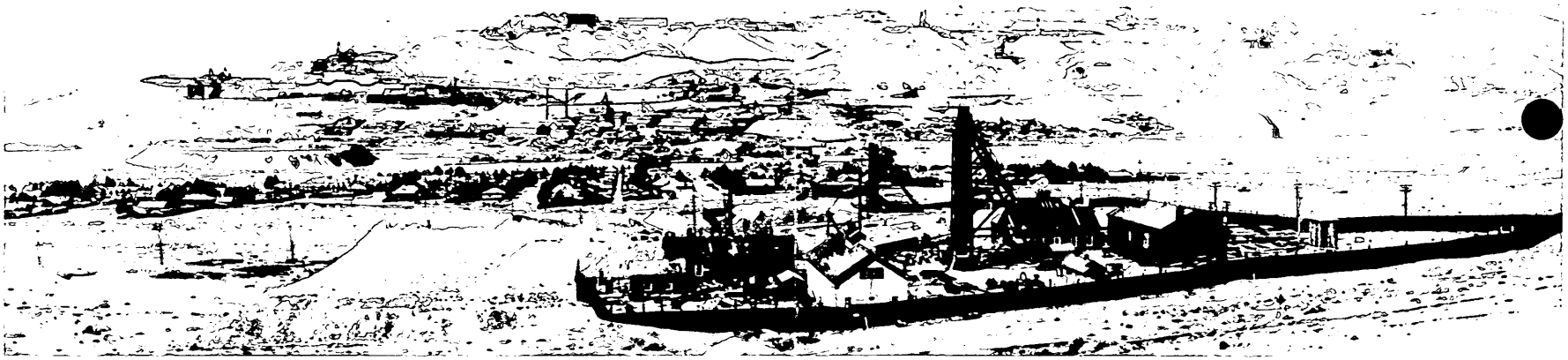
Scale 1 inch = 200 feet

Fig 8

Fig 8



GRANITE MOUNTAIN AND SPECULATOR SURFACE PLANTS OF NORTH BUTTE MINING COMPANY



MAIN RANGE SURFACE PLANT LOOKING WEST TOWARD BUTTE HILL AND GRANITE MOUNTAIN GROUP OF NORTH BUTTE MINING COMPANY

Fig. 19

UNITED STATES
DEPARTMENT OF INTERIOR
OSCAR L. CHAPMAN-SECRETARY

DEFENSE MINERALS ADMINISTRATION

Report by Examination Team
Region II

DMA-108--North Butte Mining Company's Granite Mountain Mine

Silver Bow County, Montana

R. J. Mundhausen
U. S. Bureau of Mines

With Section on Geologic Setting and Ore Reserves

by

R. W. Swanson
U. S. Geological Survey

July 5, 1951

MA-103--North Butte Mining Company's
Granite Mountain Mine

Silver Bow County, Montana

CONTENTS

	Page
Recommendations	1
Description of Proposal	1
Discussion and Summary of Proposal	2
Applicant	4
Location of Property	5
Ownership	5
History and Production	6
Description of Mine Workings	9
Geologic Setting	11
Metal Zoning	11
Grade, Reserves and Classification	13
North Crossus Vein	13
South and North Berlin Veins	15
Other Areas	15
Minable Reserves	17
General	17
Geologic Considerations	18
Historical Considerations	19
Economic Considerations	20
Mining Costs	23
General	23
Dilution	23
Recovery	24
Tons per Man Shift	24
Equipment and Facilities	24
Installed	24
To be purchased	24
To be repaired and rehabilitated	25
Shaft repairs	26
Level repairs	26
Ventilation Plans	26
Summary of Equipment and Rehabilitation Costs	28
Labor Supply	28
Power	30
Transportation	31
Adequacy of Requested Funds	31
Competence of Applicant	31
Metallurgy (Supplemental Report)	34
Discussion of Proposal and Conclusions	34

ILLUSTRATIONS

Fig.		Follows page
1 overlay.	Metal zoning at Butte	4
1.	Claim map	4
2.	Graph comparing sales price and production costs per pound of copper	5
3.	Graph compares surplus account with reserve fund for ore depletion	6
4.	Summary of Development - 1910 - 1923	9
5.	Longitudinal Section on North Crocsus Vein	10
6.	Longitudinal Section on South Berlin Vein	10
7.	Longitudinal Section on North Berlin Vein	10
8.	Geologic and assay plan of 1200 level	12
9.	Geologic and assay plan of 1600 level	12
10.	Geologic and assay plan of 2000 level	12
11.	Geologic and assay plan of 2400 level	12
12.	Geologic and assay plan of 2800 level	12
13.	Geologic and assay plan of part of 2000 foot level	13
14.	Geologic and assay plan of part of 2200 foot level	13
15.	Tonnage and grade of ore produced, 1909-1923 and 12/46 — 8/47	17
16.	Summary of cost per ton, 1909 to 1923 and 12/46 to 8/47	22
17.	Summary of costs in dollars	22
18.	Summary of costs in percent, 1909-1923 and 12/46 to 8/47	22
19.	Surface plants of North Butte Mining Co. (photograph)	23
20.	Graph comparing tons hoisted with tons per man shift	29

July 5, 1951

EXAMINATION TEAM REPORT

North Butte Mining Company's Granite Mountain Mine

DMA Docket No. 103 Silver Bow County, Mont.

R. J. Rundhaugen USBM
R. W. Swanson USGS

RECOMMENDATIONS

It is recommended that the North Butte Mining Co. be granted a loan of $968,600 to be expended as follows:

(1)	New underground mining equipment	$105,700
(2)	Surface repairs	21,100
(3)	Rehabilitation of underground workings	95,600
(4)	Mine ventilation	58,200
(5)	Mill construction (200 ton zinc-copper-lead)	465,000
(6)	Working capital	135,000
(7)	Contingencies at 10 percent	88,000
	Total	$968,600

It is further recommended that repayment, including principal, interest, and expense, be over a period of 5 years; that a zinc and copper purchase contract be negotiated for a 5-year period to insure firm metal prices; and that the loan be contingent upon the employment of a competent metallurgical staff.

DESCRIPTION OF PROPOSAL

The North Butte Mining Co. proposes to operate their Granite Mountain mine and to mill 200 tons of 12 percent zinc ore per day 360 days

per year to produce concentrates from which can be recovered an estimated 15,500,000 pounds of metallic zinc annually. Annual production of by-product copper will amount to 1,300,000 pounds. Present ore reserves are estimated by the company to be 201,000 tons averaging 12.6 percent zinc and 1.5 percent copper.

The proposal requests a loan of $697,900. This money will be spent for (1) new mining equipment; (2) surface repairs; (3) rehabilitation of mine workings; (4) improving mine ventilation; and (5) mill construction. Working capital is also required. The company proposal estimates the money will be expended as follows:

(1)	New mining equipment	$105,000
(2)	Surface repairs	19,000
(3)	Rehabilitation	80,000
(4)	Mine ventilation	50,000
(5)	Mill construction	250,000
(6)	Working capital	135,000
(7)	Contingencies	53,900
	Total	$697,900

DISCUSSION AND SUMMARY OF PROPOSAL

A discussion and cost breakdown of each phase of the Company's proposal is given in this report. In some cases, particularly mill construction, it has been necessary to greatly increase the original Company cost estimates. In general, however, the Company estimates of operating costs are accurate; estimates of ore reserves and plans for production also are realistic. A comparison of capital costs as revised by Bureau of Mines engineers and as estimated by the Company follows:

		Bureau estimate	Company estimate
(1)	New underground mining equipment	$105,700	$105,000
(2)	Surface repairs	21,100	19,000
(3)	Rehabilitation	95,600	80,000
(4)	Mine ventilation	58,200	50,000
(5)	Mill construction	465,000	250,000
(6)	Working capital	135,000	135,000
(7)	Contingencies at 10 percent	88,000	58,900
	Total	$968,600	$697,900

The Company estimated amortization at the rate of $1.80 per ton against a yearly production of 72,000 tons for 5 years. This report estimates amortization at $2.69 per ton on the same basis.

A comparative summary of estimated operating costs per ton follows:

	Company estimate	Bureau estimate
Total direct mining, including development	$14.89	$15.55
Transportation to mill	0.50	0.25
Milling	2.75	2.75
Administrative	1.00	1.00
Direct mining and milling total per ton	$19.14	$19.55
Amortization of requested loan	1.80	2.69
Total cost per ton	$20.94	$22.24

A comparative summary of expenditure and income estimates follows:

	Company estimate	Bureau estimate	
	Zn to Butte	Zn to Butte	Zn to Kellogg
Estimated income per ton of ore (depending on disposition of zinc concentrate)	$25.92	$25.94	$22.48
Estimated cost of mining, development, milling, administration, and amortization	20.94	22.24	22.24
Estimated profit per ton	$ 4.98	$ 3.70	$ 0.24

At a production rate of 200 tons per day, or 72,000 tons annually, the company should receive an estimated net operating profit per year, before taxes, of either $266,400 or $17,280, depending on the disposition of the zinc concentrates. In 5 years the company should earn $1,332,000 if the zinc concentrates are sold in Butte. During this same period the company will have repaid the DMA loan of $936,000.

APPLICANT

The North Butte Mining Co., 101 West Granite Street, Butte, Mont., is a Minnesota corporation organized April 5, 1905. The officers, directors, general manager, and chief engineer are listed on page 1 of the appendix. The company is authorized to issue 2,000,000 shares of stock at $2.50 par value; 1,365,222 shares now are outstanding.[1] The 700 stockholders own an average of 200 shares each.[2] The stock is listed on the Boston Stock Exchange; on May 19, 1951, it was quoted at $0.90 a share bid.

1/ For stock authorization history, see appendix, p. 2.

2/ For list of important stockholders, see appendix, p. 3.

LOCATION OF PROPERTY

The North Butte Mining Co. owns an undivided interest in 134 mining claims (see fig. 1 and appendix), all in the Summit Valley mining district, Silver Bow County, Mont. Practically all of the company's production has been made from the Granite Mountain mine. This portion of the property, containing 208.19 acres of mineral land, has been developed to a depth of 3,600 feet by underground workings aggregating 50 miles in length. It is located in the heart of the Butte district, surrounded by highly productive mines owned by the Anaconda Copper Mining Co. This report is limited specifically to a discussion of the Granite Mountain mine.

OWNERSHIP

All mining claims, real and personal property owned by the North Butte Mining Co. have been mortgaged to the Reconstruction Finance Corporation to secure a note for $425,000, carrying interest at 4 percent. Payments on this note are $8,250 monthly, plus accrued interest, commencing 15 months from the date of note, December 6, 1950. The balance is payable on or before 65 months from that date.

According to the balance sheet of December 31, 1950, the adjusted book value for all property, plants, building, machinery, and equipment owned by the company is $5,037,750.55.

The liquidated personal property valuation exclusive of real property is estimated by RFC to be $1,823,160.

A copy of the agreement describing the real and personal property under mortgage is given in the appendix.

A clause in the mortgage agreement extends the RFC first mortgage to all interests of the North Butte Mining Co. now held or hereafter acquired on mining claims and mining machinery, equipment, and buildings, as long as the mortgage is in force. For that reason any DMA funds made available to the company would be subject to that agreement unless clearance can be obtained from the RFC.

The RFC loan is to be used to construct, equip, and bring into operation a leaching system for treating old mine dumps and stope fills. This program now is in progress. It is anticipated that the operation will be producing cement copper at an estimated rate of 400,000 pounds per month by December 1951.

The estimated profit from the leaching operations is shown in the appendix. These data indicate that the leaching operations will net a small annual profit, but not enough, however, to put the mine in condition to produce ore.

HISTORY AND PRODUCTION

During the period April 1905 to August 1947 the Granite Mountain mine is credited with a production of 483,255,012 pounds of copper, 9,470,970 pounds of zinc, 19,643,885 ounces of silver, and 24,617 ounces of gold, having a net smelter value of $82,066,179.06. The company has paid $15,032,570.25 in dividends.[3/] A summary of production records is given in the appendix. (See fig. 2 also.)

Company operations began in 1905 and continued without interruption until 1917. On June 6, 1917, a fire destroyed the Granite Mountain shaft and killed 163 underground workers. This disaster,

---

3/ A chronological record of dividends paid is in the appendix of this report, pp. 4 and 5.

resulting in a suspension of mining operations for nearly a year while repairs to the shaft were in progress, removed the company from a production status during a period of peak copper prices. Operations finally were resumed in 1918 under adverse cost conditions. However, the unexpected close of World War I with resulting cancellation of Government copper purchase contracts forced the company to curtail operations in December 1920 and to close the mine in March 1921. Mining again was resumed for a year starting in June 1922.

For the years from 1923 to 1929, operations were of a haphazard nature; records from this period are incomplete. Most of the company's working capital was dissipated in several unsuccessful copper developments.

In 1917, probably in consequence of the fire, the company set up a reserve fund for ore depletion. Each year thereafter this reserve fund was increased at the expense of the surplus earnings, until in 1925 it totaled $4,256,504.68, and the surplus fund was depleted. (See figure 3.) No part of this cash fund was ever distributed to the stockholders. In June 1927, the company was forced into fictitious bankruptcy to satisfy a debt of $6,500. After much litigation the old directors were removed. The new directors paid off all indebtedness, discharged the receivership, and reopened the mine in March 1929. In the spring of 1931 the copper price declined to 6-1/2 cents a pound. Consequently, the North Butte operation was suspended and continued inactive until 1942.

During the period of the receivership from June 1927 to March 1929, the reserve fund of $4,256,504.68 was depleted.

During the period March 3, 1942 to March 30, 1946, the mine was operated under contract by the Anaconda Copper Mining Co. Entry for the operation was from the workings of the adjoining Anaconda-owned Badger State mine. Output during this period totaled 443,033 dry tons from which was recovered 30,140,373 pounds of copper, 708,954 ounces of silver, and 627 ounces of gold, having a gross value of $6,575,463.22 with premiums. The North Butte Co. received $1,155,997.52 in royalties.

During this period of operations the Granite Mountain workings were ventilated by facilities provided by the Anaconda Copper Mining Co. at a cost of $1,185 per month. On termination of the leasing agreement, the ACM Co. built slime seals at the property line to shut off all ventilation to the Granite Mountain mine. All rail, pipe, accessories, and equipment were removed.

The North Butte Co. attempted to operate their own property in July 1946. The Granite Mountain shaft was repaired, new stations were excavated, various connections were made, and new equipment was purchased. Copper ore production, starting in December 1946, attained a rate of 475 tons per day by August 1947. As initial costs were high the company treasury soon was exhausted. Payrolls were met by borrowing on copper in transit. Hopes for a profitable operation based on planned improvements were abandoned in August 1947, when the premium price plan was discontinued. The mine was closed immediately. During this period of operation 69,916 tons of ore yielding 4,924,322 pounds of copper, 109,122 ounces of silver, and 128 ounces of gold were produced.

DESCRIPTION OF MINE WORKINGS

The Granite Mountain mine is developed and operated through vertical shafts to a depth of 3,600 feet. The level interval is 200 feet. Crosscuts from the shaft-stations intersect steeply dipping lodes developed by drifts, laterals, and raises. Most of the ore-shoots are extracted by an overhead square-set stoping system. However, a few cut and fill stopes have been used where the walls are sufficiently strong. All stopes are waste filled shortly after the ore is removed.

The broken ore is hand shoveled to stope chutes, drawn into mine cars, and trammed to the shaft station, where it is dumped into a 100-ton skip pocket. The hoisting plant is equipped with 10-ton skips. This mine never has had a mill on the property; all ore has been shipped directly as mined to the concentrator and smelter at Anaconda, Mont.

Most of the ore has been hoisted through the Speculator shaft. The Granite Mountain shaft, attaining its present depth in 1916, was in operation only a short time before the fire occurred. In repairing the shaft after the fire, reinforced concrete construction was used from the 1700 level to the 3000 level. From the surface to the 1700 level there are twelve 5-foot concrete fire stops girdling the shaft timber. Consequently, the Granite Mountain shaft is considered one of the straightest and most stable in Butte.

Mine water accumulates on the 3600 level at a rate of 35 to 50 gallons per minute and drains into the workings of the adjoining Badger State mine. This water carries copper sulfate in solution from which copper currently is recovered by the ACM Co. It is planned to divert this water to the North Butte Co. precipitating plant.

Underground inspection of the condition of the mine was confined to the 2000 and 2200 levels. First-hand experience is therefore limited, but certain statements concerning general conditions can be made. The country rock is a highly fractured and altered quartz monzonite, heavy and difficult to hold. Close timbering is necessary, and waste filling of stopes is required.

The present practice in the Butte district is to abandon all mine workings after they have served their immediate purpose for ore extraction rather than attempt to keep them open. Crosscuts in waste generally remain open the longest. If necessary they can later be reopened at less expense than by driving new workings. Drifts and raises in mined areas soon cave. In many cases it is cheaper to drive a new drift than to reopen an old one.

It has been the practice at this mine to drive openings with flat, wide backs to facilitate the blocking of timber set. An arched back might be better advised and might reduce timbering costs appreciably.

Figure 4 shows a summary of yearly development work for the period from 1909 to 1923. These data indicate a yearly average of 3,200 feet of raises, 6,500 feet of drifts, 5,550 feet of crosscuts, and 300 feet of shafts, a total of 15,550 feet of workings. A yearly average of 333,000 tons of ore was mined during this period; each foot of development thus resulted in an average of 21.5 tons of ore. This is an unusually favorable figure, indicating that the ore is readily prepared for mining.

GEOLOGIC SETTING

General

As the geology of the Butte mining district is widely known it is considered unnecessary to detail the geologic relations of the North Butte mine. A summary of the geologic setting based largely on the literature is included, however, to aid in presenting data pertinent to the loan application in question.

The Butte district is in an area of quartz monzonite comprising a part of the Boulder batholith. This batholith, extending nearly to Helena, has been cut by later aplite and granite porphyry dikes. In the Butte area these rocks are transected by a complex vein network. Two major systems are most important: an east-west (Anaconda) system and a northwest-southeast (Blue vein) system. Several other fracture sets are present but are not as important as sources of ore minerals. Veins of the two principal systems dip steeply south although reversals are not uncommon. Displacement is not common to the Anaconda fracture system. The Blue vein system, however, is characterized by displacements of moderate throw. Later northeast-trending fractures offset veins of both the main ore systems.

Nearly all faulting is normal with usually minor displacements. The fissure pattern is so well known in the Butte mines that fault throw is reliably predicted. Undue operational complications caused by faulting, therefore, are seldom encountered.

Metal Zoning

Although Butte is principally a copper camp, zinc, silver, manganese, and lesser amounts of gold and lead have assumed importance in the total production.

Reno Sales[4] has shown that the metallization is distinctly zoned. A central zone more than a mile long and one-half mile wide contains copper ores essentially free from zinc and manganese. An indefinite but broad zone of irregular width nearly surrounds the central copper zone; in it the predominantly copper ores rarely are free from zinc. Manganese minerals are of common occurrence near the boundaries. A peripheral zone of undetermined width contains little copper but much zinc and manganese. The boundaries between zones are gradational, and in places the distribution of ore minerals is complex. Nevertheless, the general pattern is fairly distinct in most areas of significant size. (See fig. 1 overlay.)

The property of the North Butte Mining Co. lies chiefly within the intermediate zone. The veins toward the south side of the property contain principally copper, although occasional zinc is present. Farther north zinc is more abundant, although copper is present in significant quantities in all the known zinc veins. Silver is important in both vein types. As the veins change character successively from south to north, so also do individual veins change character with depth, copper being more important downward and zinc upward. The intermediate zone, therefore, may be considered a shell, surrounding and dipping outward from the central zone. This shell dips northward in the vicinity of the North Butte mine.

As the veins in the northern and northeastern part of the North Butte property have not been explored, little information is available concerning the potential of that area. However, the adjoining Black Rock mine on the north has been one of the camp's largest zinc producers. (See level plan maps, figs. 8, 9, 10, 11 and 12.)

4/ Sales, Reno, Ore deposits at Butte, Mont.: Am. Inst. Min. Engr. Trans., vol. 46, pp. 3-109, 1913.

The principal veins explored within the North Butte mine are, from south to north, the Adirondack, Edith May, Jessie, Gem, South Croesus, North Croesus, Snowball, South Berlin, and North Berlin. All but the Snowball belong to the northwest-southeast or Blue vein system. The Adirondack, Edith May, Jessie, and Snowball have been mined extensively for copper. The copper leaching program now in progress is for treatment of waste fill in the Edith May and Jessie stopes.

According to available information, the North Croesus vein contains the best deposits of zinc. Most of the 40,000 tons of zinc ore mined to date has come from this vein even though it has been incompletely explored. Significant reserves still are available for exploitation. Zinc ore is present in the South and North Berlin veins. However, most mining on these veins to date has been for copper. Ore low in copper content once was discarded as waste even though it contained good zinc. The few intersections above the 2000 level (top of main stope area) indicate that the North Berlin vein contains zinc ore.

GRADE, RESERVES AND CLASSIFICATION

North Croesus Vein

A Company map (fig. 5, Longitudinal Section on the North Croesus Vein) shows reserve blocks of measured and indicated ore, based for the most part on fairly good assay data (figs. 13 and 14), though zinc values for some are unavailable. Details of the tonnages computed by the company staff are not available. Computation of the measured ore in the blocks demonstrates more than 60,000 tons of ore averaging over 13.5 percent zinc (using a value of 10 percent for those blocks without zinc assay data),

2.7 percent copper, and 5.3 ounces of silver. Similar computations of indicated ore showed more than 30,000 tons averaging 11.7 percent zinc, 1.7 percent copper, and 4.7 ounces of silver.

Examination of company reserve maps (fig. 5) indicates only a relatively small part of the potential reserve has been included in the measured and indicated blocks. The principal ore shoot, at the west side of the property, rakes to the southeast and has a strike length of 600 to 800 feet. Between the 1600 and 2300 levels this shoot should contain about 400,000 tons (thickness 5 feet, tonnage factor 11). Less than a fifth (80,000 tons) has been mined, and probably at least a half or two-thirds of the remainder (200,000 tons) is likely to be minable. (See figs. 8, 9, 10, 11 and 12.)

Another ore shoot appears to be present to the east, with an interval of 300 to 400 feet in which the vein is thin and the metal content low. Available data do not permit a reserve estimate for this shoot. A moderate reserve, however, might be present between the 1600 and 2300 levels. Both of these shoots probably extend both upward and downward. In fact, the adjoining area to the west on the 1000 level of the Emily shaft is being developed for zinc by the ACM Co. The Emily vein, an extension of the North Crocsus, is reported to contain good zinc ore. Minable zinc may extend to the surface, but so little information is available in the uppermost levels that no valid estimates may be made in this regard. The same ground on the west is fairly well developed and is being mined to the 2300 level from the Emily and Pilot shafts and below that to the 3400 level or deeper from the Badger shaft.

South and North Berlin Veins

Insufficient assay data are available on the South and North Berlin veins to warrant detailed consideration of reserve tonnages at this time. However, the probability of significant reserves of zinc ore in these veins seems fairly likely. (See figs. 6 and 7.) One of the important factors regarding North Butte zinc reserves is the fact that the Anaconda Copper Mining Co. is mining good zinc ore from the same group of veins in an adjoining area but 1,000 feet or so to the west.

Other Areas

Another important factor is that the Black Rock mine, adjoining the North Butte property on the north, has been one of the biggest zinc producers in the camp since about 1915. It is reported that the ACM Co. recently has purchased this property and is preparing to establish a block caving system in the upper levels.

The northeastern half of the North Butte property is virtually unexplored. Although the number and character of veins present in this area are unknown, it must be considered a future source of zinc, particularly that portion near the northwest corner south of the Black Rock mine.

It is considered that the ore reserves on the North Crocsus vein estimated by the company are modest, and that a well organized mining program might produce several times that amount of ore. The situation regarding the South and North Berlin veins is likely to be comparable though not to such an extent. In addition, it seems likely that good veins farther north will be found by further exploration, particularly

near the Black Rock property. The potential tonnage from these veins may be large.

Emmons [5] states: "On the east end of the Rainbow lode (just north of the North Butte Property), for about 2,000 feet along its strike, great zinc deposits have been developed in the Elm Orlu and Black Rock Mines. In their upper levels both these mines were worked for silver. Zinc appeared in quantity at depths between 400 and 700 feet below the surface. Huge deposits are developed to the bottoms of these mines, which are opened to depths of about 1,700 to 1,900 feet below the surface." The Elm Orlu property is just west of the northwest corner of the North Butte property.

Lilley [6] states: "The zinc mines lie in an area close to but distinct from that in which the copper ores are worked. In the Black Rock mine, the largest of the zinc properties in the district, the ore yielded an average of 13.25 percent of zinc, 1.22 percent of lead, 0.22 percent of copper, 6.59 ounces of silver, and 0.0082 ounces of gold to the ton in 1930. Proved reserves of zinc ore in this district are not large; but, as in the case of the copper veins, the ore bodies are persistent and indicate that the recent high rate of production can be maintained for some time."

In conclusion it should be emphasized that although the exploration records are incomplete and the reserves estimated by the company are

---

5/ Emmons, William Harvey, The Principles of Economic Geology: McGraw-Hill, 1918.

6/ Lilley, Ernest R., Economic Geology of Mineral Deposits: Henry Holt and Co., 1936.

not large, still there is sufficient blocked ore to support a mill operation for at least 1 to 3 years. Furthermore, the potential production of the property is large. The absence of complete data must be blamed to mismanagement of former company operations, particularly in the period following World War I. It is believed that the reserves and possibilities of zinc ore in the North Butte mine are more than ample to amortize the loan for which application has been submitted.

MINABLE RESERVES

General

The physical character of the Butte granite governs the manner in which ore reserves are blocked out. To avoid excessive maintenance charges, reserves are developed one or two years in advance of extraction. Development of reserves is programmed on a "ton for ton" basis. As output is increased, development of reserves also is increased.

The following table shows the balance maintained between reserves and output at the North Butte over periods for which data are available:

	Ore reserves	Production	Production period
Jan. 1, 1910	882,200	449,875	1909
Jan. 1, 1911	958,680	408,528	1910
Jan. 1, 1912	710,920	410,694	1911
Jan. 1, 1913	1,000,000	425,248	1912
Jan. 1, 1914	1,000,000 1/	454,984	1913
Mar. 3, 1942	125,000	444,033	3/1942 - 3/30/46
Mar. 1946	240,000		

1/ Annual report states: "Our development during the past year has kept the ore reserves at the same figure at which they stood on Jan. 1, 1913."

Geologic Considerations

Neighboring mines working the same lodes up to the North Butte property lines are almost a thousand feet deeper. The significance is obvious: substantial reserves can be inferred at depth in the North Butte Company property.

Much of the unexplored property holdings to the north can be prospected advantageously at depth through existing workings. This area, reserved by the North Butte Co. in the former operating contract with the ACM Co.,[7] presents many exploration possibilities.

The grade of ore mined during the last period of company operations averaged 3.52 percent copper (fig. 15). Production records show that all of the copper ore produced has averaged 2.98 percent Cu. By comparison, the North Butte mine is still capable of producing relatively high-grade copper ore. The zinc ore produced has averaged 12.75 percent Zn. (See fig. 15.)

During the productive period from 1905 to 1924 only 7,395 tons of zinc ore was mined whereas 6,186,530 tons of copper ore was produced. The payment for the 11,000 tons of zinc ore produced in 1929 was withheld by the smelter for many months until the metal finally was marketed. In March 1930 zinc, at 4.934 cents per pound, was regarded as a detriment. Consequently, the veins to the north were neglected after they were found to contain little or no copper. Ore from some of the marginal veins in the transition zone contained both copper and zinc in varying proportions.

7/ Annual report for 1941 states: "The northeasterly portion of the mine has been reserved to North Butte under the above mentioned contract (with ACM Co.) and a separate operation in that portion of the property is contemplated which your engineers believe is capable of substantial zinc-silver production."

If this ore contained sufficient copper, it was shipped for smelting; if the ore was rich in zinc, however, it was used for stope filling. It may be found possible to recover a part of this zinc by drawing the fill in selected areas.

The veins to the north in the upper levels contained zinc. As greater depth was attained, however, an increasing copper content was observed. For this reason, some good zinc ore is left in the upper levels of the mine, relatively near the surface. This also explains why certain outcrops have not been explored.

Historical Considerations

The property's history indicates that the mine has produced profitably under stabilized operating and marketing conditions under competent management. The entire dividends of $15,032,570.25 were paid in 13 consecutive years from 1905 to 1918. In addition, a surplus cash fund of $4,256,504.68 was earned but never returned to the stockholders.[5/]

The initial failure of the mine apparently was occasioned by three major factors: (1) a fire involving loss of life; (2) a post-World War I period of low metal prices; and (3) incompetent management. Since

---

5/ The following statement in the 1929 annual report is of interest: "The Granite Mountain group on Butte Hill consists of 220 acres of which area about two-fifths has been developed to the 2800 feet level from which approximately $19,000,000 of profits have been taken." This publicity item is a tacit admission that the mine has been more profitable than the dividend record indicates. If the management of the company had invested the reserve fund of $4,256,504.68 wisely, the interest on the money would have been about $300,000 per year. This sum would have maintained the company on a standby basis indefinitely, and the working capital to reopen the mine would have been available when necessary.

the initial failure in 1923, several unsuccessful attempts to reopen the mine have been made. Each attempt evidently was badly timed.

Economic Considerations

The North Butte Co. formerly could operate successfully during periods of favorable metal prices. This no longer is true because the company does not have transportation, power, milling, and smelting facilities. Even at present copper prices, very little profit can be realized from mining operations alone; moreover, even though the North Butte Co. can mine nearly as cheaply as the ACM Co., the profit is so small that the business is not a stable one.

Table 1, which follows, gives the total income and cost of operations for the Anaconda Copper Mining Co. for the years 1948 and 1949. These data were furnished by the ACM Co. to the Montana State Board of Equalization for the "Assessment of net proceeds of mines."

Among other things, the data show net proceeds of $3,501,314.14 for 1948 and only $451,449.85 for 1949. In 1949 the profit was only 1.08 percent on an operating cost of $41,842,737.12. These figures clearly indicate the large risk involved in trying to compete in the copper mining business. The ACM Co. evidently earns their major profit from fabricating copper rather than from mining.

TABLE - Revenue and cost of mining for 1948 and 1949, Anaconda Copper Mining Co., Butte, Mont.

Metal	Production 1/ 1948	Production 1/ 1949	Percent revenue from various metals 2/ 1948	Percent revenue from various metals 2/ 1949	Prices (L. & M. J.) 2/ 1948	Prices (L. & M. J.) 2/ 1949	Average recoverable heads
Cu. in lb.	114,321,832 1,184,434 999,254	103,820,173) 1,941,951) 429,526)	56.24	49.45	.22338 .22038	.19866 .19202	2.1 percent
Ag in oz.	2,412,473 2,551,728 78,906	2,332,175) 3,102,721) 36,131)	9.73	11.66	.8778	.89950	2.202 ounces
Au in oz.	6,498 7,778 240	4,921) 7,439) 101)	1.10	1.03	35.050	35.050	0.05 ounce
Zn in lb.	61,871,069	79,260,746	20.98	25.80	.15609 .13589	.13196 .12144	1.65 percent
Pb in lb.	14,841,599 2,560,997	15,335,156) 1,323,767)	6.64	5.77	.17782 .18043	.14868 .15364	0.33 percent
Arsenic (refined in lb. (crude in lb. (metallic in lb.	2,431,656 4,195,382 27,720	1,168,790) 3,580,066) 33,000)	5.31 3/	6.29 3/			
Bismuth in lb.	76,093	13,897					
Modulized Mn (long dry tons)	28,131.107	19,862.038					
Ferromanganese (long dry tons)	4,643.246	6,920.142					
Cadmium in lb.	150,924	200,876					
TOTAL PRODUCTION (Tons Ore)	2,853,238.53	2,511,491.46	100.00	100.00			

TABLE - Revenue and cost of mining for 1948 and 1949, Anaconda Copper Mining Co., Butte, Mont. (contd.)

	Operating costs 1/		Percent costs 2/		Cost per ton 2/	
	1948	1949	1948	1949	1948	1949
Mining	$26,440,105.75	$24,466,954.83	57.44	57.86	$9.27	$9.74
Transportation	1,783,493.57	1,579,111.70	3.87	3.73	.625	.629
Reduction	8,232,702.97	8,904,761.96	17.89	21.06	2.88	3.55
Marketing	1,160,694.83	1,384,041.45	2.52	3.27	.41	.55
Repairs-mines	1,232,210.60	1,800,392.60	2.68	4.26	.43	.72
Repairs-mill, smelter	2,743,094.19	2,775,433.79	5.96	6.56	.96	1.10
Depreciation	936,942.38	932,040.79	2.04	2.21	.33	.37
Total costs	$42,529,244.29	$41,842,737.12	92.40	98.93	$14.90	$16.66
Total revenue	$46,030,558.43	$42,294,186.97	100.00	100.00	$16.13	$16.84
Net proceeds	$ 3,501,314.14	$ 451,449.85	7.60	1.07	$ 1.23	$ .18

1/ Data from Anaconda Copper Mining Co. ("Assessment of Net Proceeds of Mine") (Margaret Alrick, Asst. Sec.) State Board of Equalization.

2/ Ratios and costs calculated by A. L. G. of R.F.C.

3/ Includes all other metals, i.e., arsenic, bismuth, manganese, ferromanganese, and cadmium.

MINING COSTS

General

Information on the cost of mining straight zinc ores in the Butte area is not available, but the overall cost should be quite identical with that for copper ores.

Figures 16, 17, and 18 graphically show the copper mining costs in the past; figure 16 shows the costs per ton, figure 17 the total costs in dollars, and figure 18 the percent costs. These data cover operations from 1909 to 1923 inclusive, and also the last period from December 1946 to August 1947. Tables 1, 2, 3, and 4 in the appendix give a detailed analysis of the latest costs from December 1946 to August 1947.

Certain inferences can be made. A gradual rise in mining and development costs is indicated, while smelting and freight costs have held remarkedly uniform. Office expenses have been highly erratic but generally increasing. The effect of the fire is especially noticeable. The periodic suspension and resumption of mining is reflected by increased costs.

Dilution

Costs of mining zinc ore will vary somewhat, depending on the cut-off grade used and the width of ore mined. Very little assay information is available to determine what dilution will occur. The average assay grade has been calculated by the U. S. Geological Survey to be 13.5 percent zinc and 2.7 percent copper. Allowing 10 percent dilution, the extracted ore will average about 12 percent zinc and 1.5 percent copper; this assumption is conservative in view of the fact that in the past the ore has averaged 12.78 percent zinc.

Recovery

Although dilution may lower the ore grade somewhat, it is expected that the overall recovery of zinc will be greater than indicated by assays because of disseminated zinc sulfides in the walls which have not been considered in the ore grade calculations. Thus, the dilution of zinc ore apparently will not be as serious as with copper ore.

Tons Per Man Shift

The labor cost per ton for mining and development may be based on past results, indicating that the overall tons per man shift will be 1.5. The average cost of all labor will be about $14 per shift, giving a labor cost per ton of $9.33.

The labor cost generally is about 60 percent of the total cost in this type of operation, giving an estimated total direct mining cost of $15.55 per ton. This is conservative and can be reduced by greater mechanization. For comparison, the company cost estimate is $14.89 per ton.

EQUIPMENT AND FACILITIES

Installed

The appendix of this report lists all the mining equipment and supplies on hand for operating the property. Most of the equipment is in good condition. The three surface plants are illustrated in the accompanying photostat (fig. 19).

To be purchased

The company proposes to purchase additional mining equipment, mostly for mechanization to further reduce mining costs. The equipment

required and estimated costs are shown below:

2 Mucking machines at $3,000	$ 6,000
12 Single drum raise hoists at $600	7,200
2 Double drum slusher hoists at $880	1,760
2 Double drum slusher hoists at $1,200	2,400
3 Drifting machines at $1,000	3,000
3 Battery locomotives, 5-ton at $19,000	57,000
15 Granby type cars at $956	14,340
4 Granby dump mechanisms at $1,100	4,400
Contingencies	9,600
Total	$105,700

The company also proposes the following repairs and additions to the surface plant:

Repair main hoists and install Lilly controls	$ 6,800
Install timber frames	400
Complete installation of Nordberg compressor	2,000
Construct lamp house	2,000
Construct boiler maker shop	3,000
Paint buildings and equipment	5,000
Contingencies	1,900
Total	$21,100

To be repaired and rehabilitated

Costs of equipment can be estimated accurately, but the cost of mine rehabilitation must be estimated with a greater contingency of error inasmuch as it involves certain risks that cannot be eliminated.

The following costs for such proposed work, therefore, are subject to some latitude.

Shaft repairs:

Install water lines (surface to 2200)	$2,100
Repair skip pockets	1,500
Reguide, retimber, and repair 400 ft. of shaft	10,000
Construct skip pockets 16 and 18	6,000
Contingencies	3,900
Total	$23,500

Level repairs:

1600 level, 1,800 feet cleanup and re-equipment at $7	$12,600
18 and 24 level, 3,500 feet cleanup and re-equipment at $7	24,500
2000 level, 1,260 feet cleanup, repair and re-equipment at $10	12,600
2200 level, 760 feet cleanup, repair and re-equipment at $10	7,600
2800 level, 400 feet cleanup, repair and re-equipment at $10	2,800
Contingencies	12,000
Total	$72,100

Ventilation Plans

Before the fire this was one of the best ventilated mines in the Butte district.[9] Most of the ventilating shafts are caved now and ventilating fans are needed. The workings therefore are dry and hot; ventilation facilities must be provided for proper working conditions.

9/ Harrington, D., Bureau of Mines Bull. 188, 1922, 50 pp.

The proposed ventilation plan is not too specific and, in fact, several plans have been proposed. An adequate system can be established temporarily by converting one-half of the Granite Mountain shaft into a downcast and the other half into an upcast. There are a number of outlying, inactive shafts, however, that might be utilized for upcasts after the connecting workings are rehabilitated.

In 1947 the company was rehabilitating the Tuolumne shaft for upcast ventilation. A drift on the 2800 level of the Granite Mountain shaft had been driven to within 40 feet of that shaft. It was planned to drain the shaft by means of a diamond drill hole before completing the connection. The mine was closed before this could be done, however. The present condition of the Tuolumne shaft is not known; the volume of air that can be pulled through it, without major repairs, is a matter of conjecture. If repairs come to more than $50,000, it probably will be cheaper to drill a calyx hole from the surface to the 2800 level. The North Butte Co. obtained a firm cost estimate from a Texas drill contractor of $20 per foot for drilling a calyx hole 2,800 feet in depth. Such a drill hole should provide more than sufficient exhaust capacity to supply working faces with fresh air.

From the standpoint of conservation of time and money, ventilation facilities could be reestablished most easily by utilizing part of the existing exhaust system of the ACM Co. This also would insure safer working conditions underground by providing additional exits for both mines.

Ventilation costs are estimated as follows:

5 T.M.9 Fans at $770	$ 3,850
10 T.M.6 Fans at $440	4,400
Rehabilitation of ventilation shafts	50,000
Total	$58,250

Summary of Equipment and Rehabilitation Costs

Mine equipment and rehabilitation costs are summarized as follows:

Equipment, underground	$105,700	
Equipment, surface	21,100	
Total equipment		$126,800
Rehabilitation, shaft	$ 23,500	
Rehabilitation, level reopenings	72,100	
Rehabilitation and ventilation, Tuolumne shaft	58,200	
Total rehabilitation		$153,500
Grand Total		$280,600

LABOR SUPPLY

A total labor force of approximately 135 men is required to produce 200 tons per day. About 65 men are presently employed by the company; therefore, an additional crew of 70 is needed. This number of experienced men can be obtained locally.

The ACM Co. needs workers now. The labor turnover in the Butte mines is high, but the North Butte Co. enjoyed excellent labor relations in 1947 and should experience no unusual difficulty in finding men.

The present wage rates for the Butte district are shown below. These rates are effective until October 1951, at which time new rates will be determined.

		October 1950
Blacksmith	Boss	$ 13.56
Blacksmith	Regular	13.06
Blacksmith	Helper	12.31
Blacksmith	First fire	13.56
Blacksmith helper	First fire	12.56
Boilermaker	Boss	13.56
Boilermaker	Regular	13.06
Boilermaker	Helper	12.31
Boiler Cleaner	Special	13.06
Carpenter	Boss	13.56
Carpenter	Regular	13.06
Sealer		12.31
Compressorman		13.06
Diamond drill runner		12.81
Diamond drill runner Helper		12.31
Driver, locomotive		12.31
Engineer	First motion	13.56
Engineer	Geared	13.06
Electrician	Boss	13.56
Electrician	Regular	13.06
Electrician	Helper	12.31
Fireman		12.56
Floorman - Garage		12.56
Foreman - Surface		13.06
Laborer	Boss	12.31
Laborer	Regular	11.81
Laborer	Change house	11.56
Machinist	Boss	13.56
Machinist	Regular	13.06
Machinist	Helper	12.31
Mason	Boss	15.56
Mason	Regular	14.56
Mason	Helper	12.31
Miner	Regular	12.31
Miner	Shaft	12.81
Miner	Gun runner	12.81
Oiler	Regular	11.81
Oiler	Second class	12.31
Painter	Boss	13.56
Painter	Regular	13.06
Pipe Coverer		12.56
Pipeman	(Underground)	12.81

Pipe Fitter	Boss	$13.56
Pipe Fitter	Regular	13.06
Pipe Fitter	Helper	12.31
Pumpman	Boss	13.56
Pumpman	Regular	13.06
Sawyer	Regular	12.56
Sawyer	Helper	12.31
Station Tender		12.81
Structural Iron Worker	Boss	13.56
Structural Iron Worker	Regular	13.06
Truck Driver	Under 2 ton	12.56
Truck Driver	2 to 5 ton	12.81
Truck Driver	5 ton or over	13.06
Apprentice	1st year	10.81
Apprentice	2nd year	11.31
Apprentice	3rd year	11.81
Apprentice	4th year	12.31
Watchman	Regular	11.56
Watchman	Resident	7.45

Figure 20 shows graphically the tons per man-shift obtained during various periods of operations in the past; a fairly uniform rate of 1.5 tons per man-shift has been maintained. It is interesting to note that the operations in 1947 under a management essentially the same as at present were just as productive as in most of the preceding years.

At the average grade of 70 pounds of copper per ton, each man produced 105 pounds of copper per day or, for 300 days, 15.75 tons of copper per year. The equivalent data for the ACM Co. are not known exactly. This company employs about 5,800 men in all the copper-zinc and manganese mines. Probably 4,500 men are employed in the copper mines. The annual production of copper is 55,000 tons. The average tons per year per man on this basis would be 12.2.

POWER

Electric power is supplied by the Montana Power Co. All power lines are in operating condition; an armored cable in the shaft carries the power underground. The proposed operation will require 1,100 to 1,400

horsepower, and this load now is available on demand. The cost of the power is shown on Schedule GS-44 in the appendix.

Natural gas is used in the boiler plant at an estimated rate of 2,000 MCF per month. This gas is supplied by the Montana Power Co. at the costs shown in Schedule GSG-3 in the appendix.

TRANSPORTATION

The mine yard is served by spur tracks of the Butte, Anaconda and Pacific Railway. A good gravel road 3/4 mile long connects the mine yard with the paved city streets of Butte. The mine is ideally situated with regard to transportation facilities, as well as labor supply.

ADEQUACY OF REQUESTED FUNDS

The cost estimates given are considered accurate within engineering limits. This project involves less than the usual mining risk. If DMA funds can be secured under the same mortgage agreement as is now in force between the company and RFC, the Government would still have ample security for the loan. The mining problems, ventilation, transportation, hoisting, milling, and smelting have been met before and satisfactorily handled. Geologic data are firmly established, and geologic risks are considered negligible in this environment.

COMPETENCE OF APPLICANT

The management is entirely familiar with the mining problems of the district, and is considered competent and honest. The fact that the company satisfied the requirements for an RFC loan reflects competence of management.

Mr. I. E. Sergstad, general manager, is a mining engineer with experience as follows: Minnesota School of Mines, 1929; junior mining engineer, Braden Copper Co., Rancagua, Chile, 1929-1931; superintendent, Red Top Mining Co., Boundary, Wash., 1932-1933; cabinet maker, Lake Street Sash and Door Co., Minneapolis, Minn., 1934; draftsman, Ford Motor Co., St. Paul, Minn., January 1935 - May 1935; mining engineer, Unity Gold Corporation, Cripple Creek, Colo., June 1935 - September 15, 1937; sampler, Anaconda Copper Mining Co., Butte, Mont., September 15, 1937 - November 15, 1937; WPA engineer and construction superintendent, Butte, Mont., December 1, 1937 - May 15, 1942; area superintendent, Pando Constructors, Inc., Camp Hale, Colo., May 20, 1942 - October 15, 1942; ore boss, North Butte Mining Co., October 15, 1942 - January 1, 1943; chief engineer and geologist, North Butte Mining Co., January 1, 1943 - July 1, 1943; general superintendent, North Butte Mining Co., July 1, 1943 - July 18, 1949; general manager, North Butte Mining Co., July 18, 1949 - to date; December 9, 1949 to date, director of North Butte Mining Co. Mr. Sergstad also holds the following positions: director, Unity Gold Corporation, July 1945 to date; president, Unity Gold Corporation, July 28, 1949 to date.

Mr. C. L. Van Alstine, chief engineer and geologist, is a mining engineer with the following experience: Graduated from the South Dakota State School of Mines in 1925; mine sampler, Anaconda Copper Mining Co., Butte, Mont., July - November 1925; junior engineer, Braden Copper Co., Rancagua, Chile, S. A., November 1925 - April 1929; served as level boss, assistant level foreman, level foreman, assistant section foreman, section foreman of the Teniente mine; prospecting placer mining and contract miner in Montana, May 1929 - June 1930; clerk and paymaster for general contractor,

Boston, Mass., July 1930 - May 1931; placer mining, Alta, Mont., July 1931 - December 1931; gas station operator, Dorchester, Mass., January 1932 - June 1933; road foreman for U. S. Forest Service at Campton, N. H., in charge of road construction, surveys and quarry operations, July 1933 - October 1937; contract miner for Anaconda Copper Mining Co., Butte, Mont., November 1937 - May 1938; placer mining, Alta, Mont., May 1938 - November 1938; project engineer and construction superintendent for WPA, Butte, Mont., November 1938 - May 1942; chief of party (survey), Ellerby and Co., architects and engineers at Provo, S. Dak., Ordnance Depot and Great Falls, Mont. Airbase, May 1942 - August 1942; area superintendent of construction, Pando Constructors, Pando, Colo., August 1942 — October 1942; carpenter, Butler Construction Co., at Farragut Naval Base, Idaho, November - December, 1942; mine sampler, Anaconda Copper Mining Co., Butte, Mont., January 1943 - August 1943; chief engineer and geologist, North Butte Mining Co., Butte, Mont., September 1943 - to present.

The mine foreman, Thomas Bennett, is a mining engineer graduate of Montana School of Mines. He has been working in the Butte mines since 1937.

There has been a determined and sustained effort by the management to put this mine in operation. When the company tried to operate in 1947 and needed working capital for the reopening period, a request was made to the RFC for a loan of $300,000. Copper ore reserves claimed in their application totaled 203,570 tons averaging 4.6 percent copper. The RFC independent calculations of the ore reserves totaled 198,085 tons averaging 4.45 percent copper, an unusually close check. The application

was denied, however, because the loan could not be repaid out of profits to be accrued during the remaining short period (6 months) for which copper premiums were in effect. Without premiums an operating loss was inevitable. If premiums on copper had continued, the mine could have made an estimated operating profit of $3.11 per ton on this grade ore. The total net income, therefore, to be derived in mining 200,000 tons of ore in a period of 18 months would have been $622,000. These figures can be substantiated by consultation with RFC reports.

To insure firm metal prices for the period of operations for which the present loan is requested it is recommended that a zinc and copper purchase contract be negotiated with the company and that the loan be contingent on this contract.

METALLURGY (SUPPLEMENTAL REPORT)

Metallurgical data are presented in an attached report by J. D. Bardill, metallurgist, U. S. Bureau of Mines.

DISCUSSION OF PROPOSAL AND CONCLUSIONS

After a careful examination of this property, it is concluded that:

1. The Granite Mountain mine can produce important tonnages of ore averaging over 12 percent zinc and 1.5 percent copper.

2. Reserves and additional ore possibilities in the Granite Mountain mine are more than ample to ascertize the loan for which application has been submitted; these reserves justify plans for production at the rate of 200 tons per day.

3. In addition to zinc reserves, which are the sole consideration involved in this appraisal, there are estimated to be 196,000 tons of measured reserves averaging 4.6 percent copper.

4. In an emergency, these copper reserves would be readily available if the mine is producing. If the mine is idle, neither zinc nor copper ore would be available immediately.

5. Pending actual pilot plant tests, the tentative metallurgical products, recoveries, and tenor of concentrates should be accepted as estimated by Mr. Griswold because of his vast experience with Butte ores.

6. The company's estimated cost of a 200-ton per day selective flotation plant and tailing disposal system should be increased from $250,000 to $465,000 pending estimates from other mill construction companies.

7. To place the mine in production will require a capital investment of $968,600 to be spent as follows:

(1)	New underground mining equipment	$105,700
(2)	Surface repairs	21,100
(3)	Rehabilitation	95,600
(4)	Mine ventilation	58,200
(5)	Mill construction	465,000
(6)	Working capital	135,000
(7)	Contingencies at 10 percent	88,000
	Total	$968,600

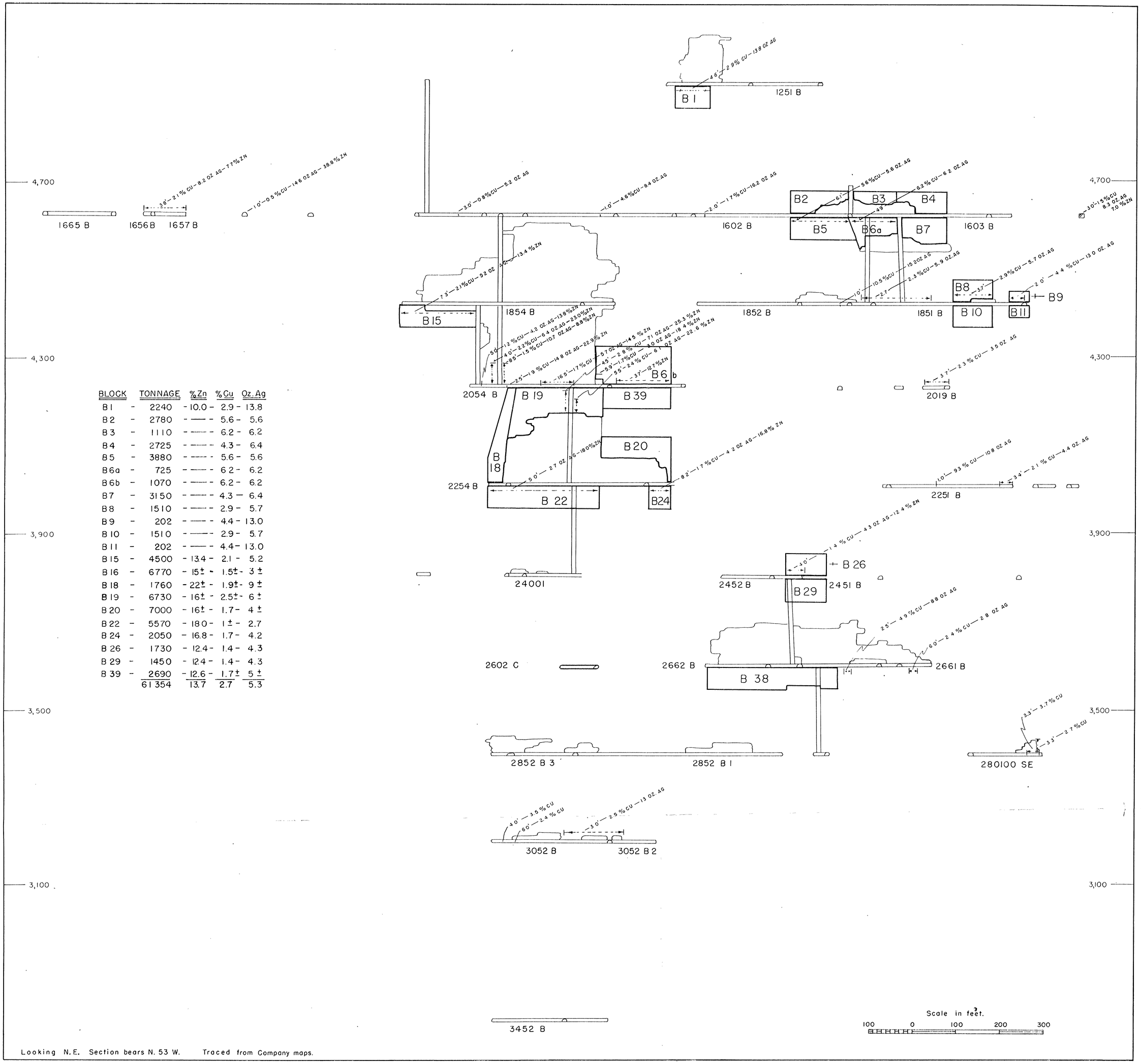
8. The total operating cost of producing concentrates is estimated to be $22.24 per ton of ore. For zinc at 17.5 cents per pound

and copper at 24.5 cents, the income from the products treated at Butte is estimated to be $25.94 per ton of ore, leaving an estimated profit before taxes of $3.70 per ton of ore. This is after amortization of the requested loan at the rate of $2.69 per ton of ore mined.

9. On an ore production and treatment schedule of 200 tons per day, the total profit per year of 360 days, after amortization of the requested loan but before taxes, would be $266,400, and for the 5-year loan period $1,332,000.

10. It will take 6 months to get the mine into production, exclusive of mill construction.

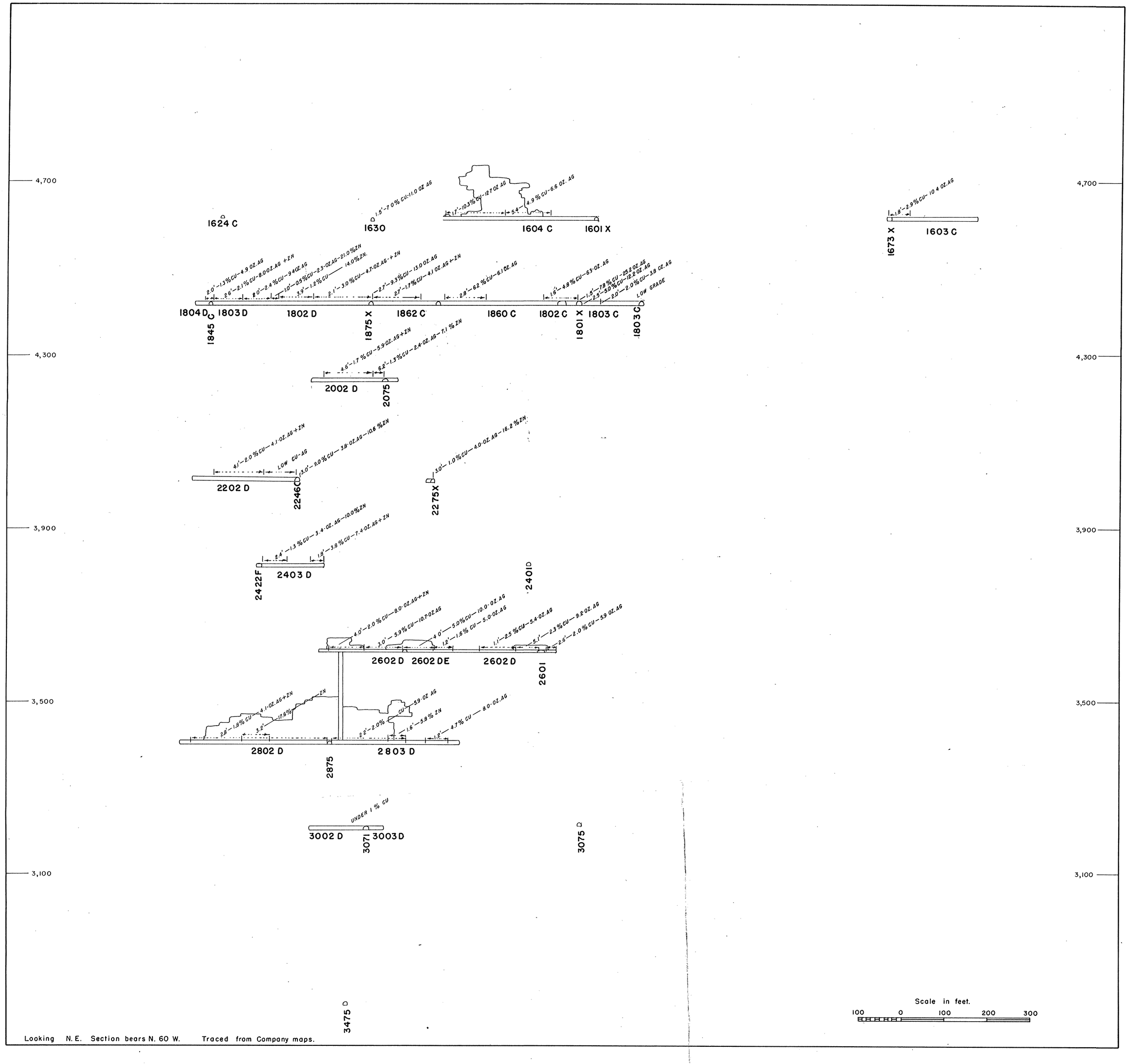
11. From the standpoint of economy and conservation, it is preferable to have this property in production now.



BLOCK		TONNAGE	%Zn	%Cu	Oz. Ag
B 1	-	2240	- 10.0 -	2.9 -	13.8
B 2	-	2780	- —— -	5.6 -	5.6
B 3	-	1110	- —— -	6.2 -	6.2
B 4	-	2725	- —— -	4.3 -	6.4
B 5	-	3880	- —— -	5.6 -	5.6
B 6a	-	725	- —— -	6.2 -	6.2
B 6b	-	1070	- —— -	6.2 -	6.2
B 7	-	3150	- —— -	4.3 —	6.4
B 8	-	1510	- —— -	2.9 -	5.7
B 9	-	202	- —— -	4.4 -	13.0
B 10	-	1510	- —— -	2.9 -	5.7
B 11	-	202	- —— -	4.4 -	13.0
B 15	-	4500	- 13.4 -	2.1 -	5.2
B 16	-	6770	- 15± -	1.5± -	3 ±
B 18	-	1760	- 22± -	1.9± -	9 ±
B 19	-	6730	- 16± -	2.5± -	6 ±
B 20	-	7000	- 16± -	1.7 -	4 ±
B 22	-	5570	- 18.0 -	1 ± -	2.7
B 24	-	2050	- 16.8 -	1.7 -	4.2
B 26	-	1730	- 12.4 -	1.4 -	4.3
B 29	-	1450	- 12.4 -	1.4 -	4.3
B 39	-	2690	- 12.6 -	1.7±	5 ±
		61 354	13.7	2.7	5.3

Looking N.E. Section bears N. 53 W. Traced from Company maps.

Figure 5 — Longitudinal section on North Croesus Vein, Granite Mountain Mine, Silver Bow County, Mont.



Looking N.E. Section bears N. 60 W. Traced from Company maps.

Figure 6 – Longitudinal section on South Berlin Vein, Granite Mountain Mine, Silver Bow County, Mont.

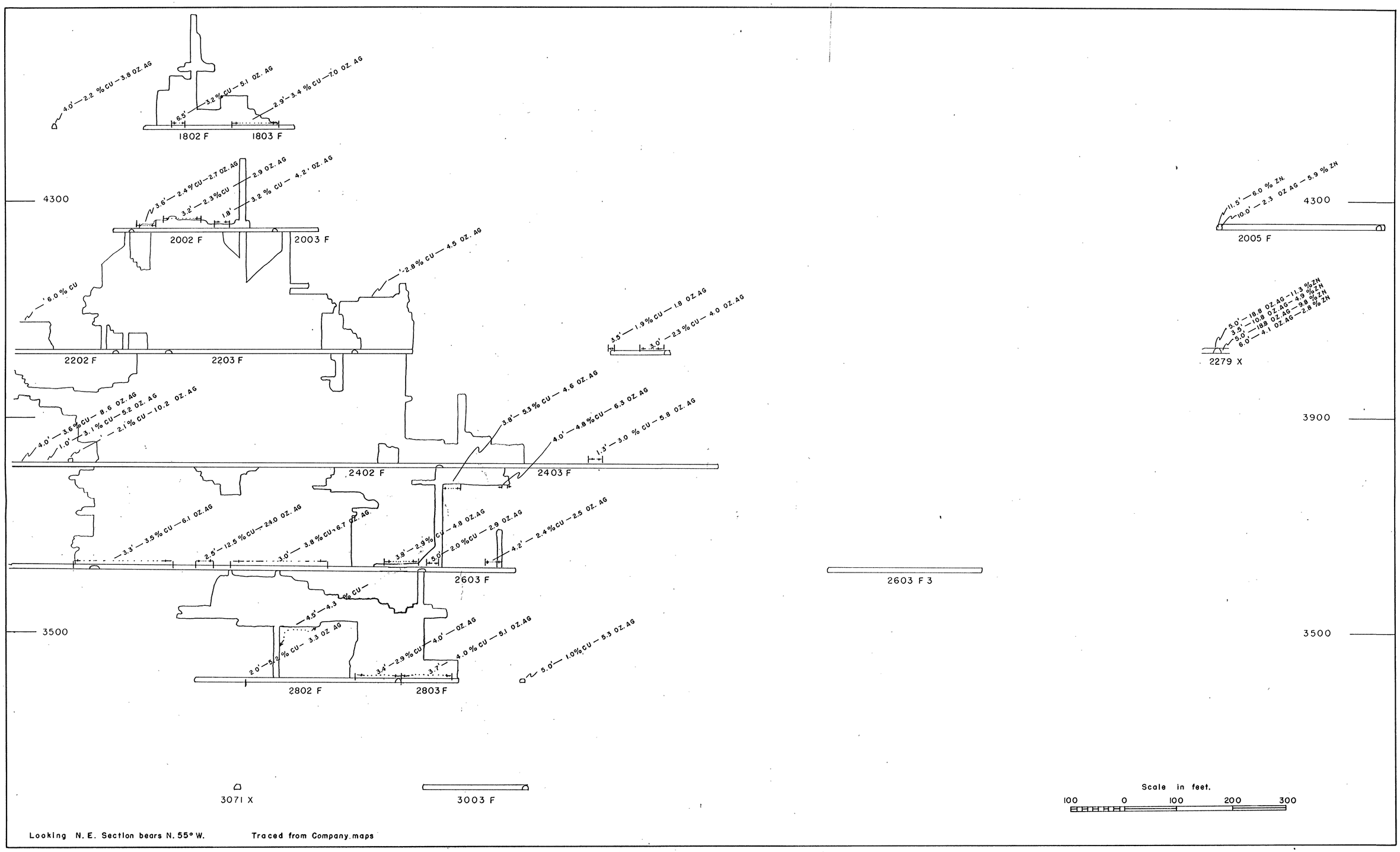
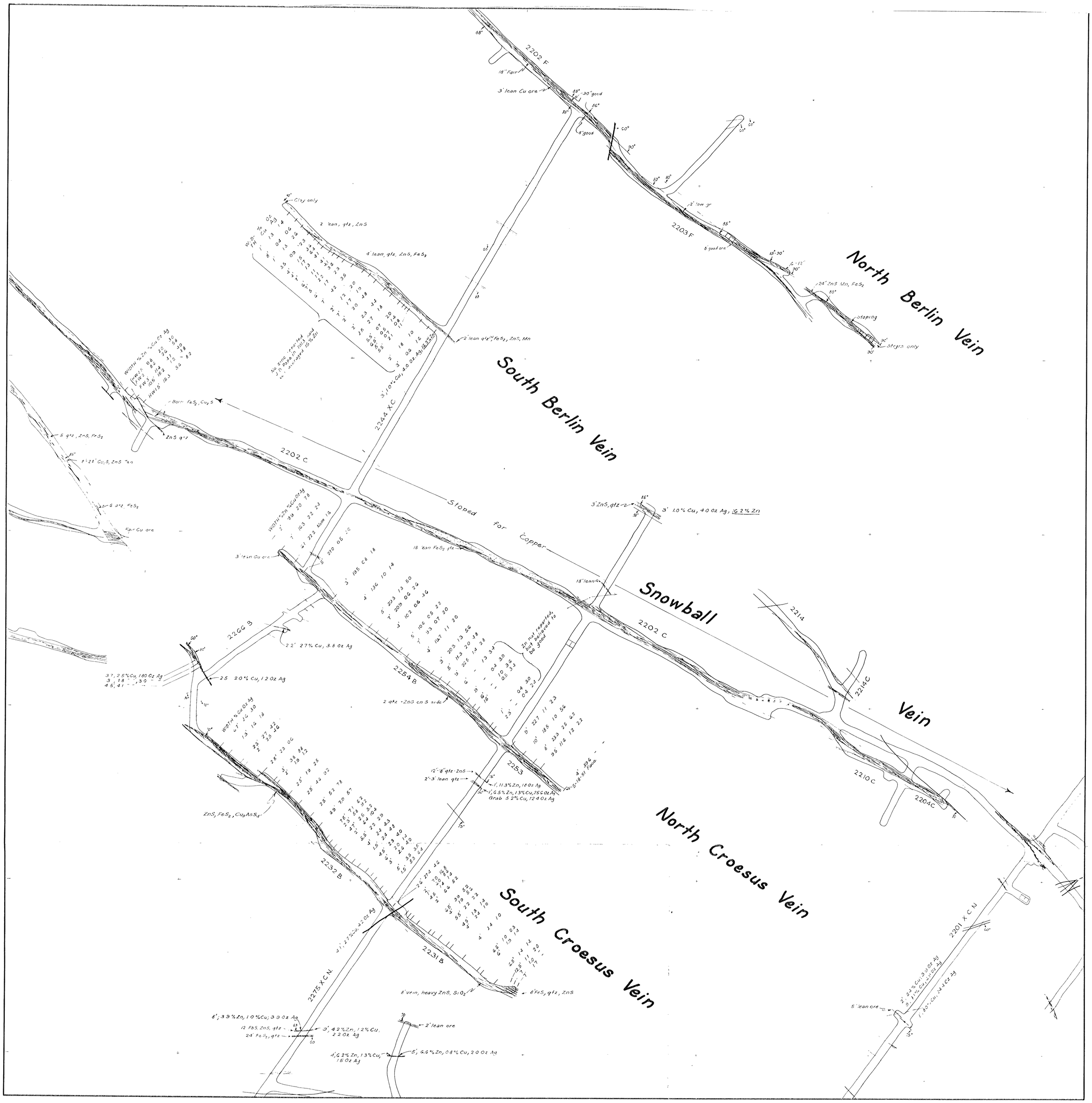


Figure 7 — Longitudinal section on North Berlin vein, Granite Mountain Mine, Silver Bow County, Mont.

DEPARTMEN. OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY



GEOLOGIC AND ASSAY PLAN OF PART OF 2200 FOOT LEVEL

0 50 100 150 200 250 300 Feet

FIG. 14

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

DEFENSE MINERALS ADMINISTRATION
DOCKET NO. 108

GEOLOGIC AND ASSAY PLAN OF PART OF 2000 FOOT LEVEL

0 50 100 150 200 250 300 Feet

FIG. 13