Arizona-New Mexico Branch
SOUTHWEST EXPERIMENT STATION
Box 4097
UNIVERSITY STATION

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES
MINING DIVISION
REGION IV

Mining Division
Date Rec'd.
DEC 21 1950
BUREAU OF MINES
Denver, Colorado

TUCSON, ARIZONA

December 18, 1950

Memorandum

To : Paul T. Allsman, Denver, Colorado

From : Chief, Arizona-New Mexico Br., Mining Div., Region IV

Subject: San Manuel Copper Corp. report.

Regarding your memorandum of December 14, asking for additional copies of the San Manuel report:

As you merely say "copies" we are sending you two. None have been sent you as we thought you would keep the carbon we sent some time ago.

Walter R. Storms

Walter R. Storms

CC 1466
DF

December 1, 1950

AIRMAIL

Memorandum

To : Paul T. Allaman, Denver, Colorado

From : Chief, Arizona-New Mexico Br., Mining Div., Region IV

Subject : Defense Production Act Report on Proposed Development of San Manuel Copper Corp. Mine, Pinal County, Ariz.

Enclosed are original and one copy of the above report by J. Bruce Clemmer and me. A copy is being given Bruce and he also is sending one to Zimmerley. Wes Goss asked for one so I am sending one to him. This report has been cleared with Wes.

Walter H. Storms

CC 462.1
1466
DF

WHSoyms:frj

CONFIDENTIAL

# PROPOSED DEVELOPMENT OF SAN MANUEL COPPER CORP. MINE

## PINAL COUNTY, ARIZONA

By J. H. East, Jr., P. T. Allsman, S. R. Zimmerley, J. B. Clemmer, and Walter L. Storms

* * * * * * * * * DEFENSE PRODUCTION ACT REPORT

UNITED STATES DEPARTMENT OF THE INTERIOR
Oscar L. Chapman, Secretary
BUREAU OF MINES
James Boyd, Director

CONFIDENTIAL

# PROPOSED DEVELOPMENT OF SAN MANUEL COPPER CORP. MINE
# PINAL COUNTY, ARIZ.

by J. H. East, Jr.,[1] P. T. Allaman,[2] G. R. Zimmerley,[3]
J. B. Clemmer,[4] and Walter H. Sterns[5]

CONTENTS

| | Page |
|---|---|
| Summary, conclusions and recommendations | 1 |
| Introduction | 3 |
| Acknowledgments | 4 |
| Location, topography and climate | 4 |
| Property and ownership | 5 |
| History | 5 |
| Geology | 6 |
| Development and ore reserves | 9 |
| Production plan | |
| Mining | 11 |
| Milling | 14 |
| Smelting and refining | 18 |
| Other surface facilities | |
| Railroad, mine to plant | 19 |
| Power plant and gas supply | 20 |
| Water supply | 21 |
| Lime and flux plant | 22 |
| Shops | 22 |
| Townsite | 22 |
| Construction schedule | 23 |
| Materials and equipment | 24 |
| Cost of project | 24 |

1/ Regional Director, Region IV, Bureau of Mines, Denver, Colo.
2/ Chief, Mining Division, Region IV, Bureau of Mines, Denver, Colo.
3/ Chief, Metallurgical Division, Region IV, Bureau of Mines, Salt Lake City, Utah.
4/ Superintendent, Southwest Experiment Station, Region IV, Bureau of Mines, Tucson, Arizona.
5/ Chief, Arizona-New Mexico Branch, Mining Division, Region IV, Bureau of Mines, Tucson, Arizona.

Appendix

(These confidential data were supplied by San Manuel Copper Corporation)


| | Page |
|---|---|
| Estimated cost of plant for handling 30,000 tons per day | 1 |
| Break-down of mine development costs | 3 |
| Estimated quantities of material for construction of permanent plant | 40 |
| Manpower estimate | 55 |
| Estimated total production costs | 58 |
| Copper recovery | 59 |
| Smelting, freight and refining costs | 60 |
| Gold-silver-molybdenum credit | 61 |
| Stoping schedule | 62 |


TABLES


| Number | | To follow page |
|---|---|---|
| 1 | Estimated power requirements | 62 |


ILLUSTRATIONS


| Figure | | To follow page |
|---|---|---|
| 1 | Location of property with respect to transportation and gas lines | 4 |
| 2 | General location plan | 4 |
| 3 | Property map | 4 |
| 4 | Ore body on 1,475 level | 8 |
| 5 | Vertical section on S. 300 | 8 |
| 6 | Vertical section on S. 2,100 | 8 |
| 7 | Vertical section on E. 1,000 | 8 |
| 8 | Vertical section on E. 1,800 | 8 |
| 9 | Vertical section on W. 1,800 | 8 |
| 10 | Details of 1,475 haulage level | 12 |
| 11 | Details of 1,415 grizzly level | 13 |
| 12 | Block caving development methods | 13 |
| 13 | Simplified flow sheet of 25,000-ton concentrator | 16 |
| 14 | Estimated monthly expenditures for construction | 23 |
| 15 | Estimated number of men required monthly | 23 |

## SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Because of a possible National emergency, the Government in the fall of 1950 requested the San Manuel Copper Corporation to expedite development of its large copper deposit near Mammoth, Pinal County, Ariz. In order that priorities for materials and equipment could be allocated to the project, Bureau of Mines personnel conferred with corporation officials to check the ore reserves, proposed mining, milling and smelting methods and costs, anticipated manpower and material requirements, and the time necessary to complete development of the mine and bring the property into production.

The plans for development of the mine, and metallurgical processing of the ore have been carefully and well formulated. Construction of the surface plants has been integrated with development of the mine. Provided construction materials and equipment are received as needed, and adequate manpower is available, the mill, smelter, power plant, townsite, mine to mill railroad, and other surface installations will be completed by the time the mine is ready to produce ore. It is believed that a minimum of 36 months will be required to complete the development and construction program, and full production will be obtained some 5 months later.

The proposed plans call for mining and processing 25,000 to 30,000 tons of ore per day, and to produce some 18 million pounds of fire-refined and blister copper per month. Estimated ore

reserves to date are 462,784,500 tons averaging 0.782 percent copper. The anticipated cost of the project is $79,339,290, or $2,690 per ton day of installed capacity. The estimate does not include, however, the cost of building a railroad to the property. Benson, some 50 miles to the Southeast, is the best entry point, and the railroad would cost about $5 million dollars.

The estimated direct cost of mining and processing the ore to finished copper is $1.93 per ton, or 13.3 cents per pound of refined copper. A credit for the gold, silver, and molybdenum in the ore reduces the direct cost of the finished copper to 10.2 cents per pound.

From an engineering standpoint, the proposed plan for development of the mine and production of copper is fundamentally sound and accords with the better practice of several large Southwestern copper producers. The estimated costs for construction and operation of the plants appear reasonable.

It is recommended that appropriate priorities be allocated the corporation so that they may proceed with their plan to bring the property into production. Such financial assistance as may be necessary to expedite the program also should be supplied.

## INTRODUCTION

In October 1950, the San Manuel Copper Corp., Superior, Ariz., was asked by the Government to expedite the development of its low-grade copper deposit near Mammoth, Pinal County, Ariz., because of a possible national emergency. San Manuel Copper Corp. had not planned to start full development of the ore body before another year.

In order that the Government could guarantee materials and manpower priorities for this project, the Bureau of Mines was asked to visit the property, check ore reserves, proposed mining, milling and smelting methods and costs, manpower and equipment requirements, and time to complete the program.

Therefore, on October 18, 19, and 20, 1950, Walter R. Storms, Chief of the Arizona-New Mexico Branch, Mining Division, Region IV, and Lincoln A. Stewart and Donald F. Kuesler, mining engineers from the same office, visited the San Manuel Copper Corp. office in Superior, Ariz. and checked the San Manuel ore reserves. On November 8 and 9, 1950, Paul T. Allsman, Chief of the Mining Division, S. R. Zimmerley, Chief of the Metallurgical Division, J. B. Glenner, Superintendent of the Southwest Experiment Station, and W. R. Storms, all engineers of Region IV, visited the company's offices in Superior and the mine office near Mammoth, and checked proposed mining, milling, and smelting methods and costs, and manpower and material requirements, for a daily production rate of 25,000 to 30,000 tons of run-of-mine ore.

## ACKNOWLEDGMENTS

Acknowledgment is made for the many courtesies extended to the Bureau of Mines engineers by officials of the San Manuel Copper Corp. and the Magma Copper Co. Special acknowledgment is made to W. P. Cone, vice president and general manager of both companies, J. F. Buchanan, Magma mine superintendent, R. I. Ashby, resident engineer of San Manuel Copper Corp. at the mine, Ben Wilson, Frank Davis, and H. F. Buchella, planning engineers for the same company, and H. J. Steele, geologist.

## LOCATION, TOPOGRAPHY AND CLIMATE

The San Manuel lode claims are situated in all, or parts of secs. 33, 34, 35 and 36, T. 8 S., R. 16 E., secs. 1, 2, 3, 4, 11, 12, and 13, T. 9 S., R. 16 E. and secs. 6, 7, and 18, T. 9 S., R. 17 E., Pinal County, Ariz. The geographical location of the property with particular regard to highways, railroads, and availability of natural gas for plant operation is shown on figure 1. The proposed plant and townsites with respect to the present shafts are shown on figure 2, and on an enlarged scale on figure 3.

The topography is fairly rugged at San Manuel with altitudes ranging from 2,400 feet along the San Pedro River on the east, to over 3,500 feet at the western end of the claims.

No permanent stream exists closer than the San Pedro River on the east although ground water was encountered a few hundred feet below the surface in the drill holes and main shafts. A large volume of water is pumped from the Mammoth-St. Anthony mine about a mile north of the property.

The climate is typical of the southern Arizona desert region with hot summers and mild winters. Rainfall is light. Vegetation is scant, consisting of a few cacti and desert shrubs.

PROPERTY AND OWNERSHIP

The Magma Copper Co. took an option of the San Manuel property in August 1944. After the San Manuel Copper Corp., a subsidiary of Magma Copper Co., was organized this option was exercised and the original claims purchased in September 1945. This company also held a number of claims under location, and in April 1950, patents were granted by the Government for 22 of these claims.

The outlines of the San Manuel claims are shown on Figure 3. The company also owns large blocks of land to the east, southeast and south of the claims. The land includes the plantsite, tailing disposal area, and townsite, as well as a considerable acreage in the San Pedro River Valley where wells have been drilled to assure an adequate water supply.

HISTORY AND PRESENT STATUS

Chapman[5] says: "This ground was first located in 1870 when the adjoining Mammoth and Mahawk mines, now operated by the Mammoth-St. Anthony Co., were located. Little was done on the San Manuel ground until 1916, when three churn-drill holes were drilled. No

---

[5] Chapman, Thos. L., San Manuel Copper Deposit, Pinal County, Ariz. Bur. of Mines R. I. 4108, Aug. 1947, 93 pp.

logs or assay records of these holes are available. The work was stopped, and the options on the claims were not exercised. The six claims were owned by James W. Douglas, Henry W. Nichols and Victor Erickson, Superior, Ariz., and R. E. Griffin, Winkelman, Ariz., when the work herein described was started. Options to purchase these and adjoining claims were acquired by the Magma Copper Co. in September 1944 [7] and were exercised in August 1945, when the San Manuel Copper Corp. was organized to operate the property. Some of the shares of this corporation were owned by the Magma Copper Co. and some by the original owners."

In April 1950, San Manuel Copper Corp. obtained patents from the Bureau of Land Management, Department of the Interior, for 82 lode claims surrounding and including the original property. Mineral leases from the State of Arizona have been acquired on 135 lode claims. Land also was acquired to the southeast and south of the lode claims for a townsite, plant site, mill tails disposal area, etc. (see figure 3).

## GEOLOGY [8]

The rocks encountered at San Manuel are Gila conglomerate, quartz monzonite, and monzonite porphyry with intruded diabase, felsite dikes, and felsite breccia.

---

[7] Option seems actually to have been taken in August 1944, and property purchased in September 1945.

[8] Chapman, Thos. L., previously mentioned in footnote 6.

The Gila conglomerate is a complex alluvial deposit interbedded with lava flows, volcanic breccias, and tuffs. At the outcrops in this area it is a coarse conglomerate of lava pebbles and boulders cemented with clay. It covers all other rocks in the area except in parts of the central and northern portions. It overlies the ore body. The quartz monzonite is pre-Cambrian and has undergone much hydrothermal alteration. It locally is impregnated with copper minerals. The monzonite porphyry was intruded into the quartz monzonite, probably in early Tertiary time. It is much finer-grained than the quartz monzonite. It also was affected by hydrothermal alteration and carries disseminated copper minerals.

Diabase dikes cut both of the older igneous rocks on the north and northwest sides of the area. A barren felsite and felsite breccia dike cuts across all the other igneous rocks.

Structural interpretation is based almost entirely upon the Gila conglomerate. The prevailing strike of these beds is northwest, and the dip is predominantly northeast. Two sets of faults intersect the conglomerate, an earlier set of low-angle faults that strike west-northwest and dip southwest, and a later set of steep faults that strike north-northwest and dip northeast. The San Manuel fault along the southwest side of the mineralized area is an example of the low-angle faults. It has an average dip of about 30 degrees. A steep fault along the east side of the area probably is the southward extention of the Mammoth fault. Another steep fault forms the east side of the main mineralized outcrop.

All the igneous rocks in the mineralized area, except the felsite dikes, have been affected by hydrothermal alteration, this alteration being related to the mineralization. The most intense alteration is in an oval area about 700 by 350 feet where the monzonite porphyry has been almost completely changed to hydrothermal clay minerals, predominantly kaolinite with alunite. Three other types of alteration are found, each usually surrounding the others. The second type surrounds the clay mass. It is very red and is conspicuous in Red Hill. The rock below the zone of oxidation contains much pyrite. Outside this second type is the third type which contains the important copper mineralization. In this type chrysocolla coats all the small fracture surfaces in the oxide zone, while chalcopyrite and pyrite occur in the sulphide zone, with some chalcocite near the oxide zone border. The fourth zone contains no, or very little, copper mineralization.

Pyrite and chalcopyrite with some molybdenite are distributed fairly uniformly through the altered rocks below the oxidized zone in the main mineralized area. Chrysocolla is the chief copper mineral in the oxide zone. However, a zone of mixed oxide and sulphide minerals usually occurs between the oxidized and sulphide zones.

Chapman,[9] in describing the ore body, says: "The San Manuel ore body appears to be a tabular mass that coincides substantially with the sericitic alteration and lies on a pyritic footwall with steep

---

[9] Chapman, Thos. L., previously mentioned in footnote 6.

dip to the southeast. The copper-bearing rock extends beneath a thick cover of Gila conglomerate to the west, south, and east. Beneath the conglomerate, the ore body has a steep hanging wall of low-grade alteration."

DEVELOPMENT AND ORE RESERVES

The Bureau of Mines drilled 17 churn drill holes from the surface of this property from November 1943 to February 1945. In August 1944 the Magma Copper Co. took an option on the property and began churn drilling in September of that year, continuing this work after the Bureau of Mines had completed its project. The Magma Copper Co. and its subsidiary, the San Manuel Copper Corp., deepened many of the Bureau's holes and also drilled a number of its own, the total being 105.

Two vertical shafts, Nos. 1 and 2, were started. Shaft No. 1 is in the footwall of the ore body and will be used as a permanent operating and ventilation shaft. Shaft No. 2 is being sunk in the ore body and will be used for exploratory and experimental purposes. As of November 9, 1950, Shaft No. 1 was 1,443 feet deep, and shaft No. 2 was 1,640 feet deep.

When the Magma Copper Co. began its drilling campaign at San Manuel it engaged Agne S. Winther as consulting engineer to advise on the drilling program and to estimate ore reserves when the program was completed. In his final report, dated March 1, 1946, Winther estimated total reserves as follows:

| | Tons | Copper, Percent |
|---|---|---|
| Oxide ore | 123,499,580 | 0.767 |
| Sulphide ore | 339,284,920 | 0.786 |
| Total ore | 462,784,500 | 0.782 |

Winther used areas of influence around each drill hole, but omitted several holes in the extreme southwest and also in the extreme northeast. The lower limit of copper content was taken as 0.5 percent. Winther also omitted an area around hole 65 as the thickness of ore was only 110 feet.

H. J. Steele, company geologist, also made an estimate as of March 1, 1946. His ore reserves were:

| | Tons | Copper, Percent |
|---|---|---|
| Oxide ore | 94,415,157 | 0.711 |
| Mixed oxide & sulphide ore | 31,178,526 | 0.679 |
| Sulphide ore | 316,115,598 | 0.776 |
| TOTAL ORE | 441,709,333 | 0.749 |

In his estimate, Steele used only ore that he thought could be mined by block-caving methods. Much of the low-grade oxide ore on the footwall of the ore body at its northeast side was omitted; also omitted was some "fringe" ore outside the drill holes that Winther included in his estimate. Steele used a system of triangles with drill holes at the corners to obtain his ore block areas and average copper content. His lower copper limit also was 0.5 percent. Steele's estimate did not include any tonnage outside the actual drill hole perimeter.

A fast, rough estimate of ore reserves was made by Bureau of Mines engineers, using a system of triangles similar to Steele's. The Bureau obtained a total of 495,487,984 tons of ore, averaging 0.777 percent copper. Because of a lack of time, the Bureau's estimate was not broken down into oxide and sulphide ore. However, it contained a larger percentage of oxide ores than did either Winther's or Steele's estimate.[10]

The estimates of both Winther and Steele were carefully studied and it is believed that either may be accepted.

In all estimates of ore reserves the lower limit of copper content was taken as 0.5 percent.

At the present time, San Manuel Copper Corp. plans to mine only sulphide ore.

## PRODUCTION PLAN

### Mining

Although the San Manuel deposit contains over 400,000,000 tons of low-grade copper ore, in order to get into production as soon as possible the company plans first to develop and mine sulphide ore from the north and southeast ore bodies (see figures 4, 10, and 11). In order to do this the company proposes to deepen shafts 1 and 2, sink 4 new shafts (2 for ventilation and 2 for operating shafts), develop the 1,475-foot haulage level, develop the 1,415-foot grizzly

---

10/ Sherman, Walter R., Estimation of Ore, San Manuel Copper Co., Pinal County, Ariz. Bur. of Mines confidential report, Oct. 25, 1950.

level above this haulage level, and develop parts of the north and southeast ore bodies for block-caving mining methods. However, before the actual stoping blocks are laid out, a large amount of exploratory work from No. 2 shaft will be done.

A more detailed description of this proposed work follows. Initial development work will consist of deepening No. 1 shaft from 1,443 feet, its present depth, to 1,663 feet. This shaft probably will be used only for ventilation later in the program, but will be an operating shaft while the main haulage level is being developed. No. 1 shaft will be sunk the additional 200 feet and a station cut at the 1,475-foot level. The cost for completing this shaft will be $140,709. Details of these costs are shown on page 4 of the Appendix.

While No. 1 shaft is being deepened, No. 2 shaft will be sunk to a total depth of 2,058 feet (it was 1,640 feet deep on November 9, 1950). A station then will be cut on the 1,475-foot level and enough drifting and core drilling will be done to fully explore the proposed stoping site in the southeast ore body. Churn drilling also will be done from the surface. At the present time this ore body has been outlined only by widely spaced churn drill holes and by a small amount of work from No. 2 shaft. More detailed information is necessary in order to more accurately lay out the stopes in this ore body. This initial stage of exploration and development from No. 2 shaft should take about 15 months. Enough

capital, equipment and supplies are on hand to complete the shaft to 2,050 feet. A total of $294,900 will be needed for core and churn drilling (see details of costs in Appendix on page 19).

While Nos. 1 and 2 shafts are being deepened and the exploratory work is being done, Shafts 3, 4, 5, and 6 can be started. Shafts 3 and 4 will be operating shafts, No. 3 for hoisting ore and No. 4 for men and supplies, while Shafts 5 and 6 will be for ventilation only. Locations of these shafts are shown on figure 10 and detailed costs are given on pages 5 - 11 of the Appendix. Complete shaft costs will be: No. 3, $1,320,011; No. 4, $1,167,078; No. 5, $744,577; and No. 6, $744,577.

After the shafts have been completed, or after the completion of any one shaft, drifting will be started on the 1,475-foot haulage level to connect the shafts with the stoping areas (see figure 10). Over 60,000 feet of drifting will be done on this level at a cost of $4,450,800. At the same time, drifting can start from the shafts to develop the 1,415-foot grizzly level. Approximately 34,415 feet of drifting will be done on this level at a cost of $2,009,050. Details of this work are shown on figure 11. Detailed estimated costs are shown on pages 12 and 13 in the Appendix.

After the haulage and ventilation drifts have been driven the stope blocks will be prepared for block caving (see figures 11 and 12). About 13,300 feet of drifting are included in stope development costs. This amount is $798,000.

If the necessary manpower is available, and all equipment and supplies are received when needed, this development program, including the initial exploratory work, should be completed in 36 months. However, as it is expected that the program will not move as smoothly as planned, it probably will be closer to 60 months, than 36, before development and all other work is completed. Present plans call for the completion of town, mill, smelter, etc., by the time the mine development is finished.

At the end of the planned 36-month development period (which may be 1 or 2 years longer than planned), 6 block-caving stopes will be ready to produce ore. However, it will take at least 5 months before these stopes can produce at maximum capacity. Production for the first 6 months is shown on page 62 in the Appendix. After the fifth month, maximum production of approximately 25,000 to 30,000 tons of ore per day can take place.

Milling

The methods and cost of milling were discussed with the corporation officials and Franklin T. Davis, plant metallurgist, for the Magma Copper Co., who has done much of the test work on the oxidized and sulfide ores. Flotation, leaching, and leach-precipitation-flotation of the oxide and mixed oxide-sulfide ores was stressed during initial exploration of the deposit. As the drilling progressed and the large body of sulfide ore was blocked out, attention was focussed on flotation of the low-grade ore to recover the copper and molybdenum.

Except for being somewhat lower grade and requiring slightly finer grinding for liberation, the sulfide ore is similar to other porphyry ores of the Southwest which are being treated successfully by fine grinding and flotation. The average ore will contain about 0.8 percent copper, present largely as chalcopyrite with some chalcocite, 0.04 percent molybdenite, 0.0015 oz. of gold and 0.025 oz. of silver per ton.

Numerous batch flotation tests on a number of drill-core and mine samples showed that the samples varied somewhat in department toward flotation but all were amenable to treatment by conventional reagents. Complementary continuous flotation tests were made on mine samples in the 150-pound per hour pilot plant of the Arizona Bureau of Mines to determine the proper grind for flotation of a classified feed and the influence of regrinding on the grade and recovery of copper concentrates when middlings were recirculated. The tests demonstrated that grinding the ore to 65 mesh was adequate for a roughing separation to reject a tailing assaying 0.045 percent copper. The rougher froth was reground to about 325 mesh to more completely liberate the chalcopyrite for cleaning. The finished concentrates assayed from 26 to 28 percent copper, 1.4 percent molybdenum, 0.05 oz. of gold and 0.[illegible]0 oz. of silver per ton. The copper recovery in the better tests was about 91 percent and the reagent requirements were nominal.

Enough copper concentrates were prepared in the pilot tests for a laboratory study of the separation of molybdenite. Subsequent tests by Messrs. Davis and Charles K. Nobes, Utah Copper Co., demonstrated that the separation and recovery of molybdenite in an acceptable product could be achieved by several methods. Although a final choice has not been made, the Utah Copper Company procedure is favored. Batch tests gave an indicated recovery of 80 percent of the molybdenite in a product which assayed 9 percent molybdenum and 0.5 percent copper.

The flowsheet selected for the 30,000 tons per day concentrator is conventional and the estimated costs appear to be of the proper magnitude. Fortunately, the design staff could draw upon records of the parent Magma Copper Company. Other information on equipment and costs was obtained from the Miami, Morenci and Ajo operations.

A tentative but simplified flowsheet of the mill showing the steps in the treatment and the equipment required is shown in figure 13. The flow sheet for the proposed 30,000 ton concentrator differs only in number and size of the equipment.

The equipment required for the concentrator, crushing plants, concentrate handling and tailing disposal, and water system are listed in pages 40-54, and the estimated cost of the separate installations are given on page 1 of the Appendix. The total cost of the mill and of adjunct units necessary for its operation approximates $21,000,000, or $700 per ton of daily capacity, which is nominal for mills of similar size.

The estimated cost of milling is 40 cents per ton; this accords with known costs of other large Southwestern operations. The costs for mining, milling, smelting and refining, itemized on pages 3-39 and 58-61 of the Appendix, total $1.93 per ton, or 13.3 cents per pound of refined copper; the cost is predicated on recovery of 14.33 pounds of copper from a ton of ore assaying 0.6 percent copper. A credit for the gold, silver and molybdenum in the ore reduces the cost of the finished copper to 10.2 cents per pound. This cost does not include taxes, compensation insurance, amortization and interest.

Although the overall plans for milling the ore are well along and the major equipment has been decided upon, the corporation did not anticipate starting full development of the mine or construction of the surface plant before another year at the earliest. Consequently, the mill plans have not been completed in detail. This could be done while preparing the plant sites and bringing the necessary power and gas to the property for the construction program.

The site for the plant is about 7 miles from the mine, and was selected because of the less rugged terrain and the availability of a large area for impounding tailings. The ore will be hauled in 100-ton cars over an electrified railroad at an estimated cost of 5 cents per ton.

Smelting and Refining

The smelter, to be located adjacent to the mill, has been designed to handle 850 tons per day of a 25 percent copper concentrate which allows some latitude in mill operation. Smelting of green charges (damp, unroasted concentrates) will be practiced. The equipment required for the smelter and flux plant are itemized in the Appendix. The smelter will cost $6,900,000. The anticipated cost of smelting is $5.50 to $6.50 per ton of concentrates, or 1 cent per pound of copper in the smelter feed.

Provisions have been made to fire refine as much of the copper as can be disposed of and to cast the remainder into anodes for electrolytic refining, probably at the El Paso plant of Phelps Dodge Corp. The smelter output is estimated at approximately 10,760,000 pounds of copper per month.

W. F. Goss stated that the American Smelting and Refining Co. had professed some interest in obtaining the San Manuel output for smelting at their Hayden plant. As Hayden is operating at near capacity on Kennecott concentrates, however, additional furnaces and converters would have to be installed to accommodate San Manuel. Phelps Dodge Corp. also is interested in obtaining the concentrates for their Douglas smelter now that Ajo will smelt its own output. Should a drastic shortage of construction material develop, part or all of the San Manuel concentrate might be smelted at Douglas as a temporary expedient. A smelter at the property, however, is essential for an integrated and economic operation.

## Other Surface Facilities

### Railroad Mine to Plant

A location for the townsite and plant some 5 and 7 miles from the mine, respectively, was selected to avoid having caving ground and rough terrain. Various schemes of transporting ore to the mill were considered. As a power plant to supply the mine, mill and smelter will be required, electric locomotive haulage is favored over Diesel operation. The cost of the 7-mile railroad is estimated at $3,450,000. The equipment needed is listed in the Appendix.

Railroad connections to the outside also must be provided. Alternative routes connecting with the Southern Pacific at Winkelman or Hayden are shown in figure 1. Although Winkelman is closer, Hayden would be the better entry point. The cost of the additional 20 miles of right-of-way and track would seem be offset by the saving in freight. No detailed estimate was included for the railroad as the route has not been completely surveyed; an off-hand estimate of the San Manuel staff for the 50-mile railroad was 5 million dollars. Although truck haulage will be necessary during the construction period, the tonnage involved when full production is attained obviously will demand rail transportation. The question as to whether the Southern Pacific Co. or the corporation will build the railroad has not been decided.

## Power Plant and Gas Supply

Although enough surplus power is available in the Southern Arizona Network to care for the construction period, extra generating capacity will have to be installed either at the property or in the network for full-scale operation at San Manuel. A gas fired, steam turbo-generating plant for 60,000 KW is included in the proposal. The plant would care for the maximum load requirements of the mine, surface plants, and townsite (38,700 KW) and leave one spare boiler and 20,000 KW generator for standby operation. The estimated cost of the plant is $8,200,000 and the equipment required is itemized in the Appendix.

A breakdown of the power required during three shift operation is given in table 1. The normal power requirements will be 26 KWH per ton of ore treated.

Gas for the power plant, smelter, and townsite could be obtained by tapping the high-pressure (1000 psi) Texas to California line at or near Willits, about 35 miles southwest of the property. The prevailing rate for large consumers is 26 cents per 1,000 cu. ft. of gas containing about 1 million B.t.u.

Power for mine exploration is now being produced in a 3,000 KW Gas-Diesel generating plant. Natural gas, used as the fuel, is brought into the property through a 6- and 4-inch gas line which connects with the low pressure main serving the Hayden smelter.

Another 2,500 KW generator could be installed to help supply power needs during the initial construction period, but demands for additional power as the project develops would necessitate installation of larger gas lines and generators, or tying into the network transmission lines serving the Tucson area. No decision has been reached as to which would be less costly. The power line now serving the Mammoth-St. Anthony operation is reported to be operating at full load.

## Water Supply

Adequate water for the project has been developed. Water from the mine and that recovered (36 percent) from the thickeners and tailing pond should be ample for the surface plants. Water for the townsite and that required for plant make-up will be pumped from two 500-ft. wells on corporation property in the San Pedro River valley. The anticipated requirements and source of water are as follows:

| Distribution | | Source | | |
|---|---|---|---|---|
| Mill-smelter | 4,200 GPM | Mine - | 3,500 GPM | (300' head) |
| Power plant | 800 " | Recirculated | 1,500 " | |
| Townsite | 700 " | Wells | 700 " | (900' head) |
| TOTAL | 5,700 " | TOTAL | 5,700 " | |

The water supply system including pipe lines in the plants will cost $964,000. The pumps and fittings required are listed on pages 44 and 51 of the Appendix.

## Lime and Flux Plant

A deposit of limestone of excellent quality has been discovered about 7 miles from the plant site. The proposal includes a crushing and screening plant to prepare smelter flux, and a kiln and slaker to supply the flotation plant with hydrated lime. The cost of the plant was set at $690,000 and the equipment required is itemized in the Appendix. It is believed that hydrated lime for flotation can be produced for about 0.5 cent per pound.

## Shops

The customary shops for maintenance and repair of mine and surface plant equipment, and warehouses for storage are included in the proposal. The major equipment are itemized in the Appendix. Estimated cost of the shop and warehouses total $1,892,500.

Cost of change houses was estimated at $207,000 and the laboratory at $86,250.

## Townsite

A model town for the 1,600 underground and surface employees is included in the proposal. The townsite, some 5 miles from the mine and 2 miles from the mill and smelter is on gently sloping ground overlooking the San Pedro River. As the prevailing wind is from the southwest, smelter fumes and dust from the tailing ponds should not be obnoxious as the townsite is at a higher elevation.

In addition to dormitories for single employees, the contemplated plan calls for construction of 300 2-bedroom and 600 3-bedroom houses. Included also is a recreation center with swimming pool, two churches, schools, a hospital, fire and police stations, and shopping center. The estimated cost of the model town, including water and sewage systems is listed at $11,500,000. A detailed breakdown of the estimate is not available.

Construction Schedule

The schedule for construction of the surface plants has been integrated with development of the mine. Provided materials and equipment are received as needed and adequate manpower is available, the program should be completed in 36 months. Another 5 months at least would be required to attain full production for the mine. If difficulties are encountered in mine development, or equipment and supplies are not received promptly, a minimum of 4 and possibly 5 years may be required to bring the property into full production. The surface plants could be completed earlier by contracting for their construction but development of the mine is the bottle neck.

Housing for the workers and power for the construction program must be provided first, and these will be given priority by the corporation.

Graphs showing the estimated rate of monthly expenditures and the number of men required for construction over the 36-month period are shown in figures 14 and 15.

## Materials And Equipment

The equipment for the mine and surface plants and the materials needed for construction are itemized in the Appendix. As many of the items are in short supply and will be increasingly difficult to obtain, priorities will be needed if the construction schedule is to be followed.

## Cost of Project

The anticipated cost of the San Manuel project, not including the railroad to Benson or Winkelman, totals $79,339,250. The costs are itemized in the Appendix.

As the Bureau of Mines engineers were informed that the Corporation had not requested a government loan, financing of the project was only briefly discussed. Should a national emergency demand that San Manuel be brought into early production, the corporation may request financial assistance from the Government. Regardless of whether the project is financed by Government or private funds, priorities for construction materials and equipment will be obligatory and an equitable accelerated amortization plan provided.

It was stated that the Corporation had already spent almost $18,000,000 on the project. While further development of the mine and construction of the surface plants will be done at an opportune time, the Corporation must be guaranteed priorities if they are to proceed on an expedited program.

ESTIMATE 11-A

# TABLE I

--- PRELIMINARY ONLY ---
ESTIMATED POWER REQUIREMENTS

5/7/50

| | | | 30000 TONS PER DAY | | | | | | 45000 TONS PER DAY |
|---|---|---|---|---|---|---|---|---|---|
| | | | MAX K.W.H. PER TON | HOURS OPERATION | MAX. LOAD DAY & AFTERNOON SHIFTS | MAX GRAVE YARD SHIFT | ESTIMATED MINIMUM LOAD | SHUT DOWN LOAD | MAX. DAY & AFTERNOON SHIFTS |
| MINING 3rd LEVEL 4000 TO 12600KW AVERAGE 8KWH PER TON ORE | | UNDERGROUND ORE HANDLING | 0.75 | 24-USE 21 | 1000 | 1000 | | 100 | 1500 |
| | (1) | PUMPING ALL SHAFTS | 2.0 | 24 | 2500 | 2500 | 2500 | 2500 | 2500 |
| | | ORE HOISTING 1st LEVEL (3300 KW) | 2.32 | 24-USE 21 | | | | | |
| | | ORE HOISTING 2nd LEVEL (4500 KW) | 3.16 | " | | | | | |
| | | ORE HOISTING 3rd LEVEL (5600 KW) | 3.93 | " | FULL EQUAL-IZATION 5600 | 5600 | | | 8400 |
| | (2) | MAN & MATERIAL HOISTS | 0.75 | " | 1000 | 1000 | 1000 | 500 | 1000 |
| | | COMPRESSED AND VENTILATING AIR | 1.5 | 24 | 2000 | 2000 | 500 | 500 | 3000 |
| | | FLUX PIT SERVICE SHOPS ETC. | 0.5 | 8 | 500 | | | | 500 |
| AV. .5 | (3) | ORE TRANSPORTATION ASSUME ELECTRIFIED | 0.75 | 24-USE 21 | 1000 | 1000 | | | 2000 |
| MILLING 16875 TO 18750 KW AVERAGE 14KWH PER TON ORE | | CRUSHING PRIMARY & SECONDARY | 1.25 | 24-USE 20 | 1875 | 1875 | | | 2800 |
| | | GRINDING | 8.5 | 24 | 10625 | 10625 | 10625 | | 16000 |
| | | FLOTATION | 2.5 | 24 | 3125 | 3125 | 3125 | | 4600 |
| | (1) | (FROM WELLS) WATER 2500 800 KW | | | | | | | |
| | | THICKENERS 1625 KW | | | | | | | |
| | | TAILINGS 700 KW | 2.5 | 24 | 3125 | 3125 | 3125 | 1000 | 4600 |
| AV. .5 | | SMELTER | 0.75 | 24 | 1000 | 1000 | 500 | 250 | 1500 |
| AUXILIARIES 2300-5350KW AVERAGE 3KW/TON ORE | | LIME BURNING PLANT | 0.25 | 24 | 300 | 300 | 300 | 100 | 300 |
| | | FLUX & LIME ROCK CRUSHING | 0.5 | 8 | 500 | | | | 500 |
| | | LIME ROCK QUARRY | 0.25 | 8 | 300 | | | | 300 |
| | | TOWNSITE | 1.0 | 24 | 1250 | 500 | 500 | 1000 | 1800 |
| | | MAIN SHOPS | 0.5 | 8 | 500 | | | | 500 |
| | | POWER PLANT AUXILIARIES | 2.0 | 24 | 2500 | 2000 | 1500 | 700 | 3750 |
| | | CIRCULATING PUMPS COOLING TOWERS COMPRESSORS, BOILERS | | | | | | | |
| | | TOTAL | | | | | | | |
| | | 3rd LEVEL | * | | 38700 | 36400 | 23675 | 6650 | 55550 |
| | | 2nd LEVEL | | | 37600 | 35300 | 22575 | | |
| | | 1st LEVEL | | | 36400 | 34100 | 21375 | | |

NOTE: ABOVE FIGURES WILL VARY SLIGHTLY ON SOME ITEMS BUT APPROXIMATE LOADS TO BE CARRIED BY POWER PLANT.
(1) INCREASE IN WATER PUMPED FROM WELLS AND DECREASE FROM MINES WILL NOT MATERIALLY CHANGE OVERALL POWER CONSUMPTION, ONLY TRANSMISSION LINE TO WELLS AND SUBSTATION AT WELLS.
(2) IF HANDLED BY ONE MAN & MATERIAL HOIST, DEDUCT 500 KW.
(3) SHOULD DIESEL ELECTRIC LOCOMOTIVE BE USED, DEDUCT 1000 KW.
* AVERAGE OVERALL POWER CONSUMPTION PER TON OF ORE TREATED WILL APPROXIMATE 26 KW AND WILL VARY DURING THE 24 HOURS OPERATION.

SAN MANUEL COPPER CORPORATION

Estimated Cost of Plant for Handling 30,000 tons of Ore per Day.

| Item | Estimated Cost 30,000 Tons per Day | |
|---|---|---|
| Mines and Equipment (2 ore shafts; 2 service shafts; including underground Equipment) | $ 26,180,000 | (1) |
| Ore Transportation (Railroad, Mine to Mill; Including Equipment) | 3,450,000 | |
| Primary Crushing Plant | 575,000 | |
| Coarse Ore Bunkers Mine at Mines | 345,000 | |
| Secondary Crushing Plant and Bins | 1,725,000 | |
| Concentrator | 8,280,000 | |
| Concentrate Handling (Dewatering, etc.) | 276,000 | |
| Tailing Disposal (Including Thickener) | 1,794,000 | |
| Concentrate Conveying | 115,000 | |
| Water Supply | 690,000 | |
| Industrial System (Trucks and Equipment) | 1,150,000 | |
| Pipe Lines | 276,000 | |
| Power Plant (60,000 hp Installed Capacity) | 7,935,000 | (2) |
| Lime Plant | 690,000 | (3) |
| Machine Shop (Including Boiler, Pipe and Welding Shop) | 575,000 | |
| Carpenter Shop | 143,750 | |
| Electric Shop | 86,250 | |
| Warehouses | 287,500 | |
| Laboratory | 86,250 | |

| Item | Estimated Cost 30,000 Tons per Day | |
|---|---|---|
| Change Houses | $ 207,000 | |
| Dropping Chutes | 632,500 | |
| Power Distribution | 661,250 | |
| Construction Plant and Equipment | 2,[illegible] | |
| Shaker (Includes Concentrate Storage and Flue Dust) | 4,900,000 | (4) |
| Administrative Building (General Offices) | 304,750 | |
| Tramwaits | 11,[illegible] | |
| Miscellaneous | 2,[illegible] | |
| TOTAL | $79,339,250 | (5) |

(1) Includes extra hoist and two extra hoisting compartments in one shaft

(2) For 40,000 hr Normal Load leaving one spare boiler and 20,000 hr generator

(3) Depends on Lime Consumption per ton of Ore Treated

(4) Depends on whether 2nd reverberatory is necessary

(5) Transportation to site not included.

## COST ESTIMATE

**For The Development & Bringing Into Production**
**The Man Hummel Mine From the 1475 (First) Haulage Level**
**On a 3 Year Program**

### Summary Sheet

| | | |
|---|---|---|
| **Direct Costs Labor & Materials:** | | |
| No. 1 Shaft | $ 140,709.00 | |
| No. 3 Shaft | $1,320,011.00 | |
| No. 4 Shaft | $1,167,078.00 | |
| No. 5 Shaft | $ 764,577.00 | |
| No. 6 Shaft | $ 764,577.00 | |
| 1475 Haulage Level | $4,450,200.00 | |
| 1415 Orizaly Level | $2,009,050.00 | |
| TOTAL DIRECT COSTS | | $10,576,202.00 |
| **Mine Equipment:** | | $ 4,744,900.00 |
| **Indirect & Overhead Costs:** | | |
| Exploratory Drilling | $ 294,900.00 | |
| Maintenance Labor & Supplies | $ 982,000.00 | |
| Mine Service Labor | $ 662,985.00 | |
| Installation of Equipment Labor | $ 677,005.00 | |
| Power Cost @ $0.01/Kw Hr | $1,041,400.00 | |
| Unapportioned Charges | $2,497,182.39 | |
| TOTAL INDIRECT & O'HEAD COSTS | | $ 6,155,472.39 |
| COST WITHOUT SURFACE INSTALLATIONS | | $21,476,574.39 |
| Headframes, Hoists, Surface Ore bins, etc. | | $ 4,620,000.00 |
| TOTAL COST | | $ 26,096,574.39 |

SAN MANUEL MINE
COST ESTIMATE

**Completion of No. 1 Shaft for Exhaust Ventilation:**

Sinking from 1463 ft. to 1663 ft.

Reinforced Concrete & Steel-4 Compartments
6' x 26½' Inside
For Additional 200 feet of Shaft.

Direct Sinking Cost per Foot:

| | |
|---|---|
| Labor | $192.10 |
| Material | 95.27 |
| Total | $287.37 |

Direct Concreting Cost per Foot:

| | |
|---|---|
| Labor | $ 51.52 |
| Material | 92.47 |
| Total | $143.99 |

Total Direct Shaft Costs per Foot:

| | |
|---|---|
| Labor | $243.62 |
| Material | 187.74 |
| Total | $431.36 |

200 Feet of Shaft @ $431.36 per Foot

| | | |
|---|---|---|
| Total Direct Shaft Cost | | $ 86,272.00 |
| Labor | 148,724.00 | |
| Material | 37,548.00 | |

Shaft Station at 1475 Haulage Level Including
**Station Pumps, Small Pocket and Loading Station:**

| | | |
|---|---|---|
| Excavation 40,000 cu. ft. | | |
| Labor @ 0.675 per Cu. Ft. | $27,000.00 | |
| Material @ 0.255 per Cu. Ft. | 10,200.00 | |
| Total @ 0.93 per Cu. Ft. | | $ 37,200.00 |
| Reinforced Concrete 590 Yds | | |
| Labor @ $11.30 per Cu. Yd. | $6,325.00 | |
| Material @ $19.84 per Cu. Yd. | 10,912.00 | |
| Total @ $31.34 per Cu. Yd. | | $ 17,237.00 |
| | | $ [illegible] |
| Total Station Excavation & Concrete | | |
| Labor | $33,325.00 | |
| Material | 21,112.00 | |
| | | $ 140,709.00 |
| Total Shaft & Station | | |
| Labor | $182,049.00 | |
| Material | 58,660.00 | |

SAN RAFAEL MINE

COST ESTIMATE

SUMMARY OF SHAFTS, STATIONS AND LOADING

POCKETS IN ADDITION TO NO. 1 AND NO. 2 SHAFTS

**NO. 3 SHAFT - ORE HOISTING:**

Shaft Proper 1850 Feet:

Reinf. Concrete & Steel

| | | |
|---|---|---|
| Labor | $464,868.00 | |
| Material | 386,334.00 | |
| Total | | $851,202.00 |

Temporary Sinking Stations:

36,000 Cu. Ft. Excavation-Timber Support

| | | |
|---|---|---|
| Labor | $ 26,424.00 | |
| Material | 8,244.00 | |
| Total | | $ 34,668.00 |

Permanent Stations:

300,000 Cu. Ft. Excav. 2475 Yds. Un. Conc.

| | | |
|---|---|---|
| Labor | $163,662.00 | |
| Material | 349,104.00 | |
| Total | | $263,566.00 |

Permanent Pockets & Loading Stations:

100,000 Cu. Ft. Excav. 1250 Yds. Un. Conc.

| | | |
|---|---|---|
| Labor | $102,975.00 | |
| Material | 68,600.00 | |
| Total | | $170,575.00 |

Total No. 3 Shaft:

| | | |
|---|---|---|
| Labor | $756,729.00 | |
| Material | 512,282.00 | |
| TOTAL | | $1,330,011.00 |

**NO. 4 SHAFT - HOISTING:**

Shaft Proper 1850 Feet:

Reinf. Concrete & Steel

| | | |
|---|---|---|
| Labor | $475,434.00 | |
| Material | 341,010.00 | |
| Total | | $816,444.00 |

Temporary Sinking Stations:

36,000 Cu. Ft. Excav.-Timber Support

| | | |
|---|---|---|
| Labor | $ 26,424.00 | |
| Material | 8,244.00 | |
| Total | | $ 34,668.00 |

**NO. 4 SHAFT - SUTTLES (Cont'd):**

Permanent Stations:
240,000 Cu. Ft. Excav. 2960 Yds. Reinf. Conc.

| | | |
|---|---|---|
| Labor | $196,040.00 | |
| Material | 119,924.00 | |
| Total | | $315,964.00 |

Total No. 4 Shaft:

| | | |
|---|---|---|
| Labor | $497,892.00 | |
| Material | 469,180.00 | |
| Total | | $967,072.00 |

**NO. 5 SHAFT - VENTILATION:**
Shaft Pumper 1300 Feet:
Reinf. Concrete & Steel

| | | |
|---|---|---|
| Labor | $363,435.00 | |
| Material | 237,600.00 | |
| Total | | $601,035.00 |

Temporary Mining Stations:
36,000 Cu. Ft. Excavation-Timber Support

| | | |
|---|---|---|
| Labor | $ 26,429.00 | |
| Material | 8,035.00 | |
| Total | | $ 34,464.00 |

Permanent Stations:
85,000 Cu. Ft. Excav. 1300 Yds. Reinf. Conc.

| | | |
|---|---|---|
| Labor | $ 64,450.00 | |
| Material | 42,225.00 | |
| Total | | $106,675.00 |

Total No. 5 Shaft:

| | | |
|---|---|---|
| Labor | $456,909.00 | |
| Material | 288,068.00 | |
| Total | | $ 744,977.00 |

**NO. 6 SHAFT - VENTILATION:**
1300 Feet Reinf. Concrete & Steel
Cost Estimate Same as No. 5 Shaft
Total No. 6 Shaft:

| | | |
|---|---|---|
| Labor | $456,909.00 | |
| Material | 288,068.00 | |
| Total | | $ 744,977.00 |

TOTAL OF ALL SHAFTS, STATIONS AND LOADING POCKETS:

| | | |
|---|---|---|
| Labor | $2,367,445.00 | |
| Material | 1,608,796.00 | |
| TOTAL | | $3,976,241.00 |

## DETAIL COST ESTIMATE
## SHAFTS, STATIONS AND LOADING POCKETS

**No. 2 SHAFT (FOR RAILROAD HOISTING)**

Concrete & Steel, 5 compartment 4' x 34½' inside
33% Greater Vol. per Ft. than No. 1 Shaft.

Direct Sinking Cost per Foot:

| | | |
|---|---|---|
| Labor | $ | 196.67 |
| Material | | 117.50 |
| Total | | 314.17 |

Direct Concreting Cost per Foot:

| | | |
|---|---|---|
| Labor | $ | 61.59 |
| Material | | 97.13 |
| Total | | 158.72 |

Total Direct Shaft Costs per Foot:

| | | |
|---|---|---|
| Labor | $ | 258.26 |
| Material | | 214.63 |
| Total | | 472.89 |

1800 Foot Shaft at $472.89 per Foot

| | | |
|---|---|---|
| Total Direct Shaft Cost | | $851,202.00 |
| Labor | $464,866.00 | |
| Material | 386,336.00 | |

TEMPORARY STATIONS DURING SINKING
TO HOLD MONTHLY PUMPING EQUIPMENT

3 Stations @ 12,000 Cu. Ft. Each:
Total Excavation 36,000 Cu. Ft.:
Labor @ $0.734 per Cu. Ft. $26,424.00
Material @ $0.209 per Cu.Ft. 7,524.00
Total @ $0.943 per Cu.Ft. — $ 33,948.00

MAIN SHAFT STATION AT 3475 HAULAGE LEVEL

Excavation 300,000 Cu. Ft.:
Labor @ $0.475 per Cu.Ft. $135,000.00
Material @ $0.255 per Cu.Ft. 51,000.00
Total @ $0.73 per Cu. Ft. — $186,000.00

Reinforced Concrete 2K 2475 Yards:
Based on 3:1 ratio Excav. to Conc.
Labor @ $13.50 per Cu. Yd. $ 28,462.00
Material @ $19.84 per Cu.Yd. 42,104.00
Total @ $33.34 per Cu.Yd. — $ 77,566.00

## MAIN SHAFT STATION AT 1475 HAULAGE LEVEL (CONT'D)

| | | |
|---|---|---|
| Total Station Excavation & Concrete | | $261,566.00 |
| Labor | $161,462.00 | |
| Material | 100,104.00 | |

### SHAFT POCKETS AND LOADING STATION

| | | |
|---|---|---|
| Excavation 108,000 Cu. Ft.: | | |
| Labor @ $0.8[illegible] per Cu. Ft. | $ 87,400.00 | |
| Material @ $0.4[illegible] per Cu. Ft. | 43,600.00 | |
| Total | | $131,000.00 |
| Reinforced Concrete 1250 Yds.: | | |
| Labor @ $11.50 per Yd. | $ 14,375.00 | |
| Material @ $19.[illegible] per Yd. | 24,[illegible] | |
| Total @ $[illegible].34 per Yd. | | $ 39,375.00 |
| Total Pockets & Loading Station | | $170,375.00 |
| Labor | $[illegible],975.00 | |
| Material | 48,400.00 | |

**NO. 2 SHAFT (FOR SUPPLIES):**

Concrete & Steel, 3 compartments 12' x 19½' inside
[illegible]% Greater Vol. per Ft. than No. 1 Shaft

| | |
|---|---|
| Direct Sinking Cost per Foot: | |
| Labor | $ 218.51 |
| Material | 117.[illegible] |
| Total | 336.[illegible] |
| Direct Concreting Cost per Foot: | |
| Labor | 45.62 |
| Material | 71.[illegible] |
| Total | 117.57 |
| Total Direct Shaft Costs per Foot: | |
| Labor | $ 264.13 |
| Material | 189.45 |
| Total | 453.58 |

1600 Feet Shaft at $453.58 per Foot

| | | |
|---|---|---|
| Total Direct Shaft Cost: | | $726,[illegible] |
| Labor | $475,434.00 | |
| Material | 341,000.00 | |

TEMPORARY STATIONS DURING SINKING
TO ALLOW BOOSTER PUMPING EQUIPMENT

3 Stations at 12,000 Cu. Ft. each:

Total Excavation 36,000 Cu. Ft.

| | | |
|---|---|---|
| Labor @ $0.734 per Cu. Ft. | $ 26,424.00 | |
| Material @ $0.229 per Cu.Ft. | 8,244.00 | |
| Total @ $0.963 per Cu.Ft. | | $ 34,668.00 |

MAIN SHAFT STATION AT 1425 GRIZZLY LEVEL

Excavation 120,000 Cu. Ft.:

| | | |
|---|---|---|
| Labor @ $0.675 per Cu. Ft. | $ 81,000.00 | |
| Material @ $0.255 per Cu.Ft. | 30,600.00 | |
| Total @ $0.93 per Cu.Ft. | | $111,600.00 |

Reinforced Concrete 1400 Yards:

| | | |
|---|---|---|
| Labor @ $11.50 per Yd. | $ 17,020.00 | |
| Material @ $19.84 per yd. | 29,363.00 | |
| Total @ $31.34 per yd. | | $ 46,383.00 |

| | | |
|---|---|---|
| Total Station Cost: | | $157,983.00 |
| Labor | $ 98,020.00 | |
| Material | 59,963.00 | |

MAIN SHAFT STATION AT HAVLAGE LEVEL

Same as Grizzly Level Station

120,000 Cu. Ft. Excavation - 1400 Yds. Reinforced Concrete

| | | |
|---|---|---|
| Labor | $98,020.00 | |
| Material | 59,963.00 | |
| Total | | $157,983.00 |

NO. 5 SHAFT (FOR VENTILATION)

Concrete & Steel Circular 16 Ft. Diameter Inside

Direct Sinking Cost per Foot:

| | | |
|---|---|---|
| Labor | $ | 196.47 |
| Material | | 102.47 |
| Total | | 298.94 |

Direct Concreting Cost per Foot:

| | | |
|---|---|---|
| Labor | $ | 45.62 |
| Material | | 56.33 |
| Total | | 101.95 |

Total Direct Shaft Costs per Foot:

| | | |
|---|---|---|
| Labor | $ | 242.29 |
| Material | | 158.40 |
| Total | | 400.69 |

1500 Foot Shaft at $400.69 per Foot

| | | |
|---|---|---|
| Total Direct Shaft Cost | | $601,035.00 |
| Labor | $363,435.00 | |
| Material | 237,600.00 | |

TEMPORARY STATIONS DURING SINKING
TO HOLD HOISTING EQUIPMENT

3 Stations at 12,000 Cu. Ft. each:

| | |
|---|---|
| Total Excavation 36,000 Cu. Ft. | |
| Same as No. 3 and No. 4 Shafts | |
| Total Cost | $ 34,668.00 |

SHAFT STATION AT 1415 GRIZZLY LEVEL

| | | |
|---|---|---|
| Excavation 40,000 Cu. Ft.: | | |
| Labor @ $0.675 per Cu. Ft. | $ 27,000.00 | |
| Material @ $0.255 per Cu. Ft. | 10,200.00 | |
| Total @ $0.93 per Cu. Ft. | | $ 37,200.00 |
| Reinforced Concrete 530 Yards: | | |
| Labor @ $11.50 per Cu. Yd. | $ 6,325.00 | |
| Material @ $19.84 per Cu. Yd. | 10,912.00 | |
| Total @ $31.34 per Cu.Yd. | | $ 17,237.00 |
| Total Station-Excavation & Concrete: | | $ 54,437.00 |
| Labor | $ 33,325.00 | |
| Material | 21,112.00 | |

SHAFT STATION AT 1475 HAULAGE LEVEL

Same as Grizzly Level Station

| | | |
|---|---|---|
| 40,000 Cu. Ft. Excavation-530 Yds. Reinf. Concrete | | |
| Labor | $ 33,325.00 | |
| Material | 21,112.00 | |
| Total | | $ 54,437.00 |

**NO. 6 SHAFT (FOR VENTILATION):**

Concrete & Steel Circular 16 Ft. Diameter Inside.

Same as No. 5 Shaft.

1900 Feet of Shaft at $400.69 per Ft.

| | | |
|---|---|---|
| Direct Shaft Cost Total | | $761,035.00 |
| Labor | $363,435.00 | |
| Material | 397,600.00 | |

**TEMPORARY STATIONS DURING SINKING**
**TO HOLD ROTOR PUMPING EQUIPMENT**

36,000 Cu. Ft. Excavation

| | | |
|---|---|---|
| Same as No. 5 Shaft | | |
| Labor | $ 26,424.00 | |
| Material | 8,240.00 | |
| Total | | $ 34,664.00 |

**GRIZZLY AND HAULAGE LEVEL STATIONS**

Same as No. 5 Shaft

Total of 20,000 Cu. Ft. Excavation
1,100 Yds. Reinforced Concrete

| | | |
|---|---|---|
| Total Cost | | $108,275.00 |
| Labor | $ 66,650.00 | |
| Material | 42,325.00 | |

## 1475 LEVEL FOOTAGE ESTIMATE PLAN 1

| | Feet | Timber Cost Per Foot | Timber Total Cost | Concrete or Timber Cost Per Foot | Concrete or Timber Total Cost |
|---|---|---|---|---|---|
| No. 3 Shaft Area | 1,130 | 360 | $ 67,800 | $105 | $ 118,650 |
| No. 4 Shaft Area | 2,700 | 60 | 162,000 | 105 | 283,500 |
| Southeast Ore Body Haulage Loop | 13,960 | 60 | 836,400 | | 1,306,400-a |
| North Ore Body Haulage Loop | 4,678 | 60 | 280,800 | 60 | 280,800-b |
| Haulage in 6 S.E. Panels | 20,990 | 60 | 1,257,000 | 60 | 1,257,000-b |
| Haulage in 2 North Panels | 4,625 | 60 | 277,500 | 60 | 277,500-b |
| No. 1 Shaft Pump Station & Sumps | 700 | 60 | 42,000 | 105 | 73,500 |
| Ventilation No. 1 to No. 2 | 4,478 | 50 | 223,900 | 90 | 402,300 |
| Ventilation Drift No. 5 to S.E. | 2,840 | 50 | 142,000 | 90 | 255,600 |
| Ventilation Drift No. 6 to S.E. | 3,425 | 50 | 171,250 | 90 | 308,250 |
| Ventilation Drift North Ore Body to No. 1 | 970 | 50 | 48,500 | 90 | 87,300 |
| TOTAL | 60,420 | | $3,306,150 | | $4,450,200 |
| Footage to Finish Block Development | 16,000 | | | | |
| Footage included in stope Development Cost S.E. 11,130 North 2,170 | 13,300 | 60 | 798,000 | | |

a – 6000' concreted @ $105

b – No concrete

## 1415 GRIZZLY LEVEL PASSAGE ESTIMATE PLAN 1

| | Feet | Timber Cost per Foot | Timber Total Cost | Concrete or Timber Cost per Foot | Concrete or Timber Total Cost |
|---|---|---|---|---|---|
| No. 4 Shaft Station Area | 960 | $ 60 | $ 57,600 | $105 | $ 100,800 |
| Supply Drift No. 4 Shaft to S.E. Ore Body | 4,620 | 50 | 231,000 | 50 | 231,000 |
| Supply Drift to North Ore Body | 1,185 | 50 | 59,250 | 50 | 59,250 |
| Fringe Loop on S. E. Ore Body | 6,470 | 50 | 323,500 | 50 | 323,500 |
| North-South Fringe Drifts S.E. | 8,600 | 50 | 430,000 | 50 | 430,000 |
| East-West Fringe Drifts S.E. | 2,070 | 40 | 82,800 | 40 | 82,800 |
| Fringe Loop on North Ore Body | 2,760 | 50 | 138,000 | 50 | 138,000 |
| North-South Fringe Drifts on North Ore Body | 1,520 | 50 | 76,000 | 50 | 76,000 |
| No. 2 - 1415 Station | | | 10,000 | | 10,000 |
| 3 Ventilation Raises | 180 | 100 | 18,000 | 100 | 18,000 |
| Ventilation Drift No. 5 to S.E. | 3,185 | 50 | 155,250 | 50 | 279,450 |
| Ventilation Drift No. 6 to S.E. | 2,825 | 50 | 141,250 | 50 | 254,250 |
| Ventilation Drift North Ore Body to Ventilation Raise | 130 | 50 | 6,500 | 50 | 6,500 |
| TOTAL | 34,415 | | $1,728,650 | | $2,009,050 |

October 24, 1950

## Cost Estimate Sunlaredary Drilling Plan

| | | |
|---|---|---|
| 4 - | 2500' Churn Drill Holes @ $10 = to determine shaft locations | $100,000.00 |
| | 41,400' D. D. Hole @ $3.50 On 125' to outline S.L. Ore Body | $144,900.00 |
| | | $244,900.00 |

## COST ESTIMATE FOR SHAFT SINKING & MINE DEVELOPMENT WORKS
## MAINTENANCE LABOR & SUPPLIES

Based on Average Maintenance Labor & Supply Cost
No. 2 Shaft July 1949 - Sept. 1950

| Month | Preparation of Shaft Sites | Shaft Sinking | Mine Development | Total |
|---|---|---|---|---|
| First | $ 2,000.00 | $ 4,000.00 | $ 4,000.00 | $ 10,000.00 |
| Second | 4,000.00 | 4,000.00 | 6,000.00 | 14,000.00 |
| Third | 6,000.00 | 4,000.00 | 6,000.00 | 16,000.00 |
| Fourth | 6,000.00 | 4,000.00 | 7,000.00 | 17,000.00 |
| Fifth | 6,000.00 | | 11,000.00 | 17,000.00 |
| Sixth | 6,000.00 | | 11,000.00 | 17,000.00 |
| Seventh | 6,000.00 | | 11,000.00 | 17,000.00 |
| Eighth | 6,000.00 | | 11,000.00 | 17,000.00 |
| Ninth | 6,000.00 | 4,000.00 | 12,000.00 | 22,000.00 |
| Tenth | 4,000.00 | 8,000.00 | 12,000.00 | 24,000.00 |
| Eleventh | | 8,000.00 | 13,000.00 | 21,000.00 |
| Twelfth | | 12,000.00 | 13,000.00 | 25,000.00 |
| Thirteenth | | 12,000.00 | 13,000.00 | 25,000.00 |
| Fourteenth | | 15,000.00 | 13,000.00 | 28,000.00 |
| Fifteenth | | 15,000.00 | 14,000.00 | 29,000.00 |
| Sixteenth | | 15,000.00 | 14,000.00 | 29,000.00 |
| Seventeenth | | 15,000.00 | 14,000.00 | 29,000.00 |
| Eighteenth | | 15,000.00 | 14,000.00 | 29,000.00 |
| Nineteenth | | 16,000.00 | 14,000.00 | 30,000.00 |
| Twentieth | | 16,000.00 | 14,000.00 | 30,000.00 |
| Twenty-First | | 16,000.00 | 14,000.00 | 30,000.00 |
| Twenty-Second | | 16,000.00 | 14,000.00 | 30,000.00 |

| Month | Preparation of Shaft Mines | Shaft Sinking | Mine Development | Total |
|---|---|---|---|---|
| Twenty-Third | $ | $ 16,000.00 | $ 14,000.00 | $ 30,000.00 |
| Twenty-Fourth | | 17,000.00 | 14,000.00 | 31,000.00 |
| Twenty-Fifth | | 17,000.00 | 14,000.00 | 31,000.00 |
| Twenty-Sixth | | 17,000.00 | 14,000.00 | 31,000.00 |
| Twenty-Seventh | | 17,000.00 | 14,000.00 | 31,000.00 |
| Twenty-Eighth | | 17,000.00 | 14,000.00 | 31,000.00 |
| Twenty-Ninth | | 18,000.00 | 14,000.00 | 32,000.00 |
| Thirtieth | | 18,000.00 | 16,000.00 | 34,000.00 |
| Thirty-First | | 18,000.00 | 17,000.00 | 35,000.00 |
| Thirty-Second | | 18,000.00 | 18,000.00 | 36,000.00 |
| Thirty-Third | | 18,000.00 | 19,000.00 | 37,000.00 |
| Thirty-Fourth | | 18,000.00 | 19,000.00 | 37,000.00 |
| Thirty-Fifth | | 18,000.00 | 19,000.00 | 37,000.00 |
| Thirty-Sixth | | 18,000.00 | 19,000.00 | 37,000.00 |
| Total | $52,000.00 | $420,000.00 | $530,000.00 | $982,000.00 |

## COST ESTIMATE

For Mine Service Men Including Helpers, Gagers and General Underground Labor
For the Development of New Hanna Mine

| LEVEL | No. of Men | Total Labor |
|---|---|---|
| First | 18 | $ 6,720.00 |
| Second | 18 | 6,720.00 |
| Third | 18 | 6,720.00 |
| Fourth | 32 | 11,945.00 |
| Fifth | 32 | 11,945.00 |
| Sixth | 32 | 11,945.00 |
| Seventh | 32 | 11,945.00 |
| Eighth | 32 | 11,945.00 |
| Ninth | 35 | 13,055.00 |
| Tenth | 35 | 13,055.00 |
| Eleventh | 35 | 13,055.00 |
| Twelfth | 35 | 13,055.00 |
| Thirteenth | 35 | 13,055.00 |
| Fourteenth | 35 | 13,055.00 |
| Fifteenth | 49 | 18,235.00 |
| Sixteenth | 49 | 18,235.00 |
| Seventeenth | 49 | 18,235.00 |
| Eighteenth | 49 | 18,235.00 |
| Nineteenth | 49 | 18,235.00 |
| Twentieth | 49 | 18,235.00 |
| Twenty-First | 49 | 18,235.00 |
| Twenty-Second | 49 | 18,235.00 |

| Month | No. of Men | Total Labor |
|---|---|---|
| Twenty-Third | 49 | $ 14,235.00 |
| Twenty-Fourth | 49 | 14,235.00 |
| Twenty-Fifth | 49 | 14,235.00 |
| Twenty-Sixth | 49 | 14,235.00 |
| Twenty-Seventh | 77 | 22,595.00 |
| Twenty-Eighth | 77 | 22,595.00 |
| Twenty-Ninth | 77 | 22,595.00 |
| Thirtieth | 77 | 22,595.00 |
| Thirty-First | 77 | 22,595.00 |
| Thirty-Second | 77 | 22,595.00 |
| Thirty-Third | 77 | 22,595.00 |
| Thirty-Fourth | 77 | 22,595.00 |
| Thirty-Fifth | 77 | 22,595.00 |
| Thirty-Sixth | 77 | 22,595.00 |
| TOTAL LABOR COST | | $660,985.00 |

## [illegible]

For Shaft Sinking & Mine Development Program

Labor For Installation of Equipment

Based on Equipment Installation Costs to Date

**SURFACE EQUIPMENT FOR MINE DEVELOPMENT OPERAT:**

Installable Equipment valued at $678,000.00

Installation Labor 17.5% $118,650.00

**MINE HAULAGE EQUIPMENT:**

Dumping Tipples, Shaft Loading Chutes, Rolling Stock & Power Units

Valued at $1,546,000.00

Installation Labor 10% $154,600.00

**LOADING EQUIPMENT:**

Shaft & Drift Machers, Slushers & Auxiliary Air Hoists with accessories

Valued at $136,000.00

Installation Labor 5% $ 6,800.00

**PUMPING EQUIPMENT:**

Temporary sinking, booster and drainage pumps--permanent pumping equipment with all accessories. Includes motors & starting equipment.

Valued at $337,700.00

Installation Labor 15.5% $ 52,335.00

**VENTILATION EQUIPMENT:**

Temporary & Permanent Fans with motors and starters plus ducts & ventilation accessories.

Valued at $285,500.00

Installation Labor 15.0% $ 42,825.00

**DRILLING EQUIPMENT:**

Drill Jumbos-Rock Drills with non-expendable accessories

Valued at $101,500.00

Installation Labor 3.0% $ 3,045.00

**UNDERGROUND PIPE LINES:**

For permanent compressed air, water, & fire protection systems.

Pipe & fittings valued at $264,000.00

Installation Labor 40.0% $106,400.00

**UNDERGROUND POWER DISTRIBUTION & SUB-STATIONS:**

Power lines, transformers & sub-station switch gear does not include starting equipment

Valued at $600,000.00

Installation Labor 30.0% $180,000.00

TOTAL LABOR FOR INSTALLATION OF ABOVE EQUIPMENT $677,005.00

November 5, 1950

## COST ESTIMATE

### Power Requirements for Shaft Sinking & Mine Development Program

Based on Gen Manual Power Requirements to Date

| Month | Gen'l Surface Requirements Kw Building Kwh | Sh. Sinking & Station Develop. Kwh | Mine Develop. Kwh | Total Kw. Hrs. Kwh | Total Power Cost at $0.01 Per Kw Hr. |
|---|---|---|---|---|---|
| First | 100,000 | 335,000 | 600,000 | 1,035,000 | $ 10,350.00 |
| Second | 100,000 | 335,000 | 600,000 | 1,135,000 | 11,350.00 |
| Third | 100,000 | 440,000 | 700,000 | 1,240,000 | 12,400.00 |
| Fourth | 125,000 | 500,000 | 750,000 | 1,375,000 | 13,750.00 |
| Fifth | 125,000 | | 1,300,000 | 1,425,000 | 14,250.00 |
| Sixth | 125,000 | | 1,400,000 | 1,525,000 | 15,250.00 |
| Seventh | 150,000 | | 1,500,000 | 1,650,000 | 16,500.00 |
| Eighth | 200,000 | | 1,550,000 | 1,750,000 | 17,500.00 |
| Ninth | 250,000 | 50,000 | 1,600,000 | 1,900,000 | 19,000.00 |
| Tenth | 250,000 | 80,000 | 1,650,000 | 1,980,000 | 19,800.00 |
| Eleventh | 250,000 | 200,000 | 1,700,000 | 2,150,000 | 21,500.00 |
| Twelvth | 250,000 | 250,000 | 1,750,000 | 2,250,000 | 22,500.00 |
| Thirteenth | 250,000 | 300,000 | 1,750,000 | 2,300,000 | 23,000.00 |
| Fourteenth | 250,000 | 400,000 | 1,750,000 | 2,400,000 | 24,000.00 |
| Fifteenth | 275,000 | 500,000 | 1,800,000 | 2,575,000 | 25,750.00 |
| Sixteenth | 275,000 | 600,000 | 1,800,000 | 2,675,000 | 26,750.00 |
| Seventeenth | 275,000 | 700,000 | 1,800,000 | 2,775,000 | 27,750.00 |
| Eighteenth | 300,000 | 800,000 | 1,800,000 | 2,900,000 | 29,000.00 |
| Nineteenth | 300,000 | 900,000 | 1,800,000 | 3,000,000 | 30,000.00 |
| Twentieth | 300,000 | 1,000,000 | 1,800,000 | 3,100,000 | 31,000.00 |
| Twenty-First | 300,000 | 1,100,000 | 1,800,000 | 3,200,000 | 32,000.00 |

| Month | Gen'l Surface Requirements Pe Refining KWH | Sh. Sinking & Station Development KWH | Mine Develop. KWH | Total K.W. Hrs. KWH | Total Power Cost at $0.03 Per Kw Hr. |
|---|---|---|---|---|---|
| Twenty-second | 300,000 | 1,200,000 | 1,800,000 | 3,300,000 | $ 33,000.00 |
| Twenty-third | 300,000 | 1,300,000 | 1,800,000 | 3,400,000 | 34,000.00 |
| Twenty-fourth | 300,000 | 1,500,000 | 1,800,000 | 3,600,000 | 36,000.00 |
| Twenty-fifth | 300,000 | 1,700,000 | 1,800,000 | 3,800,000 | 38,000.00 |
| Twenty-sixth | 300,000 | 1,800,000 | 1,800,000 | 3,900,000 | 39,000.00 |
| Twenty-seventh | 300,000 | 1,900,000 | 1,800,000 | 4,000,000 | 40,000.00 |
| Twenty-eighth | 300,000 | 2,000,000 | 1,800,000 | 4,100,000 | 41,000.00 |
| Twenty-ninth | 300,000 | 2,050,000 | 1,800,000 | 4,150,000 | 41,500.00 |
| Thirtieth | 300,000 | 2,100,000 | 1,900,000 | 4,300,000 | 43,000.00 |
| Thirty-first | 300,000 | 2,150,000 | 1,900,000 | 4,350,000 | 43,500.00 |
| Thirty-second | 300,000 | 2,200,000 | 1,900,000 | 4,400,000 | 44,000.00 |
| Thirty-third | 300,000 | 2,300,000 | 2,000,000 | 4,500,000 | 45,000.00 |
| Thirty-fourth | 300,000 | 2,000,000 | 2,180,000 | 4,480,000 | 44,800.00 |
| Thirty-fifth | 300,000 | 1,500,000 | 2,200,000 | 4,000,000 | 40,000.00 |
| Thirty-sixth | 300,000 | 800,000 | 2,500,000 | 3,600,000 | 36,000.00 |
| Total | 9,050,000 | 34,940,000 | 60,150,000 | 104,140,000 | $1,041,400.00 |

## COST ESTIMATE

## OF

## UNAPPROPRIATED CHARGES

## FOR DISPLACEMENT OF [illegible]

| | |
|---|---|
| Insurance | $ 471,[illegible].39 |
| General Supervision & Overhead Salaries | 525,600.00 |
| Taxes, Medical Services and Other Miscellaneous Charges | 1,[illegible] |
| TOTAL UNAPPROPRIATED | $ 2,477,[illegible].39 |

## [illegible]

**[illegible]:**

| | | |
|---|---|---|
| Based on Total Payroll (Ex Bonus) | | $ 5,951,735.00 |
| Employment Group Insurance $1.[illegible]/$1,000 | | 11,[illegible]3.95 |
| Workmen's Comp. Ins. [illegible]/$100 | | [illegible] |
| Unempl. Ins. | 2.5% | |
| Old Age Ins. | 1.5% | |
| | 4.3% | |
| On $3600/Year per employee | | |
| 1st Yr. 350 men at $154.00 | | $ 47,900.00 |
| 2nd Yr. 437 men at 154.00 | | 67,447.60 |
| 3rd Yr. 550 men at 154.00 | | 85,140.00 |

**FIRE & CONTINGENT INSURANCE:**

Mine Plant Valuation:

| | |
|---|---|
| $2,500,000 at $0.35 per $100 | |
| $8,750 for 3 years | $ [illegible] |
| TOTAL INSURANCE | $ 474,[illegible].39 |

## SALARIES TO CERRO

## SUPERVISION & WORKS

| Job Zero 9th Month | Monthly Salary |
|---|---|
| 1 Mine Supt. | $ 600.00 |
| 1 Mine Foreman | 500.00 |
| 1 Shaft Foreman | 500.00 |
| 3 Shift Bosses | 1,350.00 |
| 1 Ch. Engineer | 600.00 |
| 1 Asst. Ch. Engineer | 450.00 |
| 2 Engineers | 800.00 |
| 2 Engineers Helpers | 450.00 |
| 1 Ch. Geologist | 500.00 |
| 1 Geologist | 400.00 |
| 2 Samplers | 650.00 |
| 1 Master Mechanic | 600.00 |
| 1 Ch. Elec. Engineer | 600.00 |
| 1 Ch. Clerk | 450.00 |
| 1 Clerk | 300.00 |
| 1 Supply Foreman | 425.00 |
| 1 Warehouse Foreman | 375.00 |
| 22 Men | 19,800.00 |
| 9 months at $9800.00/month | $88,200.00 |

| Job Term 24th Month | Monthly Salary |
|---|---|
| 1 Mine Supt. | $ 700.00 |
| 1 Mine Foreman | 550.00 |
| 4 Shaft Foreman | 2,100.00 |
| 3 Shift Bosses | 1,350.00 |
| 1 Chief Engineer | 650.00 |
| 1 Asst. Chief Engineer | 500.00 |
| 4 Engineers | 1,000.00 |
| 2 Engineers Helpers | 700.00 |
| 1 Chief Geologist | 550.00 |
| 1 Geologist | 425.00 |
| 1 Asst. Geologist | 375.00 |
| 3 Samplers | 1,050.00 |
| 1 Master Mechanic | 650.00 |
| 1 Asst. Master Mechanic | 500.00 |
| 1 Electrical Engineer | 650.00 |
| 1 Asst. Engineer | 500.00 |
| 1 Chief Clerk | 500.00 |
| 2 Clerks | 700.00 |
| 1 Supply Foreman | 450.00 |
| 1 Warehouse Foreman | 400.00 |
| 32 Men | $14,900.00 |
| 15 months at $14,900/month | $223,500.00 |

| 25th Thru 36th Month | Monthly Salary |
|---|---|
| 1 Mine Supt. | $ 750.00 |
| 1 Mine Foreman | 550.00 |
| 1 Asst. Mine Foreman | 500.00 |
| 4 Shift Foremen | 2,100.00 |
| 3 Shift Bosses | 1,475.00 |
| 3 Level Bosses | 1,350.00 |
| 1 Chief Engineer | 700.00 |
| 1 Asst. Chief Engineer | 500.00 |
| 4 Engineers | 1,600.00 |
| 2 Engineers Helpers | 700.00 |
| 1 Chief Geologist | 600.00 |
| 1 Geologist | 425.00 |
| 1 Asst. Geologist | 375.00 |
| 3 Samplers | 1,050.00 |
| 1 Master Mechanic | 700.00 |
| 1 Asst. Master Mechanic | 500.00 |
| 1 Electrical Engineer | 700.00 |
| 1 Asst. Electrical Engineer | 500.00 |
| 1 Chief Clerk | 500.00 |
| 4 Clerks | 1,400.00 |
| 1 Supply Foreman | 450.00 |
| 1 Warehouse Foreman | 400.00 |
| 38 Men | $17,825.00 |
| 12 months at $17,825 | $213,900.00 |
| TOTAL SALARIES FOR G.S., SUPERVISION & OVERHEAD FOR 3 YEAR PERIOD | $525,600.00 |

October 1978

MINING COST ESTIMATES

## Mining Tonnage Used in Plan 1

| | Estimated Mining Tons | Grade | Av. Hard |
|---|---|---|---|
| Southeast Ore Body | 52,828,165 | 0.80 | 376' |
| North Ore Body | 7,715,800 | 0.65 | 308' |
| Total Ore | 60,543,965 | | |

| | Tons Underout First | Tons Drawn |
|---|---|---|
| Southeast Ore Body | 36,308,898 | 43,570,798 |
| North Ore Body | 6,417,138 | 7,706,356 |
| Total | 42,725,962 | 51,273,154 |

## Tons Not Underout or Underout Later

| | | |
|---|---|---|
| Southeast Ore Body Pillars | 16,591,898 | |
| Southeast Ore Body Fringe Area outside Stopes | 3,927,488 | 4,712,997 |
| North Ore Body Pillars | 1,298,678 | |
| Total | 17,818,003 | 4,712,997 |
| TOTAL ORE | 60,543,965 | 55,986,151 |

## STOPE AREA [illegible] VERTICAL FOOT [illegible]

| | Area Mined | Cost/Sq. Ft. |
|---|---|---|
| Drawpoint 17.5' x 17.5' | 306.25 Sq. Ft. | |
| Grizzly | 612.50 | $ 0.08 |
| Raise - one backover | 1225.00 | 2.45 |
| Chute | 1225.00 | .49 |
| Loading Station | 2450.00 | .13 |
| Grizzly Drift One Foot | 29.34 | 1.02 |
| Grizzly Fringe One Foot | 100.00 | .48 |
| Haulage Drift One Foot | 70.00 | .71 |
| Development Total | | $ 5.36 |
| Complete Undercut | | 2.61 |
| Development and Stoping Total | | $7.97 |

## DEVELOPMENT AND STOPING COST PER TONNE

| Haul in Feet | Development Cost/Ton | Stoping Cost/Ton | Total Cost/Ton |
|---|---|---|---|
| 50 | $ 1.325 | $ 0.647 | $ 1.972 |
| 100 | .497 | .309 | .806 |
| 200 | .309 | .164 | .473 |
| 300 | .229 | .110 | .339 |
| 400 | .164 | .082 | .246 |
| 500 | .131 | .066 | .197 |
| 600 | .109 | .055 | .164 |

## MINING COST ESTIMATE

| | | $/ton |
|---|---|---|
| **Drill** | | |
| Labor - $\frac{\$11.78}{300 \text{ ton/shift}}$ | = .046 | |
| Explosives | .01 | $0.056 |
| **Haulage Operation** | | |
| Labor - $\frac{22 \times 11.78}{30,000}$ | = .041 | |
| Haulage Power | .01 | |
| Equipment Maintenance | .01 | 0.061 |
| **Ordinary Maintenance** | | |
| Labor - $\frac{\$13.78}{300}$ | = .069 | |
| Timber | .069 | 0.138 |
| **Haulage Maintenance** | | |
| Labor - $\frac{\$13.78}{300}$ | = .046 | |
| Timber | .046 | 0.092 |
| **Hoisting** | | 0.04 |
| **Miscellaneous** | | 0.11 |
| TOTAL MINING COST | | $0.527 |
| Pumping 5000 G.P.M. | | 0.020 |

**Miscellaneous Costs**
**Including Shaft Plant**

| | |
|---|---|
| Men & supplies | |
| General Management | |
| Ventilation | |
| Sanitation | .15 |
| Safety | |
| Lights | |
| Supervision | |

**NOTE BENEAT**

Miner 7.5, 12.72 / 1.06 Overtime = $13.78/shift

## [illegible] FRUIT [illegible] COST

| | Linear Ft. | Board Feet | Cost Per Foot |
|---|---|---|---|
| 1 - 10' Cap 12" X 12" | 10 | 120 | |
| 2 - 10' Post 12" X 12" | 20 | 240 | |
| 2 - 4' Collar Brace 2" X 10" | 8 | 14 | |
| 20 - 5' Logging 2" X 10" | 100 | [illegible] | |
| | | [illegible] | |
| Allow 20% Extra | | [illegible] | |
| Total for 5' Cut | | [illegible] | |
| One Foot of Brick Kicker | | 172 | $3.76 |
| Nails, 2" 60 lb. Nail at .05 lb. = | 3.00 | | |
| Fishplate, etc. | .50 | | |
| Crack Tab | .80 | | |
| Labor - | | | |
| 6 man at 15.00 = [illegible] | .62 | | 3.80 |
| Brakeman Patch $\frac{60'}{\$15.00}$ / 3 Yd. Ft. | | | 1.50 |
| Contract Labor $3.5.00 per foot / 1/6 | | | 17.50 |
| Explosives (1.475 No. 2 Dumps) | | | 2.10 |
| 4" Pipe | | | 1.50 |
| 2" Pipe | | | .25 |
| 24" Tree | | | 3.49 |
| Miscellaneous | | | 2.00 |
| TOTAL | | | $46.33 |

Est. $50.00

July 1950 - Installing Dumps
Chief's Labor & Extra 25.54
Material 16.71
41.87

## [illegible] ESTIMATED COST

| | | Linear Ft. | Board Feet | Cost Per Foot |
|---|---|---|---|---|
| 1 - 5' Cap | 12" X 12" | 9 | [illegible] | |
| 2 - 5' Posts | 12" X 12" | 18 | [illegible] | |
| 2 - 4' 8" Collar Braces | 8" X 10" | 8 | [illegible] | |
| 27 - Longitudinal | 2" X 12" | 135 | [illegible] | |
| | | | [illegible] | |
| Allow 20% Extra | | | [illegible] | |
| Total For 5' Bed | | | [illegible] | |
| One Foot of Depth | at $80.00 per MBF | | 155 | $12.40 |
| Nails 20 Lb. Keg | | | | |
| 2/3 X $5.23 (Min. 17% Material Cost) = | | | 3.70 | |
| Labor Per Foot | | | .50 | 4.20 |
| Footings | | | | 2.16 |
| 4" Pipe | | | | 1.50 |
| 2" Pipe | | | | .20 |
| Miscellaneous | | | | 2.00 |
| Contract Labor | $12.00/Ft. / 1/4 | | | [illegible] |
| TOTAL | | | | [illegible] |

Use $40.00

## [illegible] FOOTAGE CALCULATED PER FLOOR In Line

| | | | | |
|---|---|---|---|---|
| 5 Corner Blocks | 3 | sides | = | 15 |
| 14 End " | [illegible] | " | = | [illegible] |
| 6 Inside " | 2 | " | = | 12 |
| | | | | [illegible] |

[illegible] = 1.69 Use 2 sides per block

Using a 210' X 200' Block & allowing for curves

[illegible] Sq. Ft. = 102 Sq. Ft.

Use 100

## [illegible] DRAFT CALCULATED COST

| | | Cost/Ft. |
|---|---|---|
| Originally cut (From Entry Page 32) Changed to 12" X 12" | | |
| Timber in Originally cut = | 1372 M. Ft. | |
| 8 - 12" X 12" Posts X 6' 6" | [illegible] | |
| 8 - 12" X 12" Caps X 4' 8" | [illegible] | |
| 8 - 8" X 10" C.B. X 4' | [illegible] | |
| 8" X 12" Lagging | [illegible] | |
| | [illegible] | |
| Allow 20% Extra | [illegible] | |
| | [illegible] | |
| [illegible] X $80.00 = | | $ 14.44 |
| 2" Air | | .37 |
| 2" Water | | .20 |
| Explosives | | 1.00 |
| Contract Labor $9.00 / 1/4 | | 2.25 |
| | | $ 18.72 |

Use $18.00

## ADJUSTED FINAL CALCULATED COST

| | | |
|---|---|---|
| Timber - - Same as Haulage 10 X 1,376 = | $ | 137.60 |
| Explosives | | 1.00 |
| Contract Labor (Same as Haulage) 10 X 17.50 | | 175.00 |
| | $ | [illegible] |

Use $325.00

## OFFICE CALCULATED COST

Aplison bill on Chute at No. 1 Ore Bin

| | | |
|---|---|---|
| was $1,145.50 50% Salvage | $ | 573.00 |

## TRAPPER RAISE OCLOUS-TOP COST

| | |
|---|---|
| Angle Iron (3 x 3½ x 5/16") 22.6' x 6.5 LB. x .08 | $5.37 |
| 200 BM. Ft. Timber at $60.00 | 11.52 |
| Explosives | 1.00 |
| Contract Labor at $6.00 / 1/6 | 1.00 |
| | $17.89 |

Use $40.00

## TRAPPER RAISE DETAIL

| | |
|---|---|
| Rail - 88' of 45 LB. at .05 | $21.00 |
| Labor | 19.00 |
| | $39.00 |

Stope Undercut in a 20.0' x 200' = 18,000 Sq. Ft. Block

| | |
|---|---|
| 192 Raises X 30' each = 5760' at $14.00/Ft = | $80,640 |
| 16 Undercut Drifts X 20.0' each = 3360' at $12.00 = | 40,320 |
| 40,000 Sq. Ft. at $.80 per Sq. Ft. = 32,000 - (3360' x 5') = 48,000 | 38,400 |
| Total Cost | $154,360 |

$154,360 / 32,000 = $2.43 per Sq. Ft.

SAN MANUEL MINE

COST ESTIMATE

SUMMARY FOR MINE EQUIPMENT

| | |
|---|---|
| **Surface Equipment Required:** To prepare mine for production including equipment required to carry through the development program | $1,016,300.00 |
| **Haulage Equipment Required:** For mine development and production haulage | $2,566,000.00 |
| **Loading Equipment Required:** For mine development and development expansion during production | $ 136,000.00 |
| **Pumping Equipment Required:** For mine development and permanent pumping installation | $ 337,700.00 |
| **Ventilation Equipment Required:** For mine development and permanent ventilation installation | $ 285,500.00 |
| **Drilling Equipment Required:** For mine development and development expansion during production | $ 101,500.00 |
| **Underground Pipe Lines Required:** For permanent air and water distribution and fire protection. Temporary lines for development included in development footage costs | $ 260,000.00 |
| **Underground Power Distribution & Sub-Stations:** For mine development and permanent production installation | $ 600,000.00 |
| **Hand and Power Tools Required:** To develop and start the mine in production | $ 50,000.00 |
| **Warehouse Stock Required:** To include spare parts and tools for above equipment and machinery. Ten percent of above equipment and machinery | $ 405,900.00 |
| TOTAL MINE EQUIPMENT | $4,764,900.00 |

## DETAIL OF MINE EQUIPMENT

**Surface (Per Development Program):**

| | |
|---|---|
| 4 Shaft Sites Excavation and Grading | $ 20,000.00 |
| 4 Headframes and Bins - Erected with all accessories | $ 215,000.00 |
| 4 250-H.P. Sinking Hoists - Installed including housing and all accessories | $ 250,000.00 |
| Ropes, crossheads and buckets for sinking 4 shafts | $ 22,000.00 |
| 4 temporary change rooms | $ 15,000.00 |
| Compressed air and distribution at shaft sites | $ 75,000.00 |
| Water distribution and fire protection at shaft sites | $ 15,000.00 |
| Gas distribution to shaft sites | $ 7,500.00 |
| Telephone communication | $ 2,500.00 |
| Roads | $ 10,000.00 |
| Sewerage | $ 15,000.00 |
| Power lines and sub-stations (power source not included) | $ 250,000.00 |
| Temporary warehousing | $ 25,000.00 |
| 1 Concrete batch plant (30 ton) with mixer (1/2 yard) | $ 7,500.00 |
| 1 Concrete batch plant (60 ton) with mixer (1 yard) | $ 18,000.00 |
| 2 concrete placers | $ 10,000.00 |
| 6 1-1/2 ton dump trucks | $ 14,200.00 |
| 4 1-1/2 ton cargo trucks | $ 15,600.00 |
| 2 5-ton cargo trucks | $ 18,000.00 |
| 1 motor grader | $ 18,000.00 |
| TOTAL SURFACE | $1,084,300.00 |

**Haulage (For Development & Production):**

| | |
|---|---|
| 2 Car dumping tipples at No. 3 Shaft complete with all accessories | $ 75,000.00 |
| 2 Sets of skip loading chutes each side of No. 3 shaft complete with accessories | $ 150,000.00 |
| 13 20-ton haulage locomotives complete with all accessories | $ 375,000.00 |
| 11 8-ton development and supply locomotives complete with all accessories | $ 200,000.00 |
| 110 20-ton capacity ore cars (or their equivalent) | $ 440,000.00 |
| 90 5-ton capacity development cars | $ 144,000.00 |
| 45 Supply trucks | $ 32,000.00 |
| 3 500-K.W. Rectifiers with transformers and switch gear installed | $ 150,000.00 |
| TOTAL HAULAGE | $2,566,000.00 |

**Loading (For Development):**

| | |
|---|---|
| 6 Riddell type shaft mucking machines shop built complete with clamshell | $ 30,000.00 |
| 12 Air powered drift loaders medium size | $ 50,000.00 |
| 20 2500-lb. double drum air powered slusher hoists complete with rope and scrapes | $ 45,000.00 |
| 10 2000-lb. single drum air powered utility hoist with rope | $ 11,000.00 |
| TOTAL LOADING | $ 136,000.00 |

**Pumping**

**Temporary Sinking, Booster & Gathering:**

| | |
|---|---|
| 8 75-H.P., 500 G.P.M., 400 ft. head sinking pumps with accessories and fittings | $ 40,000.00 |
| 12 75-H.P., 500 G.P.M., 400 ft. head booster pumps with accessories and fittings | $ 42,000.00 |

**Pumping (Continued):**

| | | |
|---|---|---|
| 16 | 150-H.P., 500-G.P.M., 750-ft. head booster pumps with accessories and fittings | $ 68,000.00 |
| 8 | Auxiliary 50-H.P. motor pumps 300 G.P.M. @ 400 ft. head with accessories and fittings | $ 19,200.00 |
| 12 | 40-H.P., single stage gathering pumps 500 G.P.M. at 150 ft. head with accessories and fittings | $ 36,000.00 |
| 25 | Air driven sump pumps with accessories and fittings | $ 7,500.00 |

**Permanent Pumping Equipment:**

| | | |
|---|---|---|
| 4 | 500-H.P., 1000-G.P.M. at 1500 ft. head station pumps with controls, accessories and fittings | $ 80,000.00 |
| 2 | 250-H.P., 500 G.P.M. at 1500 ft. head station pumps with controls, accessories and fittings | $ 25,000.00 |
| | TOTAL PUMPING | $ 337,700.00 |

**Ventilation:**

| | | |
|---|---|---|
| 2 | 900-H.P., 500,000 c.f.m., 8" w.g. ventilation fans complete with all accessories and necessary housing | $ 135,000.00 |
| 1 | 500-H.P., 300,000 c.f.m., 8" w.g. ventilation fan complete with all accessories and necessary housing | $ 37,500.00 |
| 8 | 100-H.P., 60,000 c.f.m., 8" w.g. ventilation fans complete with all accessories and necessary housing | $ 80,000.00 |
| 4 | 40-H.P., 20,000 C.F.M., 8" w.g. ventilation fans complete with all accessories and necessary housing | $ 16,000.00 |
| 24 | 15-H.P., 18,000 c.f.m., 8" w.g. ventilation fans complete with accessories | $ 25,000.00 |
| 20 | Compressed air 6" air movers | $ 7,000.00 |
| | TOTAL VENTILATION | $ 305,500.00 |

**Drilling:**

| | | |
|---|---|---|
| 12 | Drill jumbos complete with fittings and accessories | $ 48,000.00 |
| 68 | 3" drifter rock drills | $ 16,800.00 |
| 24 | 2-3/4" stoper rock drills | $ 15,600.00 |
| 30 | 55# sinker rock drills | $ 17,500.00 |
| 12 | 45# sinker rock drills | $ 3,600.00 |
| | TOTAL DRILLING | $ 101,500.00 |

**Mine Lines:**

**Compressed Air (Permanent System):**

| | |
|---|---|
| 3500 Ft. 12" pipe with fittings | $ 16,500.00 |
| 8000 Ft. 10" pipe with fittings | $ 29,500.00 |
| 12000 Ft. 8" pipe with fittings | $ 34,500.00 |
| 15000 Ft. 6" pipe with fittings | $ 31,500.00 |
| 30000 Ft. 4" pipe with fittings | $ 37,000.00 |
| 35000 Ft. 2" pipe with fittings | $ 13,500.00 |
| Total compressed air lines | $ 164,500.00 |

**Mine Water Distribution & Fire Protection:**

| | |
|---|---|
| 25000 Ft. 4" pipe with fittings | $ 31,500.00 |
| 50000 Ft. 2" pipe with fittings | $ 19,000.00 |
| 20000 Ft. 1" pipe with fittings | $ 5,000.00 |
| Total | $ 55,500.00 |

**Dewatering:**

| | |
|---|---|
| 3500 Ft. 12" pipe Km. S. with fittings | $ 25,000.00 |
| 10000 Ft. 6" pipe with fittings | $ 21,000.00 |
| Total | $ 46,000.00 |
| TOTAL PIPE LINES | $ 266,000.00 |

## SAN MANUEL COPPER CORPORATION

## Estimated Quantities of Material Required for Construction of Permanent Plant

MINES (Surface only) Permanent ore and service hoists, headframes, ore bins, hoist houses, compressors
ORE TRANSPORTATION Railroad, Mines to Mill
CRUSHING PLANT
CONCENTRATOR (Including Molybdenite Plant)
SMELTER (Including Flux Crushing Plant)
ACID PLANT
POWER PLANT
MACHINE SHOPS AND WAREHOUSE
ORE UNDERGROUND

** GENERAL **

| Quantity | Description |
|---|---|
| 20,000 tons | Structural steel (Fabricated for ore bins, buildings, bridges, conveyor galleries, etc.) |
| 4,500 tons | Reinforcing steel (includes smelter chimney) |
| 500 tons | Steel plate, Bar steel, angles, channels, etc. |
| 5,000 squares | Roofing, Transite, RPM or equiv. |
| 6,000 squares | Siding, Transite, RPM or equiv. |
| 90,000 sq. ft. | Steel sash with glazing |
| 40 | Steel rolling doors |
| 100 | Roof ventilators |
| 2,000 tons | 131# rails, (Ore Transportation), Splice Bars, Bolts, Nuts, Spikes, Bearing Plates, Frogs, etc. (maybe welded), approx. 8 miles of track |
| 1,000 tons | 90# rails (Plant) assuming main line railroad to be built with accessories approx. 6 miles of track |
| 24,000 | Ties 6" x 10" x 9'0" |
| 18,000 | Ties 5" x 6" x 9'0" |

PIPING AND VALVES INCLUDING DISTRIBUTORS
IN TUNNELS

| Quantity | Description |
|---|---|
| 5,800 tons | Steel pipe, 1/4" to 12". Spiral welded pipe 16", 24", 42" |
| 500 tons | Valves and fittings for above pipe |
| | CONVEYORS |
| 150 lin. ft. | 60" belt conveyor including belt & equipment |
| 2,100 lin. ft. | 48" belt " " " " |
| 850 " | 36" " " " " " |
| 2,400 " | 30" " " " " " |
| 3,200 " | 24" " " " " " |
| 12 | Conveyor Weightometers: 1-48", 1-36", 8-30", 2-24" |
| 3 | 54" suspended magnets |
| 3 | Magnetic pulleys: 2-48" x 50", 1-30" x 30" |
| | MOTORS (EXCEPT IN KNOB PLANT) |
| 750 | Electric motors, sizes 3 HP to 900 HP includes Sq. cage, wound rotor, Syn. & D. C. Total Motor HP - 36,000 |
| 750 | Controls for above motors |
| | CONCRETE - APPROX. 80,000 CU. YDS. |
| 120,000 bbls | Cement (Includes for cobbler chimney) |
| 100,000 sq. ft. | 3/4" plywood for forms |
| 3,000M bd. ft. | Lumber for forms |
| | MINE SURFACE |
| 2 | 5,000 HP double drum electric ore hoists drums 15 ft. dia. X approx. 96" face |
| 10,000 ft. | 2 1/4 ø wire rope |
| 4 | 18 ton cap'y skips bottom discharge |
| 4 | 15 ft. sheaves shafts and bearings |
| 2 | 4,000 KW flywheel motor generator sets |

| Quantity | Description |
|---|---|
| 4 | 2500 HP D. C. hoist motors & controls |
| 2 | 50 ton elec. overhead cranes 60 ft. span |
| 2 | 1000 HP double drum electric service hoists, drum 12 ft. dia. x 96" face, (Geared passenger type may be considered) |
| 18,000 ft. | 1 7/8" wire rope |
| 4 | 12 ft. dia sheaves |
| 2 | Double deck cages about 7' x 13' |
| 2 | Counter wts. |
| 2 | 750 KW syn. M.G. sets |
| 4 | 500 HP D.C. hoist motors & controls |
| 2 | 25 ton elect. overhead cranes 60 ft. span |
| 2 | 5000 cu ft air compressors 100# |
| 2 | 1000 HP syn. motors, exciters and starters |
| 2 | Air receivers and connecting piping |

ORE TRANSPORTATION

| | |
|---|---|
| 2 | 125 ton straight electric locomotives (Alternative diesel electric " ) |
| 40 | Ore cars (100 ton ore capacity) |
| 1 | Portable compressor with pneumatic tools |

ELECTRIFICATION

| | |
|---|---|
| 1 | 1000 KW substation |
| 7 miles | Trolley electrification |

ORE RECEIVING BIN AND CRUSHING PLANT

| | |
|---|---|
| 12 | Ore feeders (Manganese) 60" - 72" wide x 16 ft. long |
| 2 | 5 ft x 12 ft screens with 5 HP tenrope drive |
| 6 | 5 ft x 10 ft. screens with 10 HP tenrope drive |
| 2 | 24" x 72" primary crushers (gyratory or equiv.) with 300 HP tenrope drive |
| 4 | 18" x 84" secondary crushers or equiv. with 300 HP tenrope drive |
| 2 | Dust collecting units 20,000 CFM |
| 1 | Dust collecting unit 10,000 CFM |
| 1 | Dust Collecting Unit 2000-3000 CFM |
| 2 | 60" magnets |
| 1 | 50 Ton electric overhead crane 50 ft. span |
| 2 | 2 ton hand cranes |
| 1 | Freight elevator about 3000 lbs. capacity, 6' x 8' platform |

| Quantity | Description |
|---|---|
| | **CONCENTRATOR** |
| 1 | Traveling tripper fine ore bin |
| 2 | Dust collecting units |
| 8 | Rod mills 10' x 14' or equivalent |
| 8 | Ball mills 10' x 12' or equivalent |
| 8 | Duplex spiral 96" classifiers or equiv. |
| 240 | 66" flotation machines (Roughers) |
| 80 | 54" " " (cleaners) |
| 4 | 8' x 12' Regrind Mills |
| 4 | 54" duplex spiral classifiers |
| 8 | 6" Wilfley or Hydroseal sand pumps |
| 4 | 8" " " " " |
| 6 | 3" or 4" sump pumps |
| 1 | 225 ton elec. overhead travelling crane 60 ft. span |
| 1 | 10 ton " " " " 60 ft " |
| 1 | 5 " " " " " 64 ft " |
| 1 | 10 " " " " " 64 ft " |
| 1 | 10 " " " " " 48 ft " |
| 1 | 5 " " " " " 34 ft " |
| 1 | 2 " hand operated crane 16 ft span |
| 1 | Freight elevator about 3000# capacity 6' x 8' platform |
| | **MAINTENANCE PLANT** |
| | **APPROXIMATE EQUIPMENT REQUIRED** |
| 2 | Concentrate thickeners 50 - 75 ft. dia. |
| 2 | Concentrate filters |
| 1 | 20 ft roaster or equivalent |
| 2 | Reagent agitating and conditioning tanks |
| 24 | 54" or 66" flotation cells (roughers) |
| 12 | 28" x 28" flotation cells (or equiv.) (Cleaners) |
| 4 | 22" x 27" or equivalent flotation cells (Scalecleaners) |
| 1 | 4 ft - 4 leaf filter or equivalent |
| 1 | 18" x 12 ft. moly concentrate dryer |
| | **--- POSSIBLE ADDITIONAL REQUIRED ---** |
| 1 | 4 ft - 6 leaf filter |
| 1 | 16 ft. roaster |
| 1 | 4 ft x 4 ft ball mill |
| 1 | 24" spiral or drag classifier |

| Quantity | Description |
|---|---|
| | CONCENTRATE HANDLING AND DEWATERING |
| 2 | 100 ft. Dorr thickeners, Torque type |
| 4 | 8' - 6' dia. 7 disc filters |
| 1 | 60" x 88" vacuum receiver |
| 1 | Moisture trap |
| 2 | Filtrate pumps (3") |
| 2 | Vacuum pumps 2500 CFM capacity ea. |
| 2 | Blowers, 325 CFM @ 1 lb. sq. in. ea. |
| 2 | Return water pumps |
| 2 | Concentrate pumps, Hydroseal or Wilfley |
| 2 | 6" Diaphram pumps |
| 1 | Sump pump |
| 1 | 12' dia x 8' overflow tank |
| 1 | 2 ton elec. overhead crane 23 ft span |
| 1 | 2 ton elec. overhead crane 16 ft span |
| | TAILINGS DISPOSAL |
| 1 | 90 ft dia Dorr Hydroseparator |
| 4 | 300 ft dia Dorr thickeners (Alternatively 3 - 325 ft dia) |
| 5 | 5000 GPM, Horiz. centrifugal pumps, 300 ft. HD for return water to mill reservoir |
| 3 | 1000 GPM, Horiz. centrifugal pumps, 600 ft. HD for return water from tailings pond to mill reservoir |
| 1 | 3 ton hand crane 20 ft span |
| 1 | 2 ton hand crane 20 ft span |
| 5,000 ft | 36" pipe, transite or wood |
| 20,000 ft. | 24" " " " |
| 20,000 ft. | 30" " " " |
| | WATER SUPPLY |
| 5 | 500,000 gallons capacity water storage tanks |
| 1 | 200,000 " " " " tank |
| 3 | 1000 GPM horiz. centrifugal pumps 1200 ft hd |
| 3 | Deep well pumps or as may be required |
| 1 | 2 ton hand crane 20 ft span |
| | INDUSTRIAL SYSTEM |
| 1 | 45 ton diesel electric switching locomotive |
| 2 | Flat cars 50 ton capacity |
| 1 | 100 ton scale |

| Quantity | Description |
|---|---|
| | **PIPE LINES** |
| 2 | Sewage Disposal Plants (1 for townsite, 1 for plant) |
| 2,000 Lin. Ft. | 8" Vitrified pipe (for plant only) |
| 5,000 Lin. Ft. | 6" " " " " " |
| 2,000 Lin. Ft. | 4" " " " " " |
| | **POWER PLANT** |
| 3 | 20,000 KW preferred standard turbo-generators 850# pressure 900° F total temp. |
| 3 | 20,000 sq ft condensers with auxiliaries, pumps, air injector, etc. |
| 1 lot | Switchgear, switchboard, etc. |
| 3 | 200,000# Steam Boilers 850# pressure 900° F total temp. with auxiliaries Fans, Boiler Feed Pumps, Control Boards, etc. |
| 1 | 7-unit induced draft cooling tower 72' wide x 210' long x 30' high, 40,000 gal capacity, material redwood lumber, aluminum blades, 14 - 40 HP motors, 14 reducers |
| 1 | Water treating plant |
| 1 | Substation 40,000 KW |
| 2 | 1500 CFM air compressors 100# PSI with Air Cleaners, etc. |
| 2 | 300 HP motors |
| 2 | 30,000 CFM turbo blowers 15# PSI with condensers, pumps, etc. (For smelter) |
| 2 | 300 KW H. G. sets for smelter |
| 1 | 30 ton elec. overhead crane 70 ft span |
| 2 | 10,000 bbl fuel oil storage tanks |
| | **SHOP** MACHINE, BOILER, BLACKSMITH, PIPE, TIN, WELDING, ELECTRIC AND CARPENTER |
| 425 tons | Shop tools, lathes, shapers, planers, boring mills, plate & structural working tools, welding equipment, etc. |
| 1 | 20 ton elec. overhead crane, 30 ft. span |
| 2 | 2 " " " " , 20 ft. span |
| 1 | 10 " " " " , 40 ft. span |
| 25 tons | Shop tools for electric shop drills, grinders, etc. |
| 30 tons | Wood working tools, saws, planers, lathes, etc. |

| Quantity | Description |
|---|---|
| | WAREHOUSE |
| 1 | 10 ton elec. overhead crane, 30 ft span |
| 1 | Freight elevator, about 3000 lbs. capacity 6' x 8' platform |
| 1 lot | Steel shelving |
| 2 | Portable platform scales |
| 1 | Borrank warehouse scale |
| | LIME PLANT |
| 1 | 5' x 16' manganese feeder |
| 1 | 36" x 42" jaw crusher |
| 4 | 30" x 72" pan feeders |
| 3 | 4' x 6' screens (1 for flux crusher) |
| 1 | 5 1/2' Symons (or equit.) STD. crusher for lime |
| 1 | 5 1/2' Symons (or equiv.) S. H. crusher for flux |
| 1 | Lime Kiln (Rotary) approx. 8' dia x 300' long |
| 1 | Bucket elevator |
| 2 | Redler conveyors |
| 1 | Slaker |
| 2 | Milk of lime storage tanks 50' dia. x 20' with agitators |
| 2 | Pumps |
| 1 | 10 ton elec. overhead traveling crane 25 ft span |
| 1 | 10 ton " " " " 35 ft span |
| | GARAGE |
| 1 | 5 ton elec. overhead traveling crane 25' span |
| 1 lot | Tools, including hydraulic lift |

SMELTER

FLUX CRUSHING AND SAMPLING, FLUX AND CONCENTRATE STORAGE BIN

| | |
|---|---|
| 1 | 60" Snyder sampler (or equiv.) |
| 1 set | 24" x 14" crushing rolls (or equiv.) |
| 1 set | 42" x 16" " " " " |
| 1 | 4' x 5' screen |
| 1 | 8" Bucket elevator |
| 36 | 42" pan or belt feeders |

| Quantity | Description |
|---|---|

REVERB PLANT, CONVERTER AND CASTING PLANT, CHIMNEY AND COTTRELL

REVERB PLANT

| | |
|---|---|
| 2 | Drag conveyors (or equiv.) |
| 2 | Reverb concentrate feeders |
| 8 | Gas and oil burners |
| 2 | Waste heat boilers, 15,000 sq. ft. Heating surface ea. |
| 4 | 225 cu. ft. slag cars |
| 2 | 25 ton diesel electric locomotives |
| 500 tons | Silica brick for 1 furnace incl. Silica Arch |
| 100 tons | Fire brick for 1 furnace |
| 400 tons | Magnesite brick for 1 furnace |
| ALTERNATIVELY | |
| 850 tons | Magnesite brick for furnace incl. suspended magnesite arch. |
| 300 tons | Silica brick |
| 100 tons | Fire brick |

CONVERTER AND CASTING PLANT

| | |
|---|---|
| 3 | 13' x 30' converters |
| 1 | 13' x 25' holding furnace |
| 1 | Casting machine, Walker type |
| 2 | 60 ton D. C. electric overhead travelling cranes, 60 ft. span |
| 4 | Cast steel ladles 175 cu. ft. capacity |
| 1 | 10 ton elec. overhead travelling crane 50 ft. span |
| 600 tons | Magnesite brick for converters & holding furnace |
| 85 tons | Burnt magnesite for " " " |
| 50 tons | Magnesite cement " " " " |
| 1 | 100 tons capacity scale |

CHIMNEY

SMELTER CHIMNEY APPROX. 30 FT. DIA. x 600 FT. HIGH

CEMENT AND REINFORCING STEEL INCLUDED UNDER GENERAL QUANTITIES

| | |
|---|---|
| 1,800 tons | Acid resisting brick for lining |
| 150 tons | Acid resisting cement |
| 25 tons | Mineral wool insulation |
| 1 | Cottrell Plant (Electric copper precipitator) To handle 300,000 - 600,000 CFM of smelter gases |

| Quantity | Description |
|---|---|
| | **MAJOR MATERIALS USED IN CONSTRUCTION** |
| | Structural steel |
| | Brick |
| | Small pipe, wire, air operated |
| | Rappers and Doors |
| | Electric rectifiers |
| | Sewer scavengers |
| | **CONSTRUCTION PLANT** |
| | Following to be provided if San Manuel does own construction, part only if contracted |
| *5 | 1 to 1 1/2 yd shovels |
| *10 | 5 to 7 1/2 yd dump trucks |
| 2 | Caterpillar D-7 or 8 Dozer or equiv. |
| 2 | Road patrol 10' blade |
| 2 | Tank (water) trucks |
| 1 | 18 ton truck crane P & H 255A or equiv. with attachment for shovel, dragline, clamshell, trenches, and pile driver |
| 2 | 315 CFM portable compressors with pneumatic diggers I.R.S. 75 or equiv. with spades, flat picks, etc. |
| 2 | 210 CFM portable compressors with tie tampers, wrenches, etc. |
| 1 | Standard mobile ditcher 12" to 24" ditch to 8'3" deep |
| 1 | Small mobile ditcher 8" to 12" ditch to 3' 6" deep |
| *2 | Portable auger drill |
| 1 | Portable auger drill |
| 2 | Winch trucks |
| 1 | Hydro crane 3-ton with trailer |
| 2 | Flat bottom trucks 5 to 10 ton |
| 6 | Pickups |
| 1 | 2 Cu. yd. concrete mixing plant (bulk cement) (Capacity approx. 200 yds per shift - equipped with two mixers) |
| 3 | 2 yd trucks equipped with 2 yd dump crete body |
| 2 | 4 yd trucks equipped with 4 yd dump crete body |
| 1 | 2 cu yd concrete mixing plant (bulk cement) (capacity approx. 200 yds per shift standard one mixer) |
| 1 | Bending and cutting equipment for reinforcing steel. |
| 1 | Sand Washing and crushing plant 50 to 75 yds per hour |

*Portion of these items to be used for operation of flux and lime pits.

| Quantity | Description |
|---|---|
| 1 | 1 yd shovel |
| 7 | 5 yd trucks |
| 1 | Asphalt mixing plant |
| 1 | Spreader |
| 1 | Roller |
| 4 | 300 AMP portable welding sets |

POWER DISTRIBUTION

POWER HOUSE SUBSTATION

| | |
|---|---|
| 75 tons | Aust sizes galv. angle bars |
| 10 tons | Bus bar copper and fittings |
| 300 | Bus insulators for 15 KV |
| 200 | " " " 69 KV |
| 5 | Oil Circuit breakers 69 KV 1200 AMP 250MM KVA |
| 15 | Disconnect SWS. 69 KV 600 AMP |
| 40 | Air circuit breakers 15 KV with oscillograms and auxiliaries |
| 6 | Air circuit breakers (Gen. Main) |
| 2 | Air circuit breakers (30,000 KVA Trans Main) |
| 1 | 30,000 KVA 13.8 / 69 KV transformer (Mine Power) |
| 1 | 1000 KVA 13.8 KV/440 V transformer (power plant aux.) |
| 1 | 100 KVA 13.8 KV/ 220 / 200 transformer (power plant lighting) |
| 5 sets | 69 KV lightening arresters |
| 18 sets | 13.8 KV lightening arresters with capacitors |
| 10 tons | 13.8 KV power cable |
| 1 | 50 circuit 440V switchboard (power plant aux.) |
| 1 | 20 circuit 2300V switchboard |
| 1 | 2000 KVA 2300V transformer (power plant aux.) |
| 2 tons | 2300 V cable (power plant aux.) |
| 4 tons | 440 V wire & cable (power plant lighting & power) |
| 1 | 100 circuit lighting panel |
| 500 | Assorted lighting units with switches, outlet boxes, etc. |
| 50 tons | Galv. conduit assorted sizes |

TRANSMISSION LINES

| | |
|---|---|
| 70 tons | 4/0 - 19 Std H.D. bare copper wire |
| 40 tons | 2/0 - 7 Std H.D. " " " |
| 6,000 | 10" disc insulators |
| 400 | 50' No. 1 cedar poles |
| 100 | 40' " " " " |
| 50 miles | 3/8" Galv. 7 std Steel wire cross arms, hardware, guys, ground rods, anchor bolts, etc., for 25 miles 69 KV line |

| Quantity | Description |
|---|---|
| | **NO. 1 SHAFT SUB** |
| 10 tons | Assorted sizes of galv. angle bars |
| 4,000 KVA | 69/2.3 KV transformers with necessary switchgear |
| 10 tons | 5 KV mine feeder cables |
| 2 tons | Galv. conduit, assorted sizes |
| 2 tons | 600 V wire and cable |
| 1 ton | Bus bar copper, connectors and fittings |
| 1 set | 69 KV lightning arresters |
| 1 set | 69 KV disconnect switches |
| | **NO. 2 SHAFT SUB** |
| 5 tons | Assorted sizes galv. angle bars |
| 3,000 KVA | 69/2.3 KV transformers with necessary switchgear |
| 10 tons | 5 KV mine feeder cables |
| 1 ton | Bus bar copper connectors and fittings |
| 1 ton | Galv. conduit assorted sizes |
| 1 ton | 600 V wire and cables |
| 1 set | 69 KV lightning arresters |
| 1 set | 69 KV disconnect switches |
| | **NO. 3 SHAFT SUB** |
| 10 tons | Galv. angle bars assorted sizes |
| 10,000 KVA | 69/2.3 KV transformers with necessary switchgear |
| 10 tons | 5 KV mine feeder cables |
| 2 tons | Galv. conduit assorted sizes |
| 2 tons | 600 V wire and cables |
| 2 tons | Bus bar copper connectors and fittings |
| 3 sets | 69 KV lightning arresters |
| 3 sets | 69 KV disconnect switches |
| | **NO. 4 SHAFT SUB** |
| | Same as No. 3 |
| | **NO. 5 SHAFT SUB** |
| 10 tons | Galv. angle bars assorted sizes |
| 2,000 KVA | 69/2.3 KV transformers with necessary switchgear |
| 5 tons | 5 KV mine feeder cables |
| 1 ton | Galv. conduit assorted sizes |
| 2 tons | 600 V wire and cables |
| 1 ton | Bus bar copper connectors and fittings |
| 1 set | 69 KV disconnect switches |
| 1 set | 69 KV lightning arresters |

| Quantity | Description |
|---|---|

## No. 4 SHAFT SUB

Same as No. 5

## S.R RECTIFIER SUB

| | |
|---|---|
| 1 | 1500 KVA 69 KVA trans secondary voltage to suit |
| 1 | 1000 KW rectifier with switchgear and auxiliaries |
| 10 tons | Galv. angle bars assorted sizes |
| 2 tons | Bus bar copper, connectors, fittings and insulators |
| 6 tons | 6/0 trolley wire, supports, hangers, etc. for 7 miles track |
| 10 tons | 500 MCM trolley feeder |
| 2 tons | Galv. conduit assorted sizes |
| 20 tons | KVA lighting transformers, lighting fixtures, etc. |
| 2 tons | 600 V wire and cables |
| 7 miles | 3/8 7 std trolley messenger |
| 7 miles | Trolley hanks, guys, anchor rods, etc. |
| 3 | 69 KV disconnect switches |
| 1 set | 69 KV lightning arresters |
| 10 sets | Trolley " " |

## RETURN WATER AND THICKENERS - SUB

| | |
|---|---|
| 2 tons | Galv. angle bars assorted sizes |
| 2,000 KVA | 69 KV transformers with switchgear pump motor starters, etc. |
| 1 ton | Bus bar copper fittings and insulators |
| 1 ton | Galv. conduit assorted sizes |
| 1 ton | Wire and cable |
| 1 | 20 KVA lighting transformer, lighting fixtures, etc. |
| 3 | 69 KV disconnect switches |
| 1 set | 69 KV lightning arresters |

## SAN PEDRO, FELIX - SUB

Same as Return Water and Thickeners Sub.

## TAILING WATER RETURN SUB

| | |
|---|---|
| 2 tons | Galv. angle bars assorted sizes |
| 1,000 KVA | 69 KV transformers with switchgear, motor starters, etc. |
| 1 ton | Bus bar copper fittings and insulators |
| 1 ton | Galv. conduit assorted sizes |
| 1 ton | Wire and cable |
| 1 | 20 KVA lighting transformer, lighting fixtures, etc. |
| 3 | 69 KV disconnect switches |
| 1 set | 69 KV lightning arresters |

## LINE QUARRY SUB

Same as above

| Quantity | Description |
|---|---|
| | **TOWNSITE POWER DISTRIBUTION** |
| 200 | #1 40 ft. cedar poles |
| 300 | #1 35 ft. " " |
| 500 | #1 30 ft. " " |
| 1,500 | 8' cross arms, with pins, insulators and hardware |
| 20 tons | 2/0 AWG bare copper wire |
| 20 tons | #2 7 strand TWNP wire |
| 20 tons | Service drop wire |
| 1,000 | 3 wire secondary racks and through bolts |
| 100 | 15 KVA 13.8 KV/110/220 V transformers |
| 200 | 13.8 KV transformer fuses |
| 200 | 13.8 KV lightning arresters |
| 200 | Secondary " " |
| | **LIGHTING FIXTURES, WIRE, OUTLET BOXES, SWITCHES, ETC. FOR 1000 HOUSES** |
| 500 | 150 W. Street lighting units |
| 1 | 6.6 AMP series street lighting transformers |
| 1,000 | 15 AMP 3 wire meters and meter boxes |
| | **MILL, SMELTER AND SHOPS** |
| 4 | 4000 KVA 13.9/2.3 transformers with switchgear starters, etc., for 16 - 1000 HP ball and rod mill motors |
| 4 sets | 13.9 KV lightning arresters |
| 16 sets | 2.3 KV " " |
| 10 tons | Bus bar copper connectors, fittings, and insulators |
| 100 tons | 15 KV power cable |
| 10,000 KVA | In power transformers 13.9 KV/ 440 V of suitable size for 750 motors, with necessary switchgear, starters and control. |
| 100 tons | Galv. conduit assorted sizes junction boxes and fittings |
| 100 tons | 5 KV and 600 V wire and cable |
| 2,000 | Industrial lighting units sizes to suit area |
| 50 tons | Galv. angle bars, assorted sizes |
| 10 | 13.8 KV disconnected switches |
| 10 | 13.8 KV lightning arresters |
| 500 KVA | In 13.8 KV/110/220V lighting transformers sizes to suit. |

| Quantity | Description |
|---|---|
| | **MINE EQUIPMENT** |
| 9,316 tons | Structural Steel (Shafts, loading pockets, stations, headframes, etc.) |
| 2,207 tons | Reinforcing Steel ( " ) |
| 3,172 tons | Rail (Haulage) |
| 270 tons | Drill steel and bits |
| 2,152 tons | Pipe and fittings, Air and Water 1" to 12" |
| 610 tons | Steel ventilation pipe 24" and 18" |
| 35,000 feet | Flexwid ventilation tubing 24" and 16" |
| 70,800 bbls | Portland cement |
| 37,000 B.B.F. | Timber |
| 1,665 tons | Dynamite |
| 1,900,000 | Detonators |
| 25 tons | 4/0 Copper Trolley Wire |
| 16,000 feet | 1 1/8" wire rope |
| 25,400 feet | 1/2" " " |
| 15,000 feet | 3/8" " " |
| 45,500 feet | Rubber Hose 1" and 1/2" diam. |
| | **MACHINERY AND EQUIPMENT** |
| 4 | 250 HP - 2000 Ft. depth Sinking Hoists |
| 6 | Riddell Muckers |
| 13 | Drift Loaders |
| 8 | 75 HP - 400 ft. head sinking pumps |
| 16 | 150 HP - 750 ft. head booster Pumps |
| 25 | Sump Pumps - Air Driven |
| 8 | Auxiliary 50 HP Jetter Pumps |
| 4 | 500 HP - 1500 Head - 1000 gpm Station Pumps |
| 2 | 250 HP - 1500 head - 500 gpm Station Pumps |
| 12 | 50 HP - Gathering Pumps - Single Stage |
| 2 | Concrete Placers |
| 2 | Vent Fans - 500,000 c.f.m. - 8' wg. - 900 HP |
| 1 | " " 300,000 " 8" " - 500 HP |
| 8 | " " 60,000 " 8" " - 100 HP |
| 4 | " " 20,000 " 8" " - 40 HP |
| 24 | " " 10,000 " 4" " - 15 HP |
| 13 | Ore Haulage Locomotives - (20 Tons or equal) |
| 15 | Development " ( 8 Tons - battery) |
| 110 | Ore Cars (20 Tons or equal) weight 880 tons |
| 120 | Development Cars - 5 tons " 600 " |
| 45 | Supply trucks " 90 " |
| 12 | 5-ton trucks Dump (Auto) |
| 1 | Motor Crane |
| 2 | Concrete Batcher Plants, complete |
| 15 | Drill Jumbo |
| 20 | Slusher Hoists - 2500 Lbs. |
| 10 | Utility Hoists - 2000 |

| Quantity | Description |
|---|---|
| | **TEMPORARY SURFACE PLANTS (SINKING EQUIPMENT)** |
| 4 | Hoist Rooms |
| 4 | Head Frames |
| 4 | Bins |
| 3 | Change Rooms |
| 9 | Crown Heads |
| 12 | Sinking Buckets |
| 48 | 3" Rock Drills - Drifters |
| 50 | 55# " " - Sinkers |
| 24 | 2-3/4" rock Drills - Steppers |
| 12 | 45# Rock Drills - Sinkers |

## SAN MANUEL COPPER CORPORATION

### MANPOWER ESTIMATE

The following tabulation covers estimated number of employees required to operate proposed new plant at a capacity of 25,000 to 30,000 tons per day on a 6 to 7-day-per-week schedule, employees working 48 hours per week.

The following departments are covered by this estimate:

- Railroad (Ore Transportation)
- Crushing Plant
- Concentrator
- Molybdenite Plant
- Smelter
- Lime Plant, Flux Plant, and Slag Pit
- Power Plant
- Miscellaneous: Shops, Warehouse and General Offices
- Mining Department

| | Plant Operating 6 Days per week | | | | Plant Operating 7 Days per week | | | |
|---|---|---|---|---|---|---|---|---|
| | Employees working 48 hours per week | | | | Employees working 48 hours per week | | | |
| | 25,000 Tons / Day | | 30,000 Tons / Day | | 25,000 Tons / Day | | 30,000 Tons / Day | |
| Railroad (Ore Transportation) | | Total Dept. | | Total Dept. | | Total Dept. | | Total Dept. |
| Operation | 12 | | 12 | | 14 | | 14 | |
| Maintenance (Track Labor, Trolley Maint., etc.) | 18 | | 18 | | 21 | | 21 | |
| | | 30 | | 30 | | 35 | | 35 |
| Concentrator - Includes Crushing Plant, Moly Plant, and Tailings Disposal | | | | | | | | |
| Operation | 102 | | 126 | | 119 | | 147 | |
| Maintenance - Inc. Tailings | 30 | | 30 | | 35 | | 35 | |
| Misc. Clean-up, etc. | 18 | | 18 | | 14 | | 18 | |
| Oiling | 6 | | 6 | | 7 | | 7 | |
| Sampling | 6 | | 6 | | 7 | | 7 | |
| | | 156 | | 186 | | 182 | | 214 |
| Smelter (One furnace) | | | | | | | | |
| Operation | 136 | | 150 | | 147 | | 175 | |
| Maintenance | 12 | | 18 | | 14 | | 21 | |
| Misc. Samples, Testing, Clean-up | 12 | | 12 | | 14 | | 14 | |
| | | 160 | | 180 | | 175 | | 210 |

| | Plant Operating 6 Days per Week | | Plant Operating 7 Days per week | |
|---|---|---|---|---|
| | Employees Working 48 hours per week | | Employees Working 48 hours per week | |
| | 35,000 Tons / Day | 35,000 Tons / Day | 35,000 Tons / Day | 35,000 Tons / Day |
| Lime Burning and Slaking | 12 | 12 | 14 | 14 |
| Lime Rock Quarry & Flux Pit | 12 | 12 | 14 | 14 |
| Flux & Lime Rock Crushing & Barg. | 6 | 6 | 7 | 7 |
| | 30 | 30 | 35 | 35 |
| Power Plant | | | | |
| Operation | 30 | 30 | 30 | 30 |
| Maintenance | 6 | 6 | 6 | 6 |
| Misc. Cooling Tower Clean-up, etc. | 4 | 4 | 4 | 4 |
| | 40 | 40 | 40 | 40 |
| Mechanical Dept. | | | | |
| Machine Shop | 12 | 12 | 14 | 14 |
| Boiler Shop & Welding | 24 | 24 | 28 | 28 |
| Pipe and Plumbing | 12 | 12 | 14 | 14 |
| Black Smith Shop | 6 | 6 | 7 | 7 |
| Tin Shop | 3 | 3 | 4 | 4 |
| Test Drum Lane, etc. | 3 | 3 | 4 | 4 |
| Water Supply | 12 | 12 | 14 | 14 |
| Trunk Dept. | 24 | 24 | 28 | 28 |
| | 96 | 96 | 112 | 112 |
| Electrical Department | | | | |
| Operation Trouble Shooters | 6 | 6 | 8 | 8 |
| Maintenance | 18 | 18 | 22 | 22 |
| | 24 | 24 | 30 | 30 |
| Carpenter Shop, Paint Shop | 24 | 24 | 28 | 28 |
| Truck, Car, Yard Maintenance | 18 | 18 | 21 | 21 |
| Gen. Offices | | | | |
| Engineering Dept. | 6 | 6 | 6 | 6 |
| Accounting & Accounting | 18 | 18 | 21 | 21 |
| Accounting Dept. | 8 | 8 | 8 | 8 |
| Purchasing Dept. | 2 | 2 | 2 | 2 |
| Warehouse & Time Office | 12 | 12 | 14 | 14 |
| Safety and Welfare | 4 | 4 | 4 | 4 |
| | 50 | 50 | 55 | 55 |
| Total | 618 | 618 | 713 | 713 |
| Each Department Grade | 10 | 10 | 10 | 10 |
| Vital Service | 628 | 628 | 723 | 723 |

| | Plant Operating 6 Days per Week | | Plant Operating 7 Days per week | |
|---|---|---|---|---|
| | Employees working 48 hours per week | | Employees working 48 hours per week | |
| | 25,000 Tons / Day | 30,000 Tons / Day | 25,000 Tons / Day | 30,000 Tons / Day |
| **Mining Department** | | | | |
| Bulldozer | 12 | 12 | | |
| Drift Oilers | 3 | 3 | | |
| Pumpmen | 4 | 4 | | |
| Mechanical Maintenance | 23 | 23 | | |
| Electrical Maintenance | 15 | 15 | | |
| Surface Supply | 35 | 35 | | |
| Oxygen Gas | 6 | 6 | | |
| Oxygen Supply | 12 | 12 | | |
| Underground Train Supply | 15 | 15 | | |
| Tool Room Men | 6 | 6 | | |
| Ventilation | 6 | 6 | | |
| Grate Keepers | 83 | 100 | | |
| Trainmen | 73 | 90 | | |
| Loader | 125 | 150 | | |
| Blasters and Pigeons | 30 | 30 | | |
| Drainage | 6 | 6 | | |
| Cleaning | 45 | 45 | | |
| Drift Miners | 130 | 160 | | |
| Raise and Underout Miners | 90 | 100 | | |
| Supervision | 32 | 32 | | |
| Control Engineers | 14 | 14 | | |
| Surveying | 4 | 4 | | |
| Timekeepers | 7 | 7 | | |
| Samplers & Diamond Drilling | 23 | 23 | | |
| Engineering Office | 20 | 20 | | |
| Total | 962 | 977 | 989 | 1,044 |
| Employees Surface (see detail) | 608 | 608 | 721 | 721 |
| GRAND TOTAL | 1,570 | 1,585 | 1,612 | 1,635 |

## [illegible] MINING COST OF 1475 [illegible]

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Copper in Grade % | .5 | .6 | .7 | .8 | .9 | 1.0 | .50 | .60 | .70 | .80 | .90 | 1.00 |
| Recoverable Copper % | .431 | .5267 | .6217 | .7168 | .8119 | .9069 | .431 | .5267 | .6217 | .7168 | .8119 | .9069 |
| Pounds Copper Recovered | 8.62 | 10.53 | 12.43 | 14.33 | 16.24 | 18.14 | 8.62 | 10.53 | 12.43 | 14.33 | 16.24 | 18.14 |
| Operation | Cost Per Ton Mined | | | | | | Cost Per Pound Recovered | | | | | |
| Smelting, Freight & Ref. | .382 | .364 | .435 | .502 | .566 | .635 | .035 | .035 | .035 | .035 | .035 | .035 |
| New York Expense | .046 | .032 | .037 | .043 | .048 | .054 | .003 | .003 | .003 | .003 | .003 | .003 |
| General Expense | .150 | .150 | .150 | .150 | .150 | .150 | .017 | .014 | .012 | .010 | .009 | .008 |
| Milling | .400 | .400 | .400 | .400 | .400 | .400 | .046 | .038 | .032 | .028 | .025 | .022 |
| Mine to Mill | .050 | .050 | .050 | .050 | .050 | .050 | .006 | .005 | .004 | .003 | .003 | .003 |
| Surface Total | .928 | 1.000 | 1.072 | 1.145 | 1.216 | 1.289 | .107 | .095 | .086 | .079 | .075 | .071 |
| Handling Mine (U.G. Transportation & Hoisting) | | | | .517 | | | | | | .086 | | |
| Pumping Mine | | | | .02 | | | | | | .001 | | |
| Stope Development 400' Head | | | | .164 | | | | | | .011 | | |
| Stope Underout 400' Head | | | | [illegible] | | | | | | .056 | | |
| Mining Total | | | | .703 | | | | | | .054 | | |
| TOTAL | | | | 1.928 | | | | | | .133 | | |

[illegible]

| | | | | | | |
|---|---|---|---|---|---|---|
| Grade % | .5 | .6 | .7 | .8 | .9 | 1.00 |
| Mine 90% Recovery | .450 | .585 | .686 | .784 | .882 | .98 |
| Mill % Recovery .045 Tail | 90.80 | 92.35 | 93.44 | 94.26 | 94.90 | 95.42 |
| $ Per Ton of Heads Recovered by Mill | .445 | .543 | .641 | .739 | .837 | .935 |
| $ Per Ton of Heads Recovered by Smelter 99% Recovery | .431 | .5267 | .6217 | .7160 | .8119 | .9069 |
| Pounds Cu. Recovered | 8.62 | 10.53 | 12.43 | 14.33 | 16.24 | 18.14 |

## SMELTING, FREIGHT AND REFINING COST

| | | | |
|---|---|---|---|
| Freight | = $22.50 per Ton Copper | = | .011 per Lb. Copper |
| Refining | = 27.025 per Ton Copper | = | .014 per Lb. Copper |
| Smelting | = | = | .[illegible] per Lb. Copper |
| Total | | = | .035 per Lb. Copper |

Smelting cost at $5.00 per Ton of Concentrates

$$x = \frac{G - A}{F - G}$$

x = Ratio of Concentration

$$x = \frac{26.0 - .046}{.764 - .013}$$

G = Assay of Concentrate

A = Assay of Tail

F = Assay of Feed

$$x = 35.1$$

$$\frac{\$5.00}{35.1} = \$\ .142 \text{ per Ton of Mill Feed}$$

$$\frac{\$\ .142}{14\ \text{Lb. Cu}} = \$\ .01$$

New York Expense

$$\frac{\$[illegible] \text{ per month}}{[illegible] \text{ Lbs. Copper}} = \$\ .003 \text{ per Ton}$$

General Expense

$$\frac{\$[illegible] \text{ per month}}{[illegible] \text{ Tons per month}} = \$\ .15 \text{ per Ton}$$

October 14, 1958

GAM [illegible] CORP. [illegible]

Au-Ag-Hg Credit

Au in Concentrate = 0.05 .05 ÷ 38 = 0.0013

Ag in Concentrate = 0.95 .95 ÷ 38 = 0.0250

Ratio of Concentrates = 38/1

0.84 Hg in head recoverable in Cu Concentrate equals 0.8 Lbs per ton heads

Assume 0.7 Lbs. per ton recoverable in marketable product.

| | | | Per ton of ore | | Per pound of concentrate |
|---|---|---|---|---|---|
| 0.0013 | X | $ 35.14 = | $ 0.043 | = | $ 0.005 |
| 0.025 | X | 0.96 = | 0.023 | = | 0.0006 |
| 0.7 | X | 0.54 = | 0.300 | = | 0.0250 |
| | | | Total Credit | | $ 0.0306 |

14.35 Lbs. Cu/ton

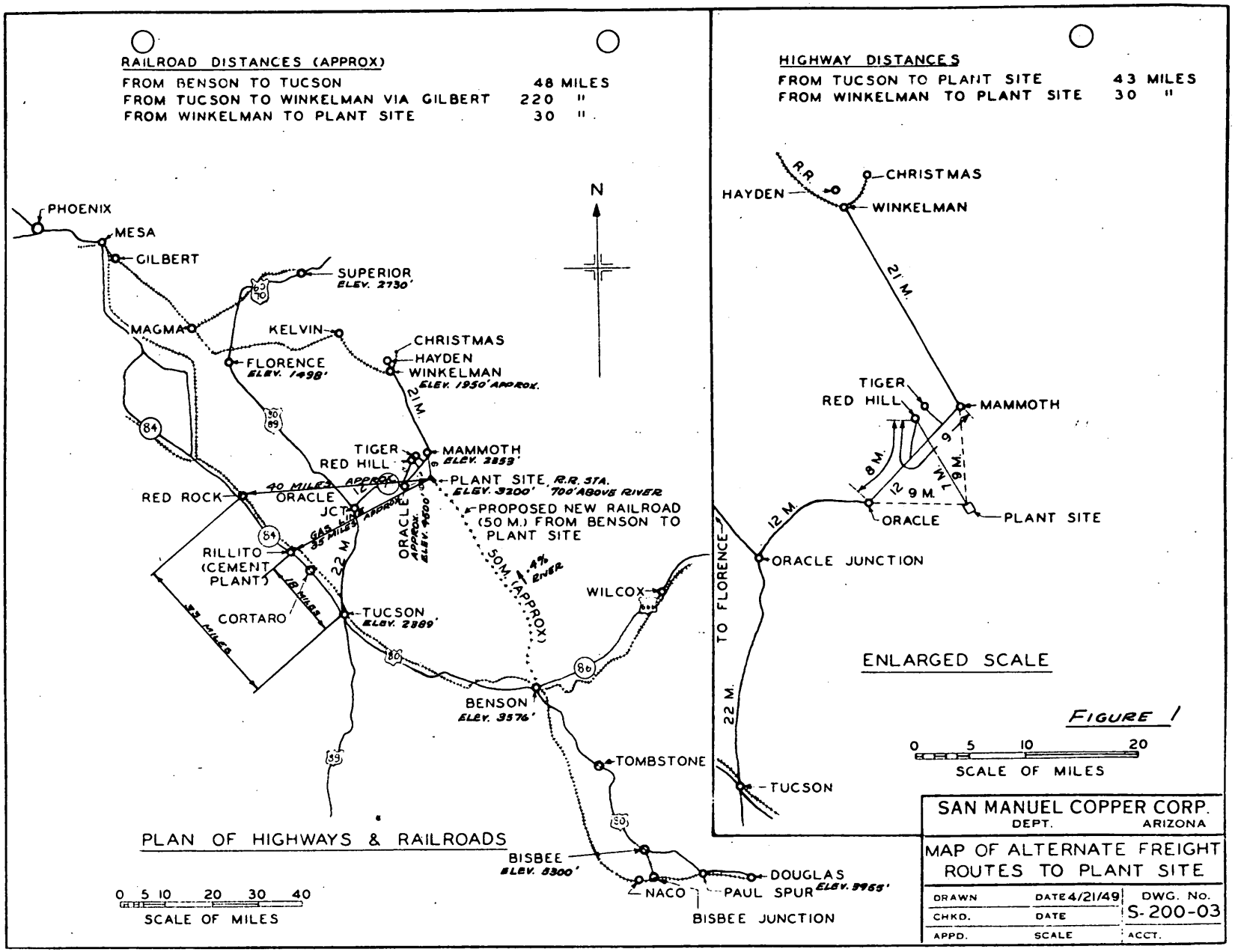
STOPING SCHEDULE FOR FIRST 6 MONTHS
(Approximately 30,000 tons per day)

Average tons per day from stopes 1-6

| MONTH | 1st | 2nd | 3rd | 4th | 5th | 6th* |
|---|---|---|---|---|---|---|
| Stope 1 | 590 | 1,760 | 2,940 | 4,110 | 4,700 | |
| 2 | 590 | 1,760 | 2,940 | 4,110 | 4,700 | |
| 3 | 590 | 1,760 | 2,940 | 4,110 | 4,700 | |
| 4 | 590 | 1,760 | 2,940 | 4,110 | 4,700 | |
| 5 | 590 | 1,760 | 2,940 | 4,110 | 4,700 | |
| 6 | 590 | 1,760 | 2,940 | 4,110 | 4,700 | |
| Total daily tonnage | 3,540 | 10,560 | 17,640 | 24,660 | 28,200 | |

* Full production in 6th month based on drawing 1 vertical foot per day from all stopes.

NOTE: Stoping starts from initial undercutting in first month, until full production is gained in 5th and 6th months. Full production is maintained after 6th month.


RAILROAD DISTANCES (APPROX)
FROM BENSON TO TUCSON 48 MILES
FROM TUCSON TO WINKELMAN VIA GILBERT 220 "
FROM WINKELMAN TO PLANT SITE 30 "
N
PHOENIX
MESA
GILBERT
SUPERIOR
ELEV. 2730'
MAGMA
KELVIN
CHRISTMAS
HAYDEN
WINKELMAN
ELEV. 1950' APPROX.
FLORENCE
ELEV. 1498'
21 M.
TIGER
RED HILL
MAMMOTH
ELEV. 2859'
PLANT SITE, R.R. STA.
ELEV. 3200' 700' ABOVE RIVER
PROPOSED NEW RAILROAD
(50 M.) FROM BENSON TO
PLANT SITE
RED ROCK
40 MILES APPROX.
ORACLE
JCT.
GAS LINE 35 MILES APPROX.
ORACLE APPROX. ELEV. 4600'
RILLITO
(CEMENT
PLANT)
22 M.
18 MILES
33 MILES
CORTARO
TUCSON
ELEV. 2389'
50 M. (APPROX)
4% GRADE
WILCOX
BENSON
ELEV. 3576'
TOMBSTONE
BISBEE
ELEV. 5300'
NACO
DOUGLAS
PAUL SPUR
ELEV. 3965'
BISBEE JUNCTION
PLAN OF HIGHWAYS & RAILROADS
0 5 10 20 30 40
SCALE OF MILES
HIGHWAY DISTANCES
FROM TUCSON TO PLANT SITE 43 MILES
FROM WINKELMAN TO PLANT SITE 30 "
R.R.
CHRISTMAS
HAYDEN
WINKELMAN
21 M.
TIGER
RED HILL
MAMMOTH
8 M.
9 M.
6 M.
12 M.
9 M.
ORACLE
PLANT SITE
12 M.
ORACLE JUNCTION
TO FLORENCE
22 M.
TUCSON
ENLARGED SCALE
FIGURE 1
0 5 10 20
SCALE OF MILES
SAN MANUEL COPPER CORP.
DEPT. ARIZONA
MAP OF ALTERNATE FREIGHT
ROUTES TO PLANT SITE
DRAWN
DATE 4/21/49
DWG. No.
S-200-03
CHKD.
DATE
APPD.
SCALE
ACCT.

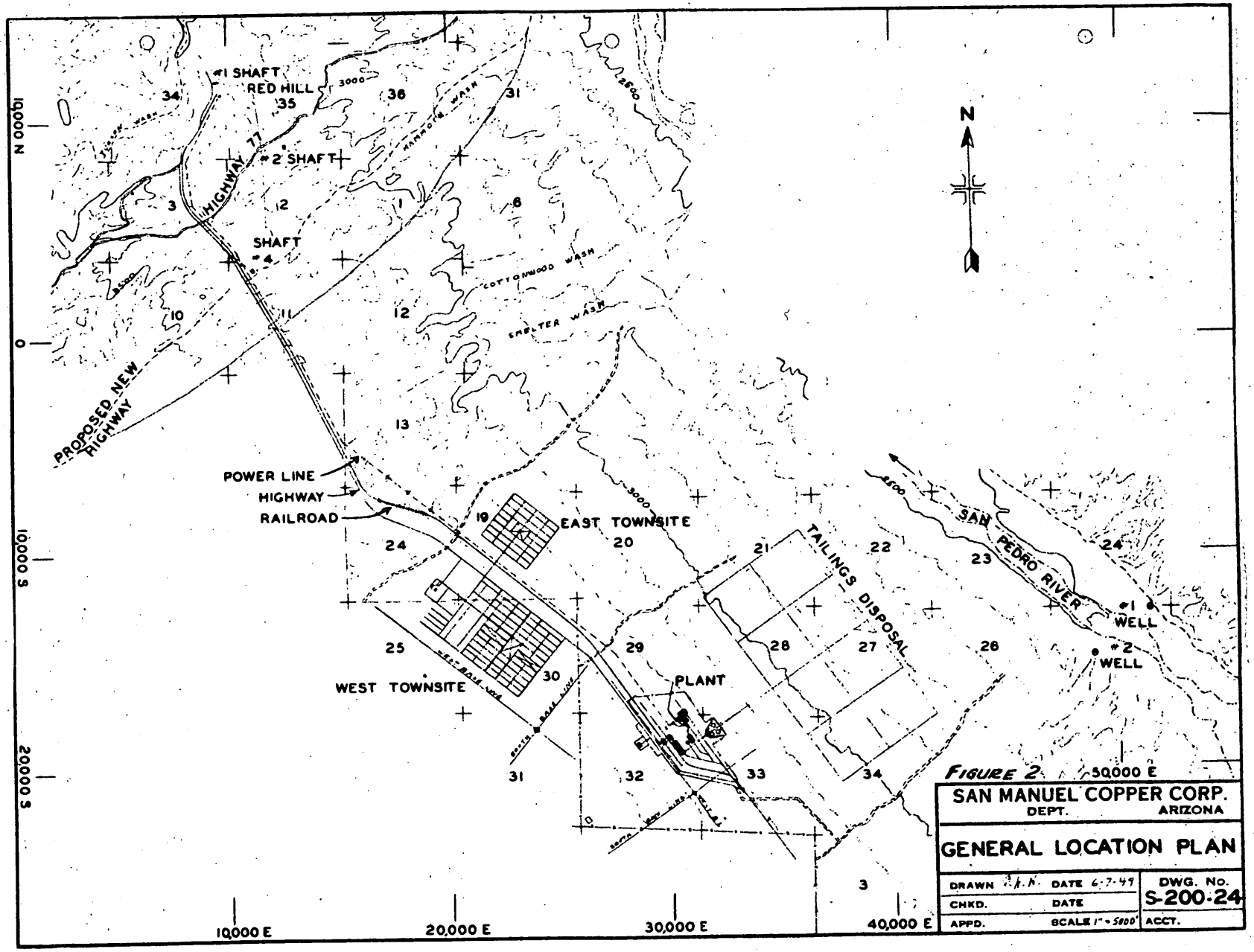



FIGURE 2

SAN MANUEL COPPER CORP.
DEPT. ARIZONA

GENERAL LOCATION PLAN

| | | |
|---|---|---|
| DRAWN A.A.N. | DATE 6-7-49 | DWG. No. S-200-24 |
| CHKD. | DATE | |
| APPD. | SCALE 1" = 5000' | ACCT. |

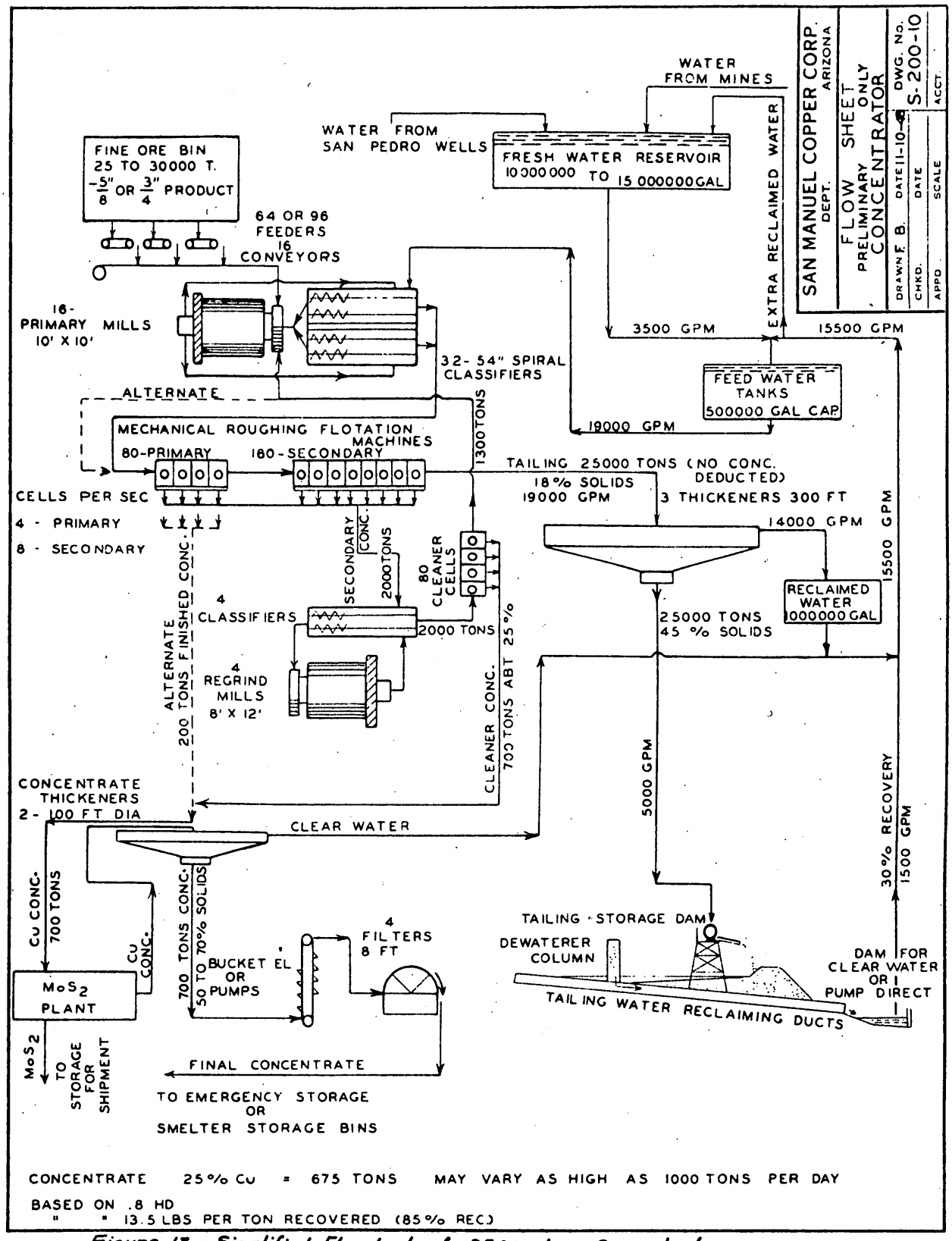
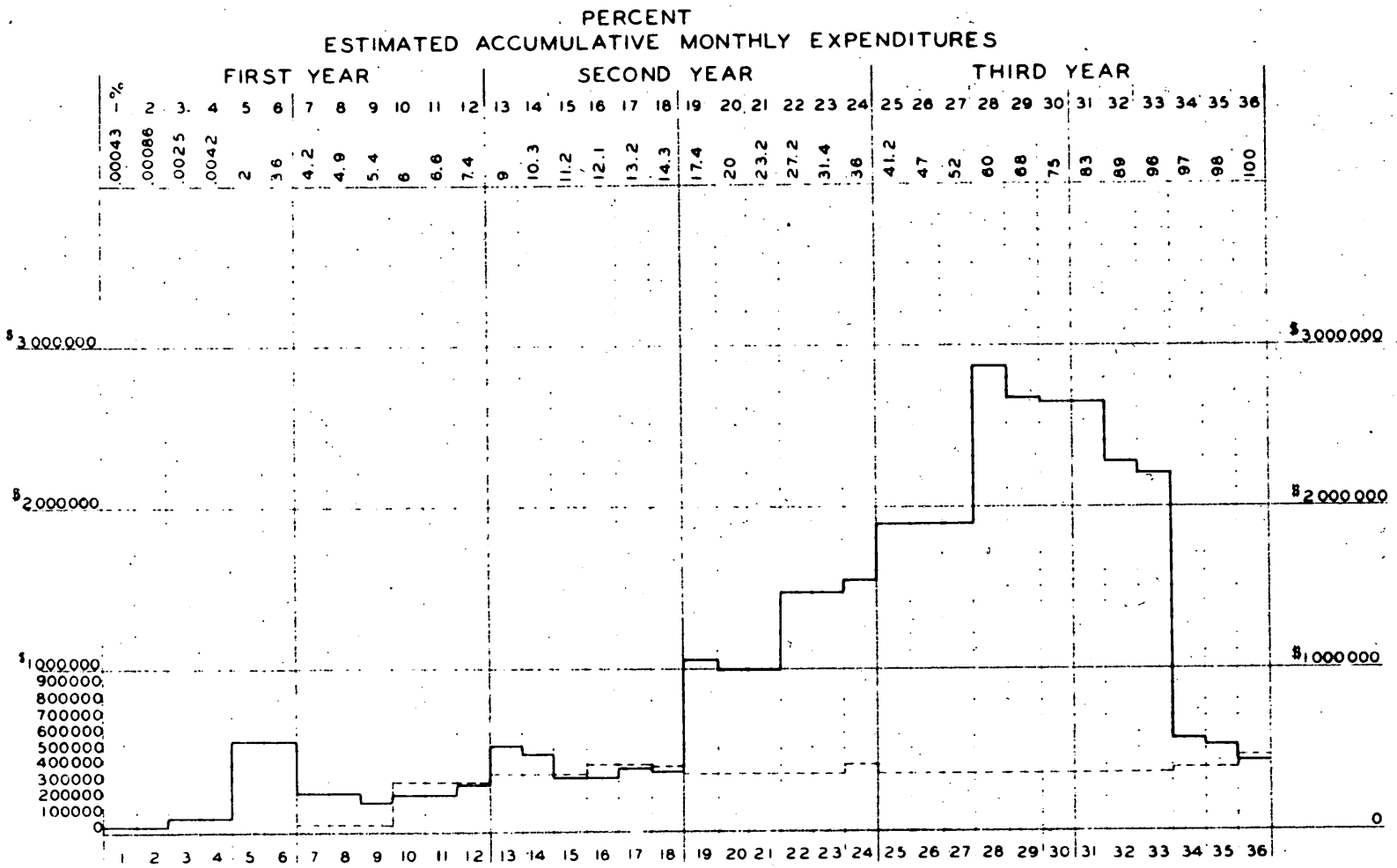



*Figure 13. - Simplified Flowsheet of 25,000-ton Concentrator.*



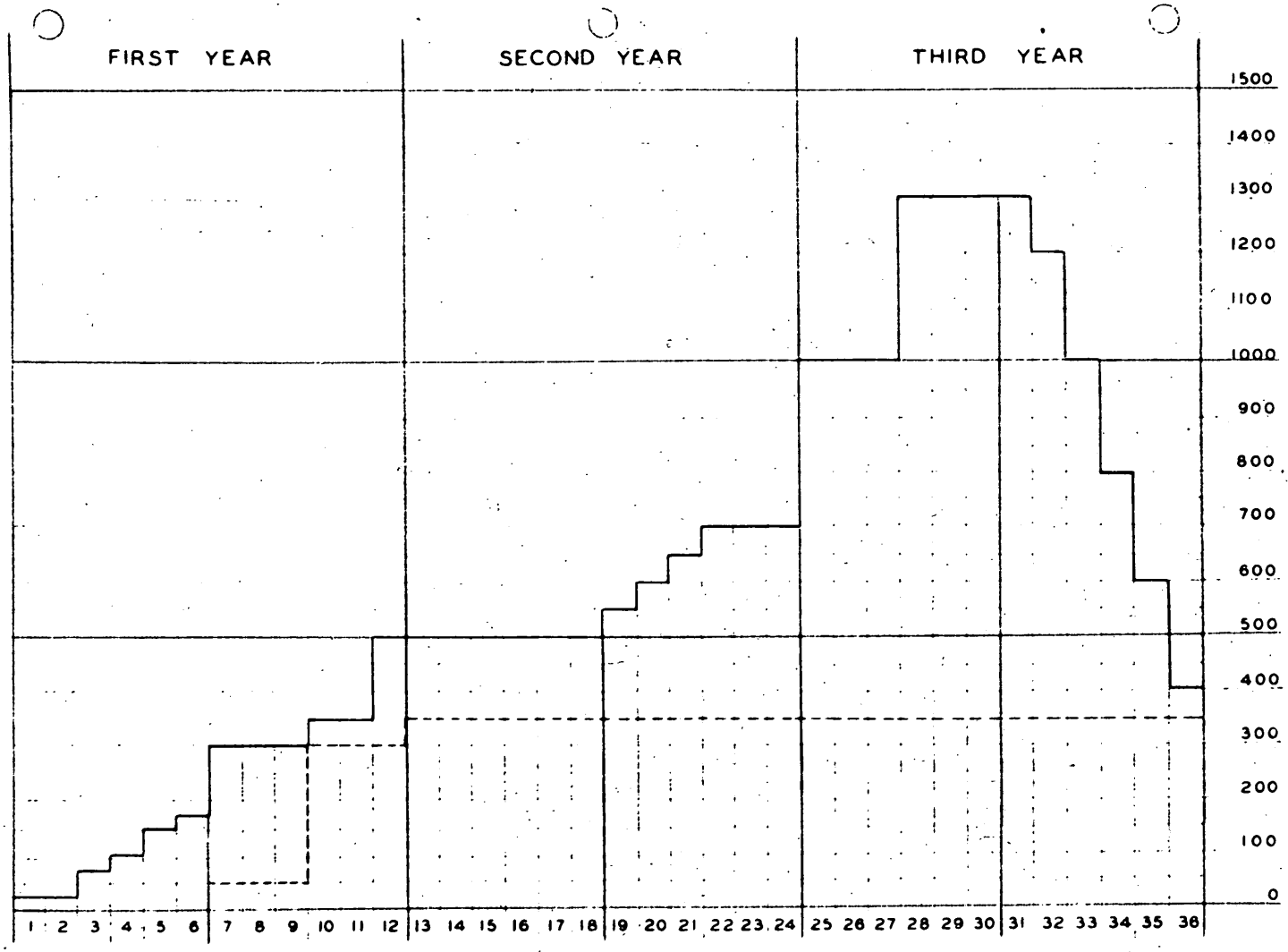

ESTIMATED MONTHLY EXPENDITURES INCLUDES
FOR CONSTRUCTION
(PRELIMINARY ONLY)
DATE: 9/16/49

MINES (ALL SURFACE)
RAILROAD
MILL
SMELTER
POWER PLANT
SHOPS & MISC.

TOWNSITE $10 000 000
$35 000 000
ADD 15%

S-200-37

FIGURE 14




ESTIMATED NUMBER OF MEN REQUIRED MONTHLY
(FOR CONSTRUCTION)
PRELIMINARY ONLY

INCLUDES: MINES (ALL SURFACE)
RAILROAD
MILL
SMELTER
POWER PLANT
SHOPS & MISC.

TOWNSITE

*FIGURE 15.*

DATE: 9/16/49

S-200-38

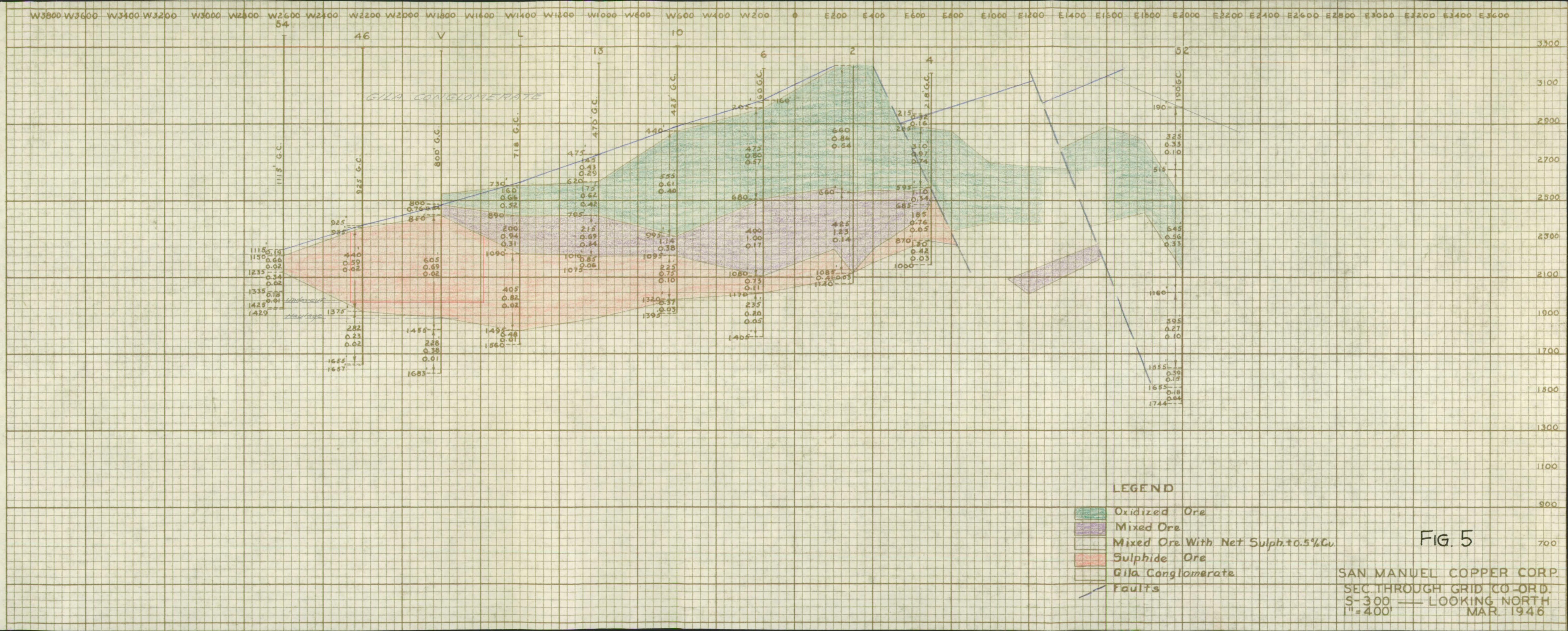



FIG. 5

SAN MANUEL COPPER CORP.
SEC. THROUGH GRID CO-ORD.
S-300 —— LOOKING NORTH
1" = 400'
MAR. 1946

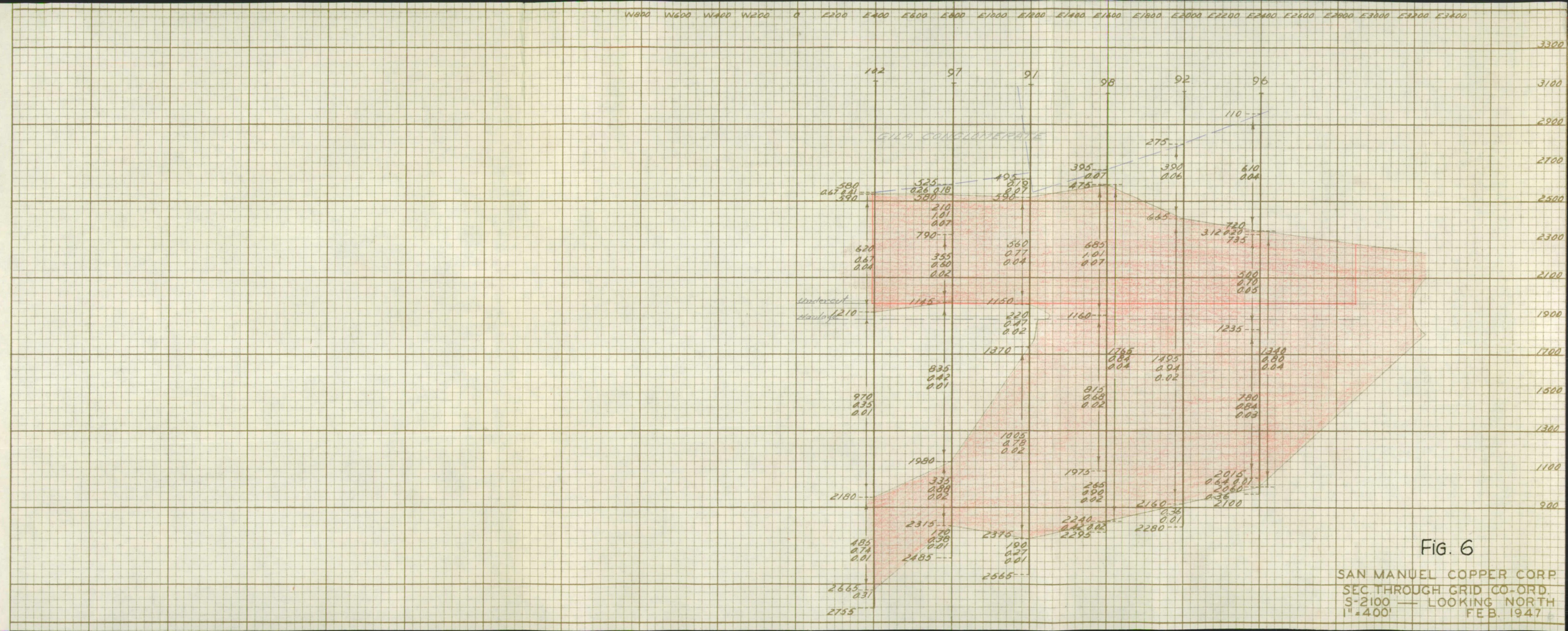



Fig. 6

SAN MANUEL COPPER CORP.
SEC. THROUGH GRID CO-ORD.
S-2100 — LOOKING NORTH
1" = 400'
FEB. 1947

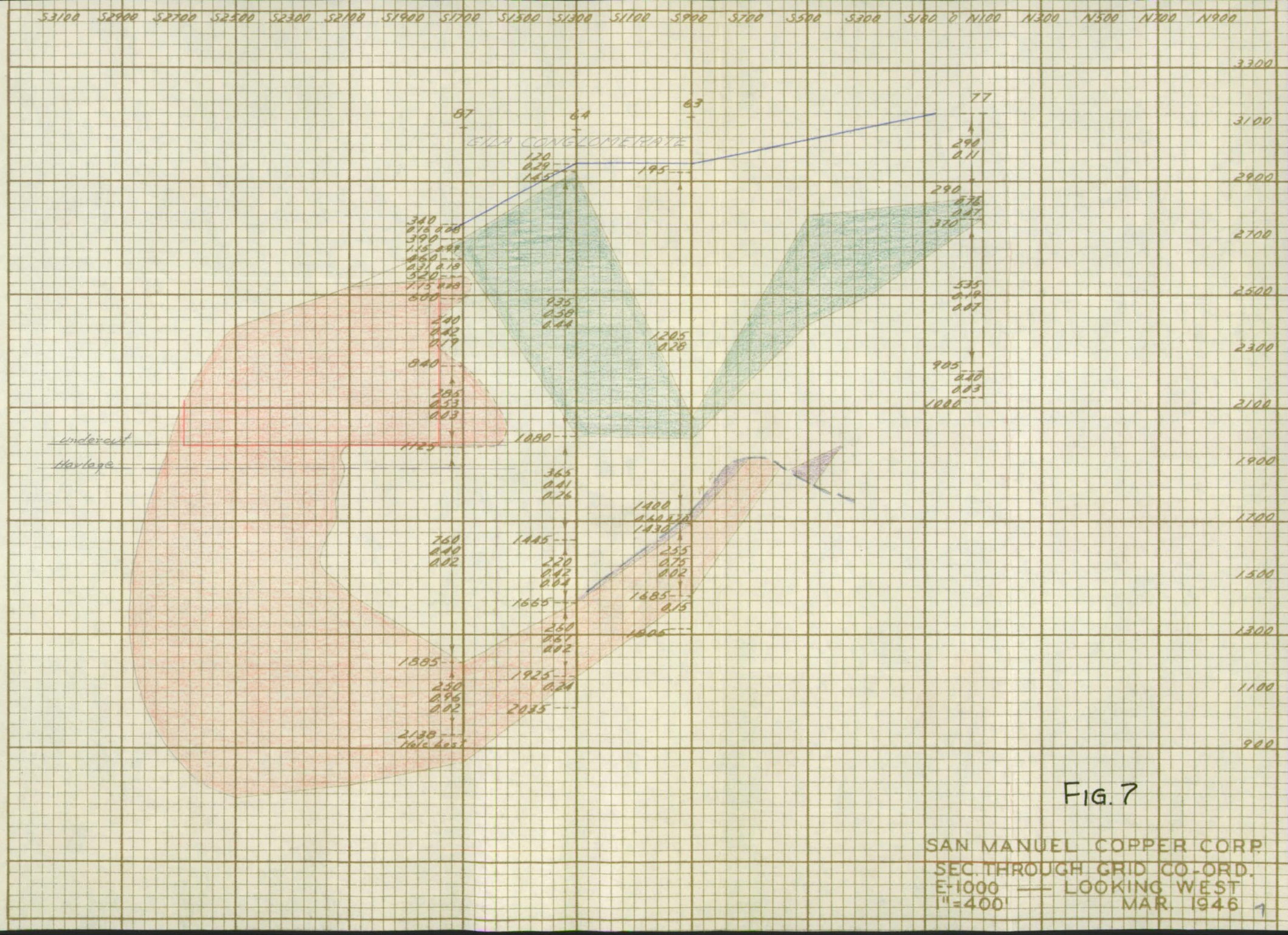



FIG. 7

SAN MANUEL COPPER CORP.
SEC. THROUGH GRID CO-ORD.
E-1000 —— LOOKING WEST
1"=400'
MAR. 1946

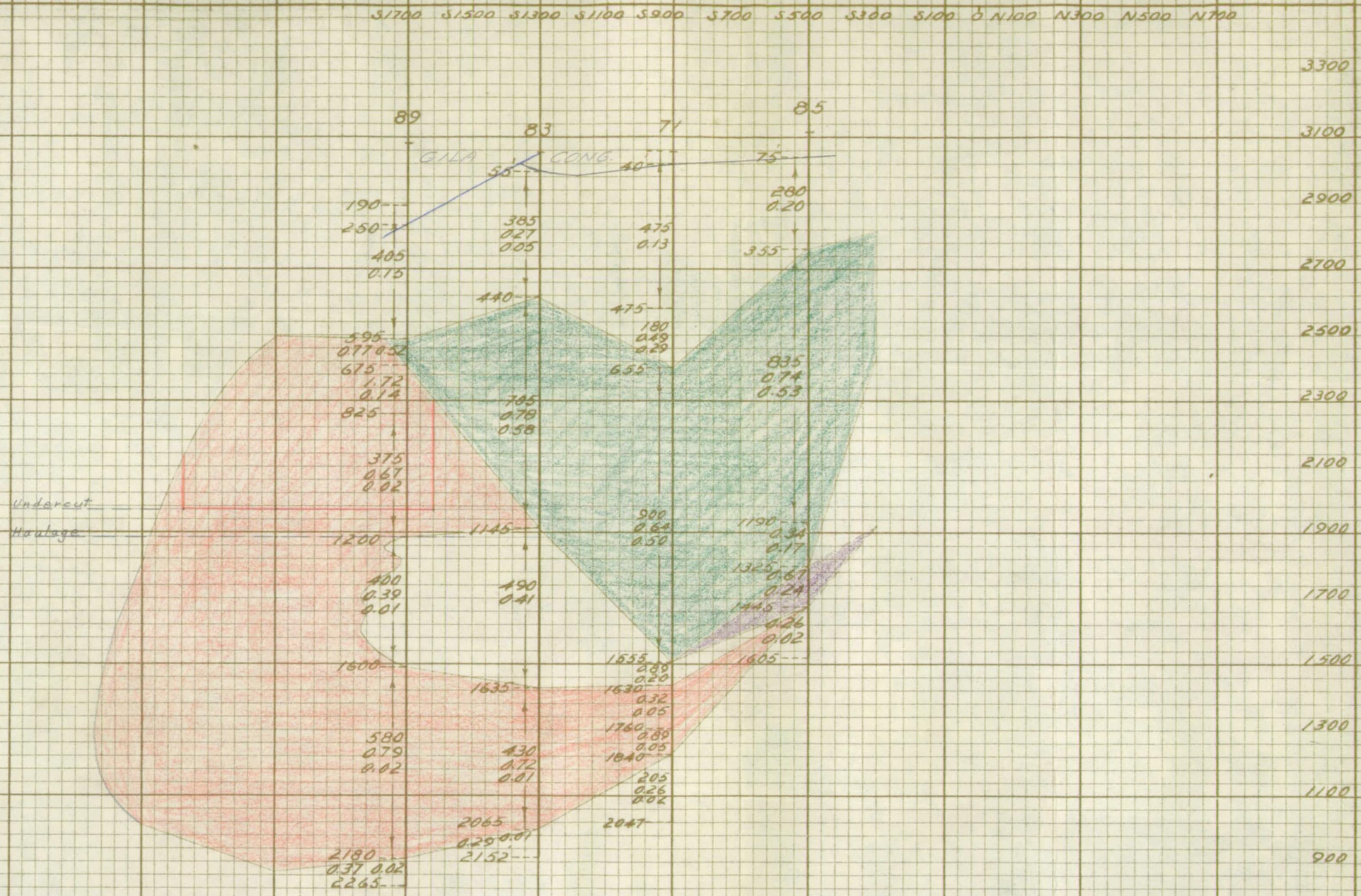



FIGURE 8

SAN MANUEL COPPER CORP.
SEC. THROUGH GRID CO-ORD.
E-1800 — LOOKING WEST
1" = 400'
DEC. 1946

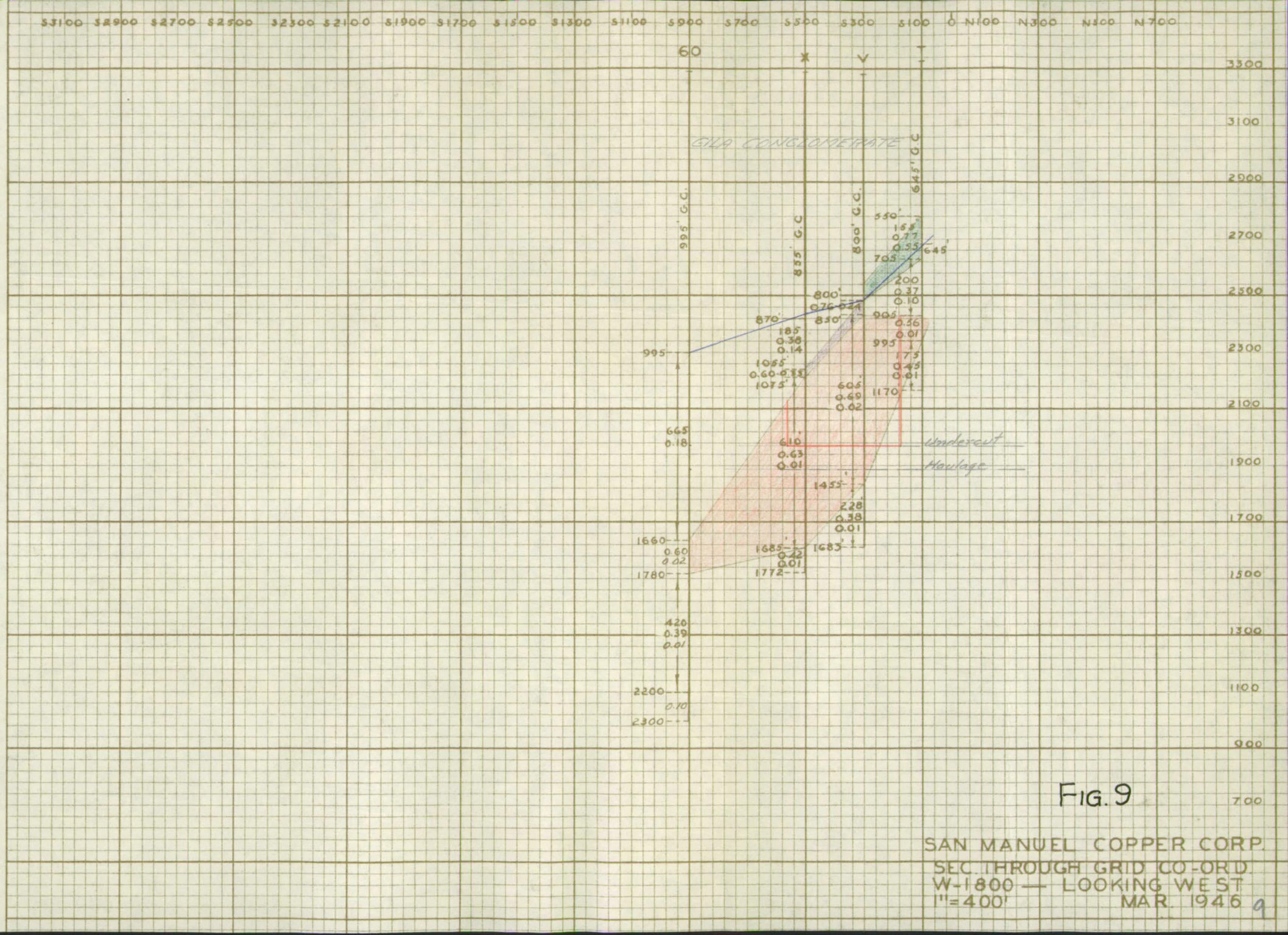
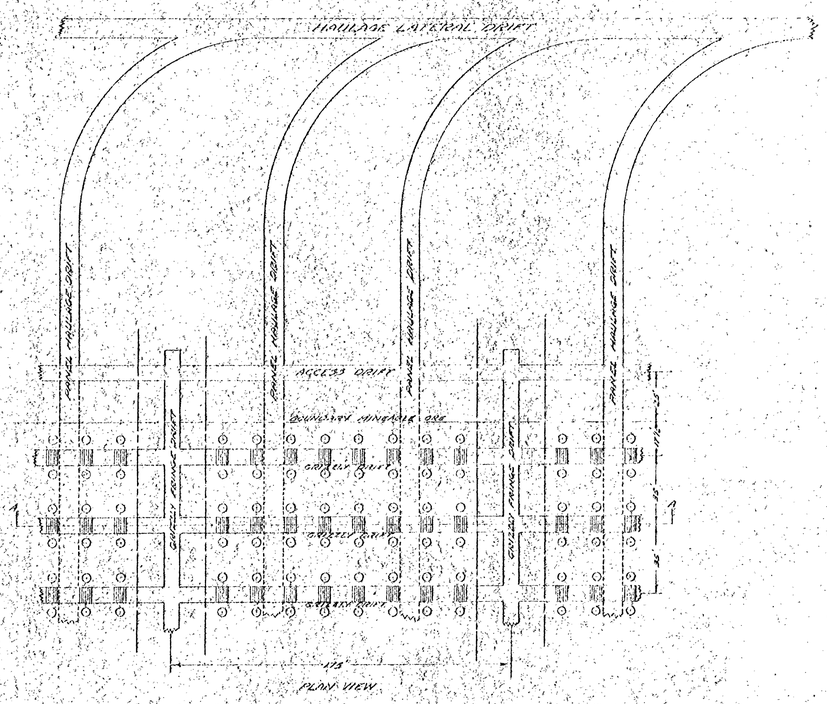
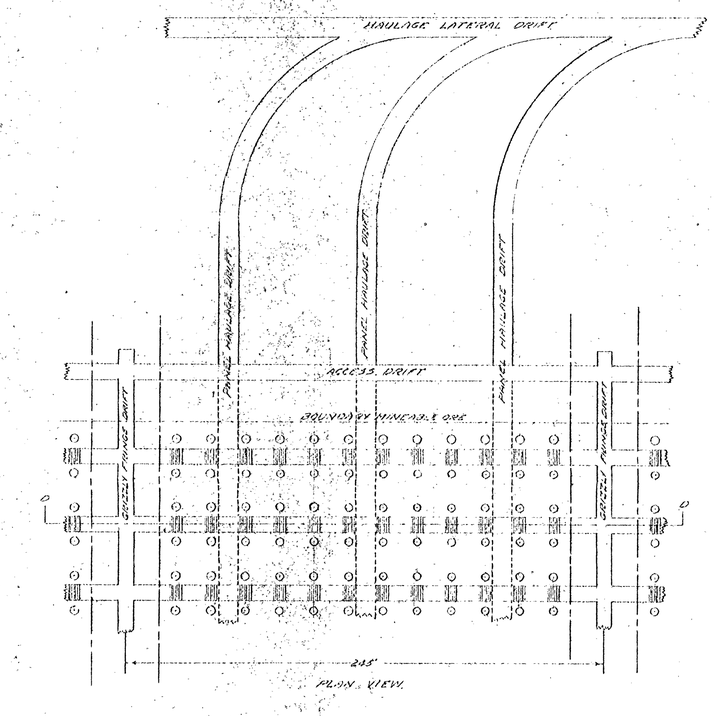


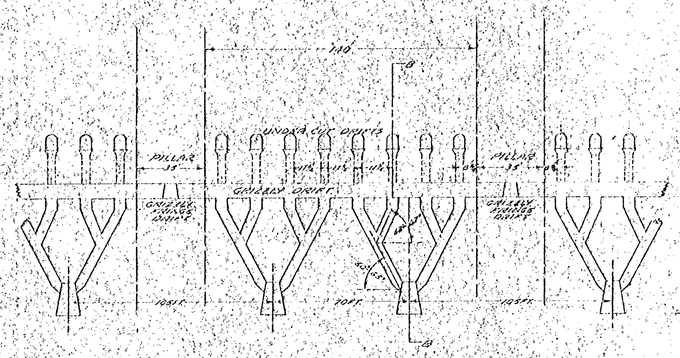

FIG. 9

SAN MANUEL COPPER CORP.
SEC. THROUGH GRID CO-ORD.
W-1800 — LOOKING WEST
1"=400'
MAR. 1946

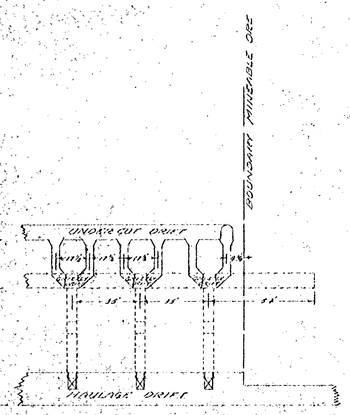



140 FT BLOCK

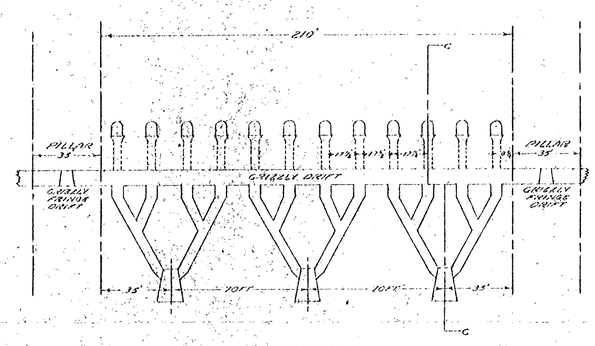



SECTION A-A




SECTION BB AND CC

210 FT BLOCK



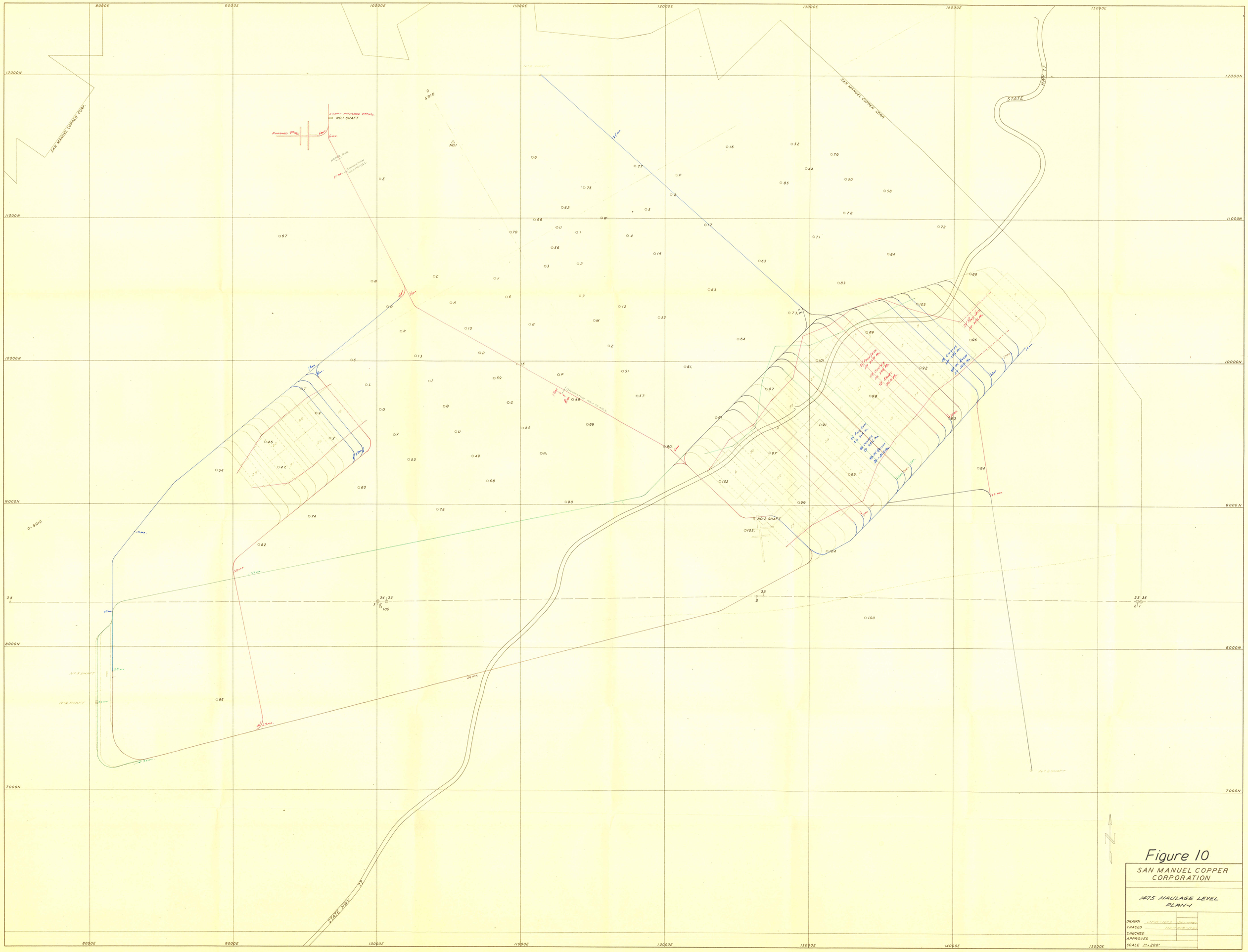

SECTION D-D

FIG. 12

SAN MANUEL COPPER CORP.

| MAGMA COPPER CO. SUPERIOR, ARIZONA | |
|---|---|
| DEPARTMENT | |
| SOUTHEAST OREBODY BLOCK FULL GRAVITY DRAW | |
| | DWG. NO. C-633 |
| DRAWN | DATE 10/1/60 |
| TRACED | |
| CHECKED | |
| APPROVED | FILE NO. |
| SCALE 1"=40' | |

8000E
9000E
10000E
11000E
12000E
13000E
14000E
15000E
12000N
11000N
10000N
9000N
8000N
7000N
SAN MANUEL COPPER CORP.
SAN MANUEL COPPER CORP.
STATE HWY 77
STATE LINE
NO.1 SHAFT
NO.2 SHAFT
NO.3 SHAFT
NO.4 SHAFT
NO.5 SHAFT
NO.6 SHAFT
NO.7 SHAFT
0-GRID
Figure 11
SAN MANUEL COPPER CORPORATION
1415 GRIZZLY LEVEL PLAN-1
DRAWN
TRACED
CHECKED
APPROVED
SCALE 1"=200'


8000E
9000E
10000E
11000E
12000E
13000E
14000E
15000E
12000N
11000N
10000N
9000N
8000N
7000N
SAN MANUEL COPPER CORP
SAN MANUEL COPPER CORP
STATE HWY 77
STATE HWY 77
0-GRID
NO.1
NO.1 SHAFT
NO.2 SHAFT
N.W. SHAFT
N.W. SHAFT
N.E. SHAFT
Figure 10
SAN MANUEL COPPER CORPORATION
1475 HAULAGE LEVEL PLAN-1
DRAWN
TRACED
CHECKED
APPROVED
SCALE 1"=200'

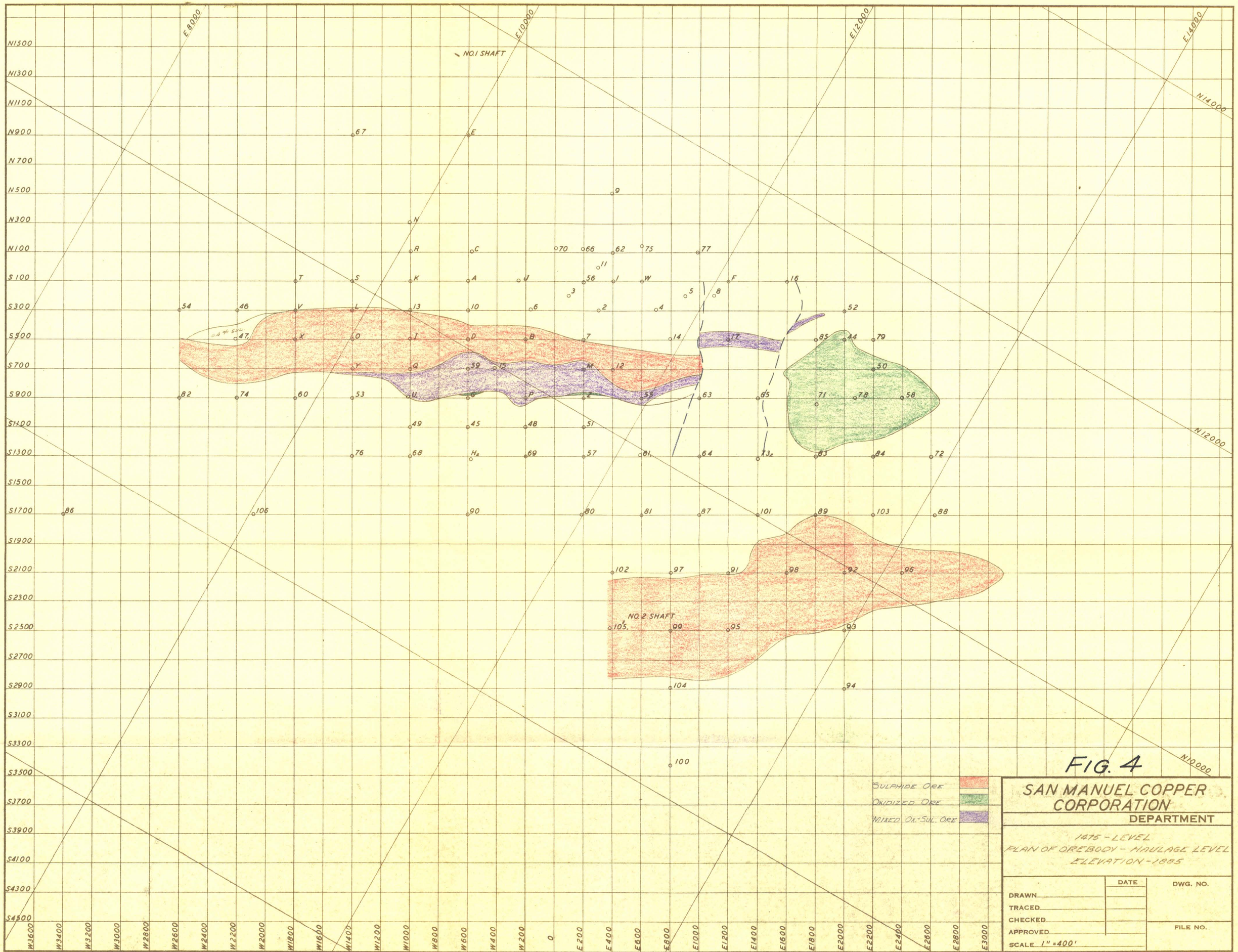



FIG. 4

SAN MANUEL COPPER CORPORATION

DEPARTMENT

1475 - LEVEL
PLAN OF OREBODY - HAULAGE LEVEL
ELEVATION - 1885

| | DATE | DWG. NO. |
|---|---|---|
| DRAWN | | |
| TRACED | | |
| CHECKED | | |
| APPROVED | | FILE NO. |
| SCALE 1" = 400' | | |

| REFERENCE DWG. NO. | TITLE |
|---|---|
| 200-01 | ARRANGEMENT OF PLANT |
| 129-01 | TOWNSITE GENERAL PLAN |

| NO. | DATE | DESCRIPTION | BY | CHKD. |
|---|---|---|---|---|
| 1 | 8/8/50 | 40' CONTOURS ADDED FROM U.S.G.S. | | |

REVISIONS

SAN MANUEL COPPER CORPORATION
DEPT. ARIZONA
DRAWN BY DATE
CHECKED BY DATE
APPROVED SCALE 1" = 1000'

FIGURE 3
GENERAL
PROPERTY MAP

DRAWING NO.
200-16
ACCT. NO.