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ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES AZMILS DATA

PRIMARY NAME: GRAND REEF

ALTERNATE NAMES:
ARAVAIPA
JOHN W. MACKAY
CALISTOGA MNG. & DEV. CO.
BRINGHAM SILVER AND LEAD
VIVIAN MINE
PATENTED CLAIMS MS 1760
JOE RUBAL
BOTTS, GEORGE H.
LEAD JEWEL

GRAHAM COUNTY MILS NUMBER: 167B

LOCATION: TOWNSHIP 6 S RANGE 20 E SECTION 29 QUARTER E2
LATITUDE: N 32DEG 53MIN 00SEC LONGITUDE: W 110DEG 19MIN 01SEC
TOPO MAP NAME: COBRE GRANDE MTN - 7.5 MIN

CURRENT STATUS: PAST PRODUCER

COMMODITY:
LEAD OXIDE
COPPER OXIDE
ZINC
SILVER
GOLD
FLUORINE FLUORSPAR
IRON
SILICON QUARTZ
VANADIUM
CALCIUM

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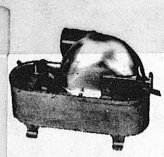


CLARKSON

Memorandum

Date: 3/24/72

To: John Jett

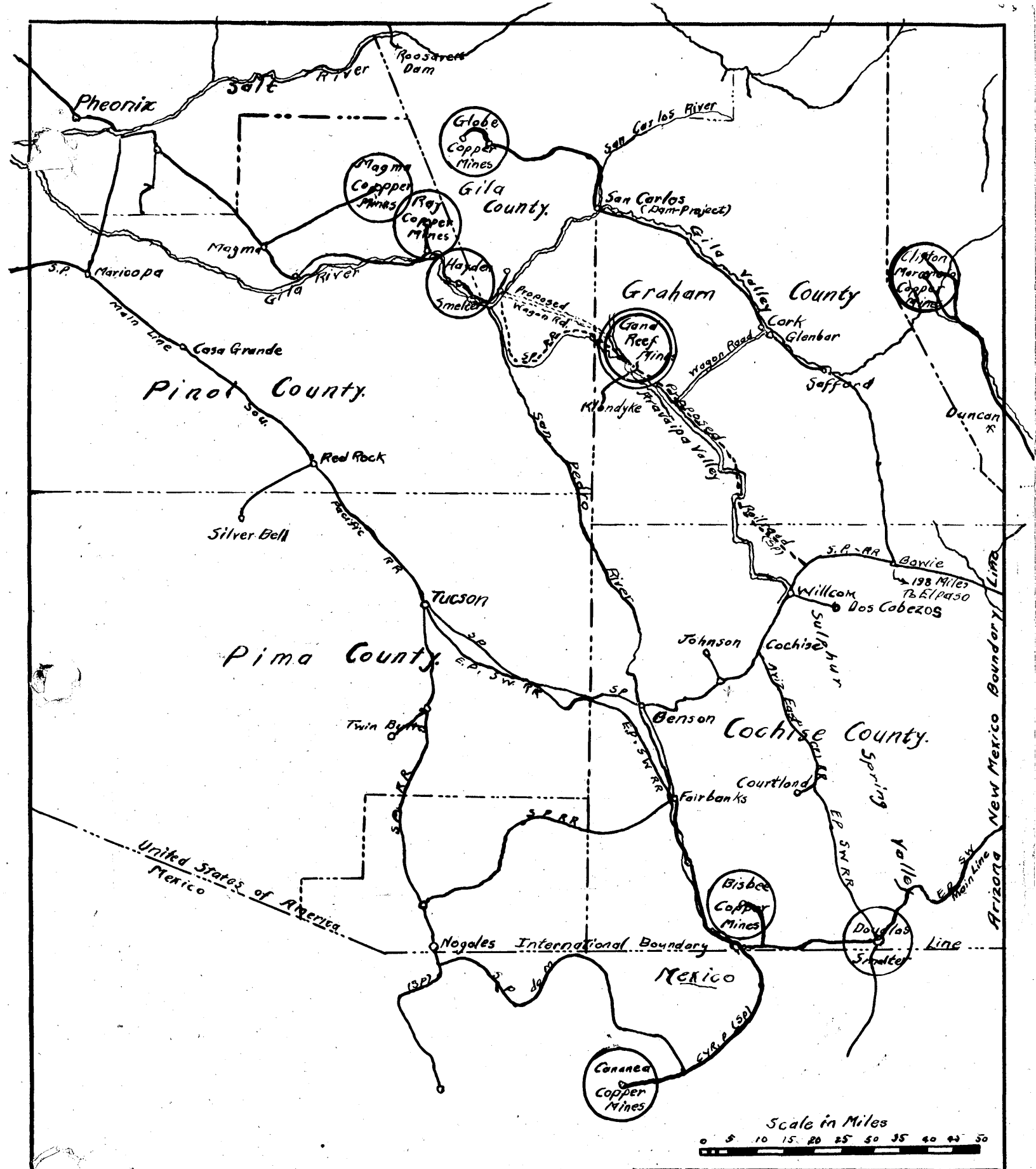
From: Robert Clarkson

Enclosures presented to the State of Arizona Department of Mineral Resources:

C. E. Minor Report
dated January 1921
On the properties of the Aravaipa Leasing Company

Also, miscellaneous material from the 1940 - 1942 activities of Calistoga Mining and Development Company (Graham-Loftus Oil Company interests, Hugh B. Martin, General Manager.)

J. R. Clarkson



AMERICAN ZINC CO., OF TENNESSEE
MASCOT, TENN.

Situation Map
Grand Reef Mines

DATE 3/20/21 SCALE —

DRAWING NO

Graham County Arizona

REPORT ON THE PROPERTIES OF THE ARAVAIPA LEASING COMPANY

By

C. E. MINOR

LOCATION

The Grand Reef Mining Group consists of seven patented and four unpatented mining claims covering about three miles along the line of a number of strongly mineralized outcrops, and also a number of adjoining unpatented claims located on lesser showings, largely for surface rights. The group is situated four miles north of Klondyke, Graham County, Arizona, in the western foothills of the Santa Teresa Mountain. Klondyke, a small settlement in the Aravaipa Valley, has a post-office and two general merchandise stores. It is, by auto road, sixty miles northeast of Willcox, Arizona and thirty six miles west of Glenbar, Arizona, the two nearest railroad stations, to both of which it is connected by good roads. Klondyke is about 4000 feet above sea-level and the group is about 500 feet higher.

THE DISTRICT

The Aravaipa Mining District, in which this property is situated, is well mineralized and central to several of the large copper camps. But it is one of the most backward sections of the State, due mainly to the inaccessibility, on account of its distance from a railroad and that the principal properties have been held for a number of years by owners neither willing to sell at a purchaser's

offer, nor inclined personally to develop their holdings. Now with good roads built, with practical motor trucks developed, and also the probability of a railroad in the not distant future (see under transportation), the district is demanding attention.

Several miles to the north of the Grand Reef group is the large Bullis group, held for many years by the late General Bullis and now owned by his estate. Adjoining this and extending still farther north, is the Aravaipa group, also in the hands of an estate and controlled by parties who prefer to hold, apparently waiting for others to develop the district.

GENERAL GEOLOGY

These various groups cover, in general, a slightly west of north zone of faulting, the contact rocks at surface being porphyries, rhyolite, granite, lime and quartzite. The main faulting extends for about eight miles and the average dip is eighty degrees to the west. At a number of places along the zone, a silicified friction breccia was formed as fault filling. The breccia being harder than the adjoining rocks, remaining exposed above the general surface, in places, as a wall ten to one hundred feet in width. It is locally termed the "Reef".

Santa Teresa Mountain, to the east, is principally granite, and the Aravaipa Valley, in general parallel to the Reef and about three miles to the west, cuts into thick beds of Gila Conglomerate. At the north end of the district the porphyries and other intrusive rocks are in places capped with lime and quartzite.

Lead-silver-copper ore occurs in the fault filling and also in the wall rocks at the contact. Near the surface the ore is lead-silver with a small amount of copper, but at depth, copper will probably be found to predominate. There are evidences of increase in copper with depth at the Grand Reef mine.

A number of small surface openings have been made along the eight miles of contact and a considerable quantity of lead-silver ore has been shipped by lessees; but the Grand Reef mine is the only place where there has been any considerable prospecting at depth and there only to a shallow depth.

TRANSPORTATION

There are good roads from Klondyke to the principal groups. From Klondyke to Glenbar, the road is over a divide but the grades are not steep, and heavy loads (3 to 5 tons) are hauled over it by trucks and wagons. The road-bed is well graded and drained. The road to Willcox is a valley road with very light grades. It follows the Aravaipa Valley from Klondyke to its head and from there down the Sulphur Spring Valley to Willcox. There are no difficult grades for a railroad from Willcox to Klondyke. The two towns are at about the same elevation, and the divide, half way between them, is perhaps 1000 feet higher. In time a railroad will come into the district even without mining, as the Aravaipa and Sulphur Spring Valleys are part of the railroad route surveyed for an eastern outlet from Winkelman (see situation map) and also the ranches in the valleys are rapidly being cut up into farms. I am told that both the Southern Pacific and Santa Fe Railroads have detailed figures on this route and it looks reasonable

that one of them will make use of it so soon as there is a period of railroad expansion. A good railroad grade can be obtained from the valley of the Grand Reef Group, a distance of four miles. The Glenbar route is not feasible for a railroad but on account of the shorter distance, it will be the main outlet for the district until a railroad is built into the valley. The cost of hauling by trucks between the Grand Reef Group and Glenbar will vary, at present prices, from six to ten dollars per ton according to the tonnage and whether or not there are loads both ways.

Graham County is now working on roads, and has recently sold bonds to the extent of $250,000.00, the entire proceeds of which will be used for roads.

Graham and Pinal Counties are proposing to build a road from Klondyke to Winkelman a distance by proposed road, of about thirty miles. When built, Winkelman will become Aravaipa district's main supply station for materials from the West Coast.

POWER

Wood is scarce and should not be considered as fuel for power. There is an undeveloped coal field about fifteen miles north-west of the Grand Reef Group. Reports are that the beds are of workable thickness and that it is fair bituminous coal. This field should be investigated as a possible source for electric power. The closest electric power line is at Winkelman, twenty five miles to the west. In time, electric power will be available twenty three miles to the north of the Grand Reef, at San Carlos where the Government proposes to build a huge dam and hydro-electric plant that will surpass the Roosevelt Dam project.

From the present and during the development stage, oil burning engines should be used at the Grand Reef, having a central plant at the major operation and distributing electric power to the other mines.

WATER

Plenty of water will probably be found in the mines for operations, including milling, but if not, enough to fulfill all requirements can be pumped from the Aravaipa Valley, a distance of about three miles and a maximum lift of five hundred feet, and considerably less to mill sites. The Aravaipa Leasing Company owns 160 acres of bottom land in the valley and there is a strong flow of good water sixty feet below surface at this place. This tract was purchased for a pumping site and probably also as a townsite. Water will need be pumped from there for domestic use at the mines.

MINE SUPPLIES

All supplies including timber, will need be brought in from the nearest railroad station.

REDUCTION PLANTS

Conditions are favorable for concentrating plants close to the mines. At present the nearest lead smelter is at El Paso, Texas (a distance of 250 miles), the railroad freight rate from Glenbar being five to six dollars per ton. It is reported that the Phelps Dodge Corporation is soon to add lead furnaces to its smelter at Douglas, Arizona one hundred and twenty miles south of Klondyke. A local smelter would be a great help not only in reduction of freight

rates but also that a lower smelting charge may be expected due to competition. At present the El Paso smelter controls the lead smelting for the entire South-west. Copper smelters are located at Douglas, Miami, and Hayden in Arizona, and at El Paso, Texas.

LIVING CONDITIONS

There are ideal locations for townsites both near the mines and in the Valley. The cost of living can be made as low as for the average of the mining camps in the State. In the Aravaipa Valley there can be raised sufficient crops for a fairly good size camp and there is also the rich Gila Valley from which to draw, the railroad station at Glenbar being in the Gila Valley.

CLIMATE

Climatic conditions are ideal for operating the entire year. The range in temperature is from 20 to 90 degrees. Due to the altitude, (4500') the summer temperature is not as oppressive as one might expect of the latitude.

LABOR

With good accommodations, labor will be at par with that of other mining camps in the State, and in a number of cases, more plentiful, as the property is close to a farming district. During the War the scale of wages was four to five dollars per eight hour day for Mexicans and five to six dollars for Americans. With conditions becoming more normal, wages are dropping and now the scale is three to four for Mexicans and four to five for Americans.

BUILDINGS

At the Grand Reef mine there are three dwelling houses, a boarding house, office, and store room, warehouse, assay office, power house, blacksmith shop, oil house, powder house, and two other buildings, together with several tent houses. The buildings need repairs such as new roofs, floors, etc. There are several small buildings at the Dog Water and Aravaipa claims, which are serviceable as dwellings for Mexicans.

EQUIPMENT

The following is a list of the main items of equipment owned by the company:

* 1 50 HP type Y Fairbanks Morse oil engine
* 1 40 HP " NB " " " "
* 1 307 cf Sullivan belt drive compressor
* 1 152 cf " " " "
* 1 6-1/2 x 8 Deane Triplex pump, 150 pounds working pressure
* 1 6-1/2 x 8 steam hoists
1 6-1/2 x 8 " "
1 Anaconda hoist
* 1 5 ton hand winche
3 Steam boilers
3 Cameron sinking pumps, 2-#7 and 1-#5
2 Steam engines
1 Steam Compressor (obsolete)
1 3 HP Gasoline hoist
4 Machine drills
* 2 Wagon tanks
3 Water storage tanks
Gyratory crusher and other parts of the old mill
Complete assay outfit
Engineering equipment
Tools, pipe lines etc.

The greater part of the equipment is almost new, having been used only for a few months.

* Stored at Willcox, (date of report)

THE MINES

The principal mines of the Grand Reef Group, are the Grand Reef, Aravaipa, Dog Water and Silver Cable. They will be described below in the order given. See claim map for their relative location.

HISTORY

The principal claims were purchased from the locators by John W. MacKay of California mining fame, in the nineties. He began development of the Grand Reef mine carrying it to the 300 level, and did considerable other work on the property. An extensive exploration campaign was stopped by his death about 20 years ago. From that time until 1915, the property was held in status quo by his estate and other eastern interests. In that year a lease was granted local people who erected a crude mill, and after paying some $40,000.00 in royalties, the lessor and lessees became involved in litigation. In 1919, the Aravaipa Leasing Company of 55 Congress Street, Boston, Massachusetts, settled the litigation and acquired the property, unwatered the Grand Reef mine (the first time it has been completely unwatered since Mr. MacKay's operations), and did considerable exploration work together with sampling the mine. The company also did some work on the other properties, its activities being stopped by the abrupt change in 1920, of financial conditions.

THE GRAND REEF MINE

The Grand Reef mine is developed on the Grand Reef claim, which was located in 1893 and patented in 1899. The claim covers 1500 feet of the outcrop.

The outcrop of the vein or reef, at this point is spectacular in that it projects four hundred feet above the bottom of Laurel Canon which has cut a deep and narrow channel through it, and also that the exposed part of the reef contains an ore shoot.

The vein or reef here is twenty to eighty feet in width with a strike of North 12 degrees West and a dip of 82 degrees to the West. The hanging wall rock is a light colored porphyry, and the foot wall rock is a dark, fine grain rock, probably quartz-porphyry. Back of the quartz porphyry which is about 100 feet thick, is granite. The vein material is a breccia composed of small fragments of the quartz porphyry and light colored porphyry, cemented with quartz, light colored porphyry, and also quartz with very little of the wall rocks or porphyry. The light colored porphyry of the vein will herein be called "white porphyry". At the hanging wall there is several inches of gouge, showing that there was movement at the wall after the vein was formed. The foot-wall line is not well defined. Where the filling is principally quartz, the foot wall is quite plain, but at places there is no distinct line between the breccia and the quartz porphyry.

At the deepest workings, 300 feet below the adit at the creek level, and 650 feet below the outcrop of this shoot, a crosscut into the foot-wall formation shows a quartz porphyry granite contact 125 feet back of the footwall and dipping 70 degrees to the East, or away from the vein. It may be that the diabase is present as a dyke formed after the main faulting, the breccia being the result of the dyke intrusion. However, there has not been enough development for sufficient data to draw conclusions as to the vein occurrence.

Laurel Canon, which cuts deeply across the reef formation, follows probably the line of a cross break where it crosses the main vein. Although the line of the main outcrop and the underground workings do not show a displacement in the vein where this creek crosses, there are evidences, such as creek water entering the mine, indicating there has been such cross fracturing at the creek. Further development may show displacement. On the south side of the canon, the edge of the exposed section of the main outcrop stands almost vertical, while that on the north side slopes back as it rises at about an angle of forty-five degrees. South of the creek the vein is principally quartz and very hard. To the north it is composed of breccia containing largely porphyry.

The principal known ore shoot at the mine occurs immediately north of where the creek crosses. At the outcrop, the shoot is twenty to forty feet in width and about two hundred and seventy five feet in length. It has been partly developed to the three hundred level, 650 feet below the outcrop. The ore occurs principally in white porphyry breccia which predominates in that section of the vein. Further north, there are in sight several smaller ore shoots next to the hanging wall. The vein will be further described in connection with the outcrop and workings.

DESCRIPTION OF MINE

The general map and McCart's map show the mine workings at the time the Aravaipa Leasing Company started work in 1919, except that stopes 1, 2 and 3 had been enlarged since the above maps were made to within about thirty feet of the Dey Drift and the ore was partly stoped above the Dey drift between crosscuts 2 and 3. The general

map is incorrect in a number of places, and must be considered more as a sketch giving a general idea of the workings. It was made from data on old level maps, before the company unwatered the mine. The company's Level Relation map shows the relative position of the levels. The normal water level is between the 55 and 100 level, all referring to the main adit as zero. No mining has been done below the tunnel level. The present owners mined and milled about three thousand tons of ore from stopes 1, 2 and 3; extended the tunnel north; unwatered the mine; cleaned out the lower levels; drifted a little at the 300 level, and did some diamond drilling. The accompanying maps show the additions to the general map. As only the tunnel or adit, level and the stopes above are now accessible, a more detailed description of the mine will be given than there would if it were subject to examination without the expense of unwatering. Assays quoted are from the Aravaipa Leasing Company's records and from McCart's map. The company did not check McCart's sampling but knowing the ore and by comparing his assays with past mill and shipping records; the wrtier feels that his map is closely correct.

THE OUTCROP AND UPPER WORKINGS

The outcrop has been described above in general. For the first 300 feet north of the canon it has a light colored appearance due to the white porphyry predominating, and north of that to where it enters the hill at No. 4 Shaft, it has an iron rust color. In the first described section are the croppings of the main ore shoot. The line of the ore croppings is about half way between the lines on the General Map showing "Croppings enter ground (West)" and "Outline of croppings".

The Dey workings are close to the outcrop and near the north end of the ore shoot. A 30 foot cross section of the stope averages 8.2 Oz. Silver, 1.2% Copper and 6.8% Lead. Another cross section of the stope fifty feet north of the one above for 28 feet averages, 5.4 Oz. Silver, 1.4 Copper and 9.5% Lead. The ore is Galena, Anglesite, Cerussite, Chalcopyrite, Malachite, Azurite and Chrysocolla, in the breccia. It is semi-oxidized. South of the stope the outcrop shows the ore to be more oxidized and leached. A cut sample of the outcrop one hundred feet south of the entrance to the Dey stope shows an average of 2.8 Oz. Silver, 0.7% Copper and 4.6% Lead for 27 feet across. An 8 ft. sample, at about the same location, assayed 7.8 Oz. Silver, 1.6% Copper and 10.3% Lead. Higher assays can be obtained from the outcrop by selecting the cuts. The ore where these samples were taken is almost entirely oxidized. Still further south, the outcrop is on oxidized and leached vein material, and at the creek bottom malachite is showing. No samples have been taken of this section.

A few feet west of the Dey stope, and next to the hanging wall, is the outcrop of No. 3 ore chute, showing mineralization. The writer has no record of samples from there. It is a small ore shoot and will be described in connection with the tunnel level.

600 feet north of the Dey stope is number four shaft and No. 4 ore shoot. The outcrop is mineralized but no samples were taken as it is partly covered with loose material. McCart's map shows good lead ore in the shallow shaft. What is supposed to be the same ore shoot is partly developed at the tunnel level 350 feet below the outcrop and vertically below No. 4 shaft. This ore shoot will be described in connection with the tunnel level.

Continuing north for about 1200 feet, on the Blevin claim, there are intermittent croppings of mineralization, some of which show fair lead-silver values.

Immediately south of Laurel Canon, there is not much mineralization apparent in the outcrop. About five hundred feet south, where it enters the hill, there is some copper carbonate ore showing.

THE TUNNEL OR ADIT LEVEL

The tunnel is about 1400 feet in length running north, in the vein, from near the bottom of the canon. A crosscut near the portal shows leached porphyry which has not been sampled but probably carries low values. From there to the beginning of the stoped area, where there is good ore, oxidation and leaching diminishes and the values increase. At the beginning of the stope, the average assay for 30 feet across the vein is 6.8 Oz. Silver, 1.6% Copper and 11.4% Lead. Seventy five feet further north, the average of 38 feet across the vein is 9.5 Oz. Silver, 1.2% Copper and 12.0% Lead, and twenty five feet further, at the end of the stope, the average for 22 feet is 7.2 Oz. Silver, 1.3% Copper and 10.0% Lead. At the stope, the tunnel level is 200 feet below the outcrop of the ore shoot. It is probable that good ore will be found between the tunnel and the hanging wall opposite McCart's samples 123,124, and 125, making a length of about 150 feet and width of from 15 to 38 feet of ore similar to that shown by the assays quoted.

West of the main stope is No. 3 stope, next to the hanging wall. This appears to be a distinct ore shoot separated from the main shoot by ten to fifteen feet of quartz breccia. The vein material is

white porphyry and quartz with very little brecciation. It is claimed that this shoot furnished a better grade of shipping ore (galena) than the main shoot and that the percentage of silver is higher. The writer has classed it as a hanging wall shoot mineralized probably at a different period. There are similar hanging-wall ore shoots at the Aravaipa and Dog Water claims, as well as further north in the Grand Reef claim. The shoot is about five feet in width and one hundred feet in length. It has been stoped and back-filled from the tunnel level down about thirty feet and up close to surface. McCart's map shows one 5.5 foot sample cut assaying 7.0 Oz. Silver, 0.9% Copper and 32.4% Lead and another one, at the north end, and probably out of the shoot, seven feet in length assaying 1.0 Oz. Silver, 0.3% Copper and 0.9% Lead. The back of the stope shows good galena ore in spots. The lower level workings do not show this shoot but it is quite probable that it extends to those levels, and was missed by the few crosscuts driven to the hanging wall.

Along the reef from the main stope to number Four stope, the vein is more silicious and the breccia contains less of the white prophyry. The mineralization is slight but quite uniform, principally as carbonates and silicate of copper. A little chalcopyrite can be found in the hard quartz. From number Four stope north the drift follows the hanging wall and shows more white porphyry with an increase in mineralization.

Number Four ore shoot at this level is about seventy five feet in length and from five to seven feet in width. McCart's map gives as the average value at the back of the stope for 60 feet in length and 6.4 feet in width, 1.8 Oz. Silver, 0.4% Copper and 6.8% Lead. The lead is principally as galena. What is supposed to be the same shoot, outcrops

at number Four shaft 350 feet above the tunnel level. McCart's map shows 21 feet in width of ore, at the 50 ft. level, that averages 2.5 Oz. Silver, 0.3% Copper and 11.0% Lead. A good grade of milling ore can be obtained from this shoot by doing a little sorting. It is to be noted that the silver contents are lower than for the ore of the main shoot.

The end of the tunnel seems to be just entering another hanging-wall ore shoot similar to number Four. A 4 ft. cut across the face of the drift assayed 1.6 Oz. Silver and 17.7% Lead.

The writer has been told by responsible people that in the floor of the drift between cross-cuts 7 and 8 North, north of number Four stope, there are stringers of high grade copper sulphide ore; that the ore extends for about fifteen feet along the drift and that it extended about half way up into the drift. A specimen given to the writer, is hard jaspery breccia impregnated with a black mineral which may be tetrahedrite. It is too hard for chalcocite. The specimen also contained some chrysocolla. It assayed 7.0 Oz. Silver and 5.1% Copper. The find is interesting as it indicates the class of copper ore there is below in the oxidized zone of the vein. This spot should be prospected with a winze.

DIAMOND DRILLING

The Aravaipa Leasing Company made two attempts to undercut the vein with diamond drill holes from the end of crosscut 7 N. W., but the holes were abandoned before the vein was reached. The holes caved, the drill water was lost several times and the cuttings were so sandy that it was almost impossible to drive casing. It was decided to be impractical to drill the vein from the hanging wall side, drilling

through the porphyry wall rock. A hole was then drilled from the foot wall side from near the end of crosscut 5-NE, pointed to cut under number Four stope 200 feet below the level. The drilling was not satisfactory as several small fissures were encountered in the vein and a part of the cuttings were lost; the heavier mineralized particles being more liable to be lost than the lighter unmineralized cuttings. About fifty per cent of the core was recovered, which means that only the hard and probably less mineralized part was recovered. However, the hole shows encouraging results; It shows 36 feet of mineralized and oxidized vein, with iron oxides and a small amount of copper as carbonate and silicate, and no lead. 15 feet of the vein next to the hanging wall averaged, according to the core recovered, 0.8 Oz. Silver and 0.6% Copper. The result would indicate that 200 feet below the tunnel level, in that section of the vein at least, the mineralization is below the lead zone and in the upper part of the copper zone; also as there is some lead ore on the 300 level, that copper ore may be found at a higher level in the north end of the mine than in the vicinity of the main ore shoot. There are no drifts at the lower levels to the north end of the mine.

THE ONE HUNDRED LEVEL

The shaft from the tunnel is vertical to a few feet below the one hundred level and from there it is inclined with the vein but at a slightly greater angle, thus approaching the foot wall.

Attached are two assay maps of this level, showing the original and resampling by the Aravaipa Leasing Company. The resampling which on the average, gave slightly lower values, has been used by the writer for ore calculations and the assay value of sections. The other map is included with this report as it gives assays of parts not covered

by the resampling, and the error of those sections can be considered negligible.

The Aravaipa Leasing Company did not do any development work at this level. The station crosscut was used as a pumping station, and the south drift was dammed and used as a pump sump.

From crosscut 2 NE, to where the south drift crosses under the creek, the vein filling is white porphyry breccia and quartz, and the better ore is in this area. At crosscut 2 S, 50 feet south of the shaft, the average assay for 40 feet across the vein is 6.1 Oz. Silver, 1.3% Copper and 5.4% Lead. At the station crosscut the average for 33 feet is 5.5 Oz. Silver, 1.4% Copper and 5.0% Lead. Crosscut 2 N. seems to be just entering good ore. There is some good ore in the vicinity of crosscut 3 S. The ore in the vicinity of the station and crosscut 2 S is less oxidized than the ore directly above at the tunnel level, and contains somewhat less silver, a little more copper, and considerably less lead. The difference is probably due to less oxidation, especially at the north end of the area, and probably also with depth as the copper zone is approached, the lead values will be found to decrease and the copper values increase.

The north drift has been back filled a few feet north of crosscut 2 N. One old map shows that the drift extends one hundred feet beyond the crosscut and at the end there is a long crosscut into the footwall formation. Another old map has a note that the north end of the drift is in "quartz strongly mineralized with iron oxides". The formation is probably similar to that north of the main stope at the tunnel level.

The sampling south of the creek shows low values. The writer knows very little about that part of the level as the drift, being used

for a pump sump, was inaccessible most of the time the mine was unwatered. Where the drift crosses under the creek, the vein is fractured and creek water enters. When there is much water in the creek, water enters the drift at the rate of twenty-five gallons per minute.

Between crosscut 2 S and where the creek crosses, it is probable that better ore than shown, will be found on one side or the other of the drift. (See under description of the two hundred level for remarks regarding crosscut 3 S and vicinity). It is twenty to thirty feet from the drift to the hanging wall at this point.

TWO HUNDRED LEVEL

The assay map of this level, shows two sets of samples both of which were taken by the Aravaipa Leasing Company. For the resampling, the old cuts were first made deeper and then new samples were taken. Where possible, the writer has used the results of the resampling for ore calculations.

As at the One Hundred, no development work was done by the company at this level. The station crosscut was used for a pumping station and the north drift was dammed and used as a sump.

At this level there is at the north end of the ore shoot, or in the vicinity of the shaft, partly oxidized ore, while at the south end the ore is almost entirely oxidized and there is also considerable secondary copper ore. The mineralization corresponds with what one would expect on examining the outcrop.

In the vicinity of the shaft there is the same extent of partly oxidized ore as at the levels above. The lead is principally as a sulphide and more of the copper is as a sulphide. But, as may be

expected, there is less lead and more copper than at the One Hundred level. There is also less silver in the sulphide body. At the station crosscut, the average assay for 45 feet across the vein is 3.9 Oz. Silver, 1.7% Copper and 2.7% Lead, and at crosscut 2 S, (70 feet south of the station) the average for 30 feet is 4.9 Oz. Silver, 2.5% copper and 3.1% Lead. A 1000 pound sample taken along the crosscut, for milling tests, assayed 5.7 Oz. Silver, 2.7% Copper and 3.4% Lead, somewhat higher values than the averages of the cut samples. In my ore estimate, for mining on a small scale, I have included only the higher grade ore as outlined on the map. The high grade oxidized and secondary ore near the south end of the ore shoot will be described below.

Crosscuts #1 and #2 N are in hard white porphyry breccia and quartz. South of the station, as crosscut 4 S is approached, the vein material is softer, white porphyry predominating. The west wall of the drift from the crosscuts #1 to#2 S is hard and is the line of a fracture or small fissue. The first forty feet of crosscut 2 S is soft and partly leached, and the end is in hard breccia. Continuing south, the east wall opposite samples 25390 and 25400, contains native silver (plate silver) and copper carbonates. This ore was not included in the samples. On south to crosscut #3 S the drift shows copper stains in stringers. Crosscut 3 S shows copper stained white porphyry, and from there to the next crosscut the drift is in soft talcy white porphyry containing malachite, cuprite (earthy), cerusite, chalcocite, native silver and in the center of several hard pieces of ore were found pyrite and chalcopyrite. The talc carries good values as well as the ore. The same ore appears to extend into the east wall of the drift for at least two feet. The drift is timbered and the roof and part of the sides are

lagged. The west wall is the line of a fracture. The timbering was removed for sampling. The average assay of the back of the drift for 50 feet in length and five feet in width, is 16.9 Oz. Silver, 5.0% Copper and 3.3% Lead, and a sample of the talc assayed 2.5 Oz. Silver, 9.5% Copper and 1.8% Lead. It is very good copper ore. Between crosscuts #3 and #4, I believe the ore is 7 to 8 feet in width, and it probably extends as far north as crosscut #2 S, a distance of 60 feet (making a total length of 110 feet) where there is native silver and copper ore in the side of the drift as mentioned above. Judging by the distance from the hanging wall, width of mineralization at the outcrop, and indications at "A" as will be noted below, it is also probable that similar ore will be found between the drift and the hanging wall. At the outcrop the same distance south of the line of the shaft there is similar mineralized formation for 27 feet in width. (See under outcrop, samples 100 feet south of the Dey stope). So far as I know, the ore shoots of the reef are practically vertical. The ore if continuous from the Two Hundred to the outcrop, should be found at the One Hundred in the vicinity of crosscut #3 S. A few samples from there do show good values. One 5 ft. cut (#24870) assayed 12.8 Oz. Silver, 3.6% Copper and 12.3% Lead according to the original sampling and 5.6 Oz. Silver, 3.0% Copper and 12.1% Lead, on the resampling. The difference in silver values is probably due to native silver in the ore. At the tunnel level, similar ore will probably be found opposite samples 123, 124 and 125 as noted under "tunnel level", by crosscutting from the tunnel to the hanging wall.

Crosscuts 4 S and 4½ S are in white porphyry while crosscut 5 S and the drift south are in hard breccia and quartz containing less

white porphyry. Crosscut 5 S is under the creek. At "A" there is timbering and back of the timbers there is soft white porphyry, with talc, similar to that with the copper ore, just described. A grab of the talc from behind the timbering assayed 0.7 Oz. Silver and 1.5% Copper.

Surface water enters the mine between crosscuts 4 and 5 S at the rate of about 15 gallons per minute.

THREE HUNDRED LEVEL

There is a progress map and two assay maps of this level. The progress map shows all of the workings except a 20 foot raise from the north drift for diamond drilling.

The level makes about 100 gallons of water per minute and most of it comes from the north drift and from small north and south fissures at the station crosscut. The water is practically non-mineralized.

There has not been enough development to draw conclusions regarding the extent of the ore shoot at this level. In 1900, Mr. MacKay developed the level as shown by the assay map dated September 1919. His progress was no doubt slow as I understand he had difficulties keeping the level unwatered with a steam pump. The Aravaipa Leasing Company did not have the level unwatered long enough to do any amount of development. It extended the south drift, drove the long crosscut east for a diamond drill station and drilled a down hole from the north drift.

The station crosscut from the shaft to the drift is in leached, hard quartz breccia and jasperoid. The station crosscut west of the main drift and the drift as far south as crosscut 3 S, are in leached breccia. The writer has no notes regarding the breccia but according to his

recollection, it contains considerable white porphyry. Crosscut #2 S shows diabase with finely disseminated pyrite, and breccia. At the face there is hard quartz breccia. Crosscut 3 SW is in white porphyry breccia, and 3 SE for the first ten feet is in fractured iron stained quartz breccia and white porphyry. In this section and at the south side of the drift there are stringers of cuprite (earthy) and chalcocite. It is the beginning of a fault zone further south which will be described below. The next twenty feet of the cross cut is in quartz breccia with disseminated pyrite, and the last thirty five feet of it is in fractured diabase in places iron stained, with disseminated pyrite and occasional small crystals of chalcopyrite. South of crosscut 3 S, crosscut 4 S and most of the drift are in a strongly iron stained fault zone, showing diabase, which in places has a schistose structure, quartz, white porphyry and talc. The lines of movement are north and south. The end of the drift is in hard quartz. The drift south to crosscut 4 S is between two lines of movement, which connect with the fault zone.

In the long crosscut east, the apparent footwall of the vein is a few feet back of the shaft. East of the foot wall is diabase iron-stained and in places showing pyrite. Thirty six feet from the end of the crosscut is the diabase-granite contact dipping 70 degrees west and with about the same course as the vein. The granite is also iron stained and slightly mineralized with pyrite. In both the granite and diabase can be found occasional crystals of chalcopyrite.

It is of interest that all of the foot wall rock exposed at this level, is mineralized and also that part of the original chalcopyrite disseminated in the rock, has not been altered.

The only place the hanging wall rock is exposed is at crosscut

3 SW. At the wall there is fifteen inches of gouge. The course of the wall as shown is probably not the course for any distance. Judging by the Level Relation Map, the hanging wall is 15 to 20 feet west of the line of the main drift.

Without knowing conditions at this level, the assay maps are not of much interest as the values are low. However, when one considers the heavy oxidation and leaching, and that this level is either at or close to the zone of change from lead to copper, low values are to be expected. The lead is as cerussite and the copper, except for a little secondary ore in the fault zone, is principally as chrysocolla. The writer's opinion as to why this level has been subjected to more oxidation and leaching than the upper levels, will be given under "Conclusions". It is quite probable that better copper ore will be found north of the station crosscut and between the drift and the hanging wall.

At the south end, which is under the copper ore at the Two Hundred level, there has been a great deal of movement and oxidation, and in the movement planes are found stringers of high grade secondary ore. A 10 inch seam of talc in crosscut 4 S assayed 14.0 Oz. Silver, 5.1% Copper and 0.7% Lead. Twelve inches of copper oxide ore in crosscut 3 S, assayed 16.2 Oz. Silver, 24.8% Copper and no lead. Close to the copper oxide ore, 10 inches of soft gray material with pyrite, assayed 2.3 Oz. Silver, 3.3% Copper and no lead. A little north of crosscut 3 S a specimen, showing native silver, from the west wall of the drift, assayed 37.3 Oz. Silver, 2.4% Copper and no lead. From the east wall, a specimen of black sulphides, principally iron, assayed 2.7 Oz. Silver, 4.9% Copper and trace lead. These stringers were not included in the drift samples. More development should be done at the south end and the high grade stringers should be followed, prospecting

for bodies of the same class of ore.

DIAMOND DRILLING

Drill hole number Four is a down-hole from the north drift following the dip of the vein. It was located with the idea of determining the depth to the sulphide zone, but unfortunately, at 45 feet down the drill encountered a crevice and water course and followed it to a depth of 157 feet when the hole was abandoned after over a month of difficult drilling. As soon as the crevice was encountered, water came up the casing, and near the bottom of the hole, water camp up at the rate of 50 gallons per minute. The hole cored poorly and considerable of the cuttings were lost. Except for a little zinc sulphide (which was more noticeable in the cuttings), the core was quartz and quartz breccia with a little chrysocolla and cerussite. The company planned drilling a deep under-cutting hole from the end of the long crosscut but all work was stopped just as the crosscut was completed.

REMARKS AND CONCLUSIONS

Indications are that the original ore deposition was by ascending solutions and not by descending solutions or from the exposed wall rocks.

The breccia was formed either by faulting and silicification of the fault filling, or, if the diabase occurred in the form of a dyke, as suggested, by a mixing of fragments from wall rocks with the dyke material during the extrusion, followed later by silicification. After the brecciation, there were movements, which may have been the main fault movements, forming the wall lines and causing longitudinal cracks

or fissures in the vein. The fact that the hanging wall rock which is separated from the vein by a gouge, is not mineralized, and that the footwall rock which was not protected by a gouge, is mineralized for some distance from the vein, indicates that the mineralization took place after the vein lines were formed.

The minerals deposited by the ascending solutions, were galena, blende, copper-iron pyrites and pyrite, at least part of them being argentiferous. In general, as regards depth, they were probably deposited in a reverse order to that given and formed zones in which the different minerals predominated. We know that the solutions were liberally mineralized with lead but we do not know so much regarding the proportions of zinc and copper. Zinc being closely associated with lead and the fact that there is very little of it with the lead ore, indicates that the mineralization as a whole was without much zinc. (The galena carries more copper than zinc. There is one to three per cent of copper, as chalcopyrite, with the galena ore indicating that a very good grade of copper ore should be found deposited in the copper zone.

As oxidation progressed, due to the action of surface water working down through the vein to the water level of that period, most of the copper of the vein went into solution and was redeposited as secondary copper ore, at or near the water level and also at favorable places above the water level, as for example at the south end of the Two Hundred. Lead being comparatively insoluble, was left in its original position, as the oxide.

The present workings are all in the lead zone. Since there is a marked decrease in the lead of the main ore shoot, as the Three Hundred level is approached and an increase in copper, (except at the

Three Hundred where oxidation is so pronounced), and also as drill hole number Three (from the north end of the tunnel level) shows practically no lead, it would appear that the copper zone is but a short distance below the Three Hundred in the neighborhood of the shaft, and probably higher at the north end of the mine. But we do not know how much of the copper ore has been oxidized and carried in solution to a greater depth, and how deep the oxidation extends. It is the writer's opinion, taking into consideration the geology of the district, that the limit of oxidation and beginning of the sulphide zone is between five and eight hundred feet below the tunnel level and probably higher at distance north from Laurel Canon crossing the vein. He would expect in places to find a large quantity and a good grade, of secondary copper ore between those levels.

Regarding the pronounced oxidation at the Three Hundred Level. The mine water, including that from drill hole Number Four (a down hole from the the 300 level) is cold and practically non mineralized. The water evidently circulates only in the oxidized zone and must be surface water that enters the ore body through a crevice. I have been told by men who worked in the mine for Mr. MacKay, that when the creek was dry the flow at the bottom of the mine decreased considerably. It is probable that the fracturing under the creek and to the east of the reef was originally the course of descending water which followed the south end of the ore shoot to the Two Hundred level, and thence to near the station at the Three Hundred level; the result being that above the Two Hundred, the oxidation is more complete at the south end of the shoot, also that at the Three Hundred, practically all of the ore of the developed area is strongly oxidized, as it is within the limits of the water course.

In general on the Grand Reef claim, there are three ore shoots partly developed, one being 200 to 300 feet in length and with an average of about 30 feet in width, extending at least 500 feet below the outcrop. The other two are smaller shoots and located along the hanging wall, averaging 6 feet by 70 feet, and extending at least to the tunnel level, several hundred feet below the outcrops. All three contain considerable tonnage of commercial ore. North, on the Elevin claim, there are ore croppings, and no doubt other shoots will be found in this immediate section, which do not outcrop. The shoots apparently follow the dip of the vein, but may be found to change in position and general dimensions, according to the nature of the filling at various parts of the vein. The degree of mineralization will probably also be found to be variable. All of the secondary copper ore will probably be found to contain considerable silver.

SHIPMENTS

Lessees in 1914-15 built a crude and inefficient concentrating plant at the mine. They mined and milled ore from above the tunnel level, the higher grade ore being sorted and shipped without milling. The mill recoveries were very low, as little of the oxides went into the concentrate. The records show on a 1000 ton test the recoveries were 38.0% of the silver, 24.0% of the copper and 50.6% of the lead. About 30,000 tons of ore were mined, from which about 1550 tons of lump and 2613 tons of concentrate were shipped. The average analyses computed from a list of the smelter settlement sheets (August 1915 to June 1919) are :

	Tons	Ag.Oz.	Cu.%	Pb.%	Ins.%	Fe.%	Lime%	Zn.%	S.%
Ore	1416	20.6	2.4	40.5	29.5	2.3	3.5*	1.2	6.1
Concs.	2613	21.2	2.5	45.6	20.2	4.2	3.0*	1.3	4.9

*Available lime.

A list of all shipments on record is given in Appendix.

The gold ran 0.01 Oz. and less, per ton. It is of interest that the minerals of the ore and concentrate were principally as sulphides, and also that there was less silver in proportion to the lead than shown by average assays of ore in the mine. At least part of the silver evidently occurred as a separate mineral, and was lost in the concentration. Shipments since June 1919 are given in the Appendix.

ORE ESTIMATE

Until recently, the methods of milling oxidized lead and copper ores produced very low recoveries, but now by use of a sulphidizing reagent and flotation, good recoveries are being made. For milling the Grand Reef ore without flotation, the average recovery would probably be less than fifty per cent and only the higher grade ore of the mine could be mined and milled at a profit under normal conditions, but by such flotation as above noted, a considerable quantity of the ore developed becomes of commercial value. Without having made milling tests but considering all data available, I have outlined on the assay maps the probable limits of ore than can be mined and milled at a profit, before a railroad is built to the property. Milling tests must be made and operating plans outlined before a close estimate can be had as to what grade of ore can be considered commercial ore. For operating on a large scale and with a railroad on the property, lower grade ore can be treated, which would materially increase the tonnage given in my estimate.

As the ore outlined, has not been fully developed, nor the continuity between levels fully proven and also as McCart's map does

not give assay sections at sufficient intervals for a close estimate, the writer classified the ore as "Probable Ore". There are showings of good ore outside of the limits noted but as a factor of safety, these have not been considered. Ore in the vicinity of the shaft is figured as continuous from the tunnel to 20 feet below the Two Hundred level. The secondary ore at the Two Hundred, South, is figured as shown by drift samples and is considered extending 25 feet below and 25 feet above the level. For tonnage above the Tunnel level, I have depended principally on my personal knowledge of the mine, as there is not enough map data for a close estimate, and have assumed 14,000 tons of the same grade as obtained for the ore below that level. I believe this is a conservative figure. The estimate is as follows:

Tunnel to 100 Level,	43270 Ts.	7.0 Ag.,	1.5 Cu.,	8.8 Pb.
100 to 200 Levels	29000	5.9	1.8	5.7
200 to 250	2570	5.5	2.5	4.0
200 Level, south,	1250	16.9	5.0	3.2
Below Tunnel,	76090	6.7	1.7	7.4
Above Tunnel	13910	6.7	1.7	7.4
Total	90000	6.7 Ag.	1.7 Cu.	7.4 Pb.

There is a tailing dump at the mine, containing from ten to fifteen thousand tons of tailing that I believe can be milled at a profit. A few general samples from the outside of the dump, show four or five ounces silver, a little less than one per cent copper and three to five per cent lead. It is probable that the average values of the entire dump are between those limits.

TUNNEL SITE

A tunnel starting from the foot of the steep grade approaching the mine, would be at the same level as the Three Hundred level of the

mine. The distance in a straight line from the portal site to the mine is about 4000 feet, but as the portal would be only about 1900 feet from the Dog Water mine, the closest point on the vein, the tunnel, if built, should be slined to enter the vein at the Dog Water mine and from there follow the vein to the Grand Reef mine, a total distance of about 5300 feet from the portal.

SHAFTS

The shaft from the tunnel to the Three Hundred level has two 4 x 4 Ft. compartments. It is vertical to a short distance below the One Hundred level and from there it is inclined at about 85 degrees. It should not be considered as a working shaft, not only because using it would prevent mining part of the ore around it but also because it is poorly located for operations. The cost of putting it in serviceable condition would be high, and if extended to a greater depth, the cost of sinking would be excessive.

The location for a working shaft is in the hanging wall rock on the north side of the canon. There is a good site several hundred feet from the vein and about the same distance from the centre line of the canon. The collar of the shaft would be about fifty feet above the level of the present main tunnel and a safe distance from the vein so that by sinking vertically, the hanging wall would not be encountered if sunk to the 1000 ft. level assuming that the dip of the vein does not change at depth. The hanging wall rock is very good ground for sinking and it is probable that very little water will be encountered before connections are made with the vein.

RECOMMENDATIONS

It is probable that more ore will be developed by extending

the present drifts, crosscutting and upraising, but in order to prove the real value of the mine, the first developing should be confined to depth, at least down to the 800 level, to determine how deep oxidiation extends, the character and amount of mineralization in the sulphide zone, and the extent of secondary enrichment. If the findings are favorable, as expected, it will then be in order to consider a railroad to the property and other plans for operating on a large scale. Developing at depth should be not only beneath the Three Hundred level workings but also north and south along the vein, especially north. There are two methods of procedure; diamond drilling and then sinking if the drill holes show favorably, or by sinking without first drilling.

If by drilling, the Three Hundred level drifts should be extended, crosscuts made into the footwall formation and under cutting holes drilled from the ends of the crosscuts. Drilling will be slow, expensive and not altogether satisfactory. While I feel that it is possible to drill the vein from the footwall side, I am doubtful as to whether it is advisable. It will require time, a great deal of cementing and it can be expected that some holes will be "lost" due to "caving". With the overhead expense and cost of keeping the mine unwatered, drilling enough holes to gain reliable data regarding the vein at depth, will be as costly and require as much time as for sinking and drifting provided the flow of water is not found to be too great. If, in connection with developing the Dog Water mine and the part of the vein between the two mines, it should be decided to drive the long tunnel before developing the Grand Reef mine, drilling from the Three Hundred level should be considered, for with the tunnel draining that level there would be no pumping charges, the overhead expense would be reduced and very little equipment would be required.

The quicker and more satisfactory method of developing at depth is to sink a vertical shaft in the hanging wall formation, crosscuts to the vein at 200 ft. intervals, and develop by drifts, crosscut and upraises. This will require a good organization, a power plant of at at least 200 horse power, and other equipment. The work would need be pushed rapidly so as to keep the pumping charge as low as possible for the amount of development. The amount of water to be pumped is questionable but it is of importance to determine the flow of water as well as it is to determine the character of ore at depth. An excessive flow may be the deciding factor as to whether the ore can be mined at a profit. The flow can be determined only by sinking. It is possible that the greater part of the flow at the Three Hundred can be stopped by cementing part of the creek bottom. After the mine is developed, it may be found advisable to drive the long tunnel in order to avoid lifting water above the Three Hundred level.

I have not given estimates as to the cost of operations, for the reason that this is a period of readjustment for the entire Country and until the prices of material, labor and metals come to an equilibrium, any estimate I would make would be subject to too many conditions. Roughly, I would say that to sufficiently develop the mine for determining the character and extent of the ore at depth, will require from three to five hundred thousand dollars and from two to three years time.

Milling tests should be made on the ore now developed, and if it is found that the ore can be mined and milled at a reasonable profit above paying for the mill, in connection with the developing campaign, a 100 ton mill should be erected, the profits from which would partly offset developing costs. There is enough ore developed for mining and

milling at the rate of 100 tons per day, for several years and probably before the end of that period additional ore will be developed to warrant increasing the capacity of the mill.

I recommend that the mine be developed to at least the 800 level or 500 feet below the present workings, following one of the schemes outlined above, preferably by sinking.

THE ARAVAIPA MINE

The Aravaipa mine on the Aravaipa claim of the Aravaipa Leasing Company is one and one half miles north of the Grand Reef mine and on the same line of faulting. It is the first prominent outcrop north of the Grand Reef, and the two outcrops are at about the same elevation.

The accompanying sketch shows the form of deposit and the workings. The hanging wall rock is the same type light colored porphyry as at the Grand Reef mine, and the footwall rock is a gray porphyry. The breccia has the same general appearance as the breccia at the Grand Reef mine, and contains some white porphyry. The outcrop is from ten to thirty feet in width, well mineralized, iron and copper stained. On the hanging wall side, between the wall rock and the breccia there is strong mineralization in what I have termed a hanging wall vein, the filling of which is principally white porphyry and quartz with some brecciation. It appears to be a separate deposit formed by movement along the hanging wall of the breccia which became the footwall of this vein. A gouge between the vein material and the wall rock is the hanging wall. I have mentioned this form of deposit in describing number Three ore shoot of the Grand Reef mine and suggested that it was mineralized at a different stage. Here the dividing line between the two veins and the difference in mineralization is more marked than at the Grand Reef mine.

The workings shown in the sketch, are in the above hanging wall vein. Except for a little trenching and one shallow shaft, as shown, no work has been done in the breccia vein. The hanging wall vein was favored as it is softer and shipping ore was found close to surface.

THE HANGING WALL VEIN

The stoped area, except for stopes a, b and c, was mined years ago by lessees, and the tunnel was driven in 1919 by the Aravaipa Leasing Company with the idea of determining the width and strength of mineralization and also exploring north of the old workings. A cave occurred in number One drift and later in number Two drift, and it was then found that the stopes extended almost to that level making further exploration at the tunnel level of little importance. But sufficient data was collected to show that the hanging wall vein is 15 to 20 feet in width and that it is mineralized under the old stopes for a width of at least 15 feet.

Drifts 1 and 2 and crosscut 1 E, are now inaccessible due to a cave after the company stopped work. The writer having had charge of operations can vouch for the following data which is taken from the company's records:

At crosscut 1 E, there is 15 feet of iron stained vein material with lead carbonate ore. The average assay for the fifteen feet at this crosscut is 4.7 Oz. Silver, 0.3% Copper and 6.9% Lead. In drift number One there is six to twelve inches of galena, a sample of which assayed 29.8 Oz. Silver and 66.5% Lead. Another sample taken across ten inches of galena and cerussite with quartz, assayed 12.0 Oz. Silver and 28.6% Lead. In the cave at drift number Two were found large pieces of galena,

two feet through, that came from the stope above. A general sample of the galena assayed 31.4 Oz. Silver 1.0% Copper and 49.6% Lead. The end of the drift had just entered galena when the cave occurred, and a sample of the galena from the end assayed 54.1 Oz. Silver 66.4% Lead. The company drew part of the stope fill and from it sorted about 9 tons of shipping ore to which was added 4 tons of lower grade ore from other properties, making a shipment of 13 tons, which assayed, according to the smelter sheet, 17.6 Oz. Silver, 1.2% Copper and 41.8% Lead. It is quite evident that there was good lead-silver ore in the stope.

Between crosscut 1 E and the shaft, the drift shows strongly oxidized and leached vein material. Carbonate ore and stringers of lead were found in stopes a, b and c. Eighty five tons of ore was shipped from these stopes. They were made narrow on account of being afraid of breaking into stoped ground above. The average for the lot shipped, as shown by the smelter sheets, is 8.9 Oz. Silver and 35.1% Lead. The copper was not recorded as it was less than one per cent. The average is higher than the writer expected considering the class of ore shipped. The lessees did very little sorting.

At the south end of the workings, the vein is not so well mineralized and the stoped area is narrow, two or three feet in width, the ore being principally lead carbonate. It is claimed that four car loads of ore was shipped from the two stopes on the Ten Strike claim and that the ore assayed 6 to 10 ounces silver and 40 to 50 per cent lead, which is all that could be expected where there has been so much oxidation and leaching. The lead carbonate ore throughout the district, is low in silver.

Three hundred feet north of crosscut 1 E, there is at surface, a shallow shaft caved 20 feet below the collar. The width of the vein at the

shaft appears to be about four feet. It is claimed that 30 tons of good galena ore was shipped from the shaft by lessees. A crosscut near the shaft shows lead ore at the outcrop. There are no other openings further north on the hanging wall vein.

It can be seen from the above that the hanging wall vein is as much as 20 feet in width, and that it has an ore shoot probably 500 feet in length and 2 to 15 feet in width, containing lead-silver-copper ore near the outcrop, and that the upper part of the ore-shoot has been very much oxidized and leached. The galena contains more silver than the galena at the Grand Reef mine. The copper is present in small amounts as chalcopyrite with the galena and as carbonates in the vein material. There is probably also a silver mineral not associated with the galena. The finding under the old workings show that a very good grade of lead-silver ore was mined from the stopes. I have not a record of shipment from the stopes, and the only information I have been able to obtain regarding them is that the lessees paid twenty to twenty-five per cent royalty on "Gross Smelter Payments for Metals", which is a high royalty and further indicates that they shipped a good grade of ore.

THE BRECCIA VEIN

The outcrop is heavily iron stained and in places, copper stained. The open cut, shown at the left margin of the sketch shows considerable copper staining. About 100 feet south are other copper stains, and 200 feet still further south there are showings of copper at the hanging wall side. A shallow shaft, now filled with wash, was sunk on this showing. It is claimed that the shaft is 20 feet deep and that there is three feet of copper ore in the bottom. Near the shaft there is a small pile of ore that I judge will average three per cent copper. It shows not only carbonates,

but also some copper pyrites. The Aravaipa Leasing Company's records show two assays of samples from the pile, one, 1.6 Oz. Silver, 11.6% Copper and 0.2% Lead, the other, 7.6 Oz. Silver, 4.1% Copper and 19.2% Lead. They were picked samples.

CONCLUSIONS

The section in the lower left hand corner of the sketch illustrates my idea of the ore deposition in the two veins. The breccia vein may have long shoots of ore as at the Grand Reef mine, although I expect isolated bodies of ore will be found in both mines. Mineralization at depth will be found to be the same in general as I have stated for the Grand Reef mine at depth, that is, the amount of lead will diminish as the copper values increase, and at the beginning of the sulphide zone, and also above it, will be found secondary ore with good copper-silver values. Developing the Grand Reef Mine at depth will give valuable information as to what may be expected at depth in this mine. The mine has the white porphyry which is found where there is strong mineralization at the Grand Reef mine. It has a well mineralized outcrop of breccia, and the showings for a good shoot of ore in the hanging wall vein, of the Grand Reef Group, this mine, in my estimation, is next in importance to the Grand Reef mine.

CLAIMS - AT THE ARAVAIPA MINE

At the south end of the workings there is the north end line of the Ten-Strike claim which does not belong to the Aravaipa Leasing Company. The claim has no showings of importance except at the extreme north end where it takes in part of the Aravaipa mineralization. The Aravaipa claim is 1500 feet in length along the vein, and at the north end there is the Oronoco claim which also is not owned by the company.

It has merits.

WATER

There is no water in the workings and the nearby draws and canons are dry most of the year. Water for domestic purposes can probably be found by sinking at one of the draws. The mine water level is probably several hundred feet below the present workings.

RECOMMENDATIONS

I recommend, in connection with developing at the Grand Reef mine, sinking a two-compartment shaft and developing the hanging wall vein, in the vicinity of the old workings, and also crosscutting from the levels into the breccia, one and two hundred feet below the tunnel level, provided water is not encountered at a shallower depth. Before going to the expense of pumping much water or sinking to a greater depth, I would wait for developments at the Grand Reef mine, for the findings there, will probably decide the merits of this mine, at depth. The development outlined will give good information regarding the amount of mineralization, and it is quite probable that enough ore will be developed in the hanging wall vein to more than pay for the work, shipping the high grade galena and milling the other in connection with the Grand Reef ore.

The shaft should be located in the hanging wall rock, several hundred feet from the vein, at about the location shown in the sketch.

The work will cost about fifty thousand dollars.

THE DOG WATER MINE

The Dog Water mine is four fifths of a mile south of the Grand Reef mine along the general strike of the reef, and on the Dog Water claim.

Silver Cable Gulch, where it crosses the vein, is about 100 feet lower in elevation than Laurel Canon where that crosses the vein on the Grand Reef claim. The accompanying sketch shows the mine workings and a longitudinal section of the vein.

The vein outcrops at the bottom of the gulch, for 350 feet south and, at Mountain Spring tunnel, 500 feet north of the Gulch. It has the same slightly west of north course as the Grand Reef vein and is, I think, an extension of it. From Mountain Spring tunnel to the Grand Reef outcrop, the vein, if continuous, which I expect, is covered with loose material on the high ridge between the two mines.

The width of this Dog Water vein, as shown by the outcrops and the few shallow openings, is from three to eight feet and will average at least four feet. It appears to be nearly vertical, but deeper workings will probably show that it is inclined a few degrees west from the vertical, the same as at the Grand Reef mine.

Section "AA" of the sketch, shows the wall formations. The hanging wall rock is light colored porphyry, and on the foot wall side, there is a strip, about 200 feet in width at surface, of fractured and altered dark fine grained rock and porphyry, cut by a number of small stringers of spar and quartz. The dark rock resembles the foot wall rock (Diabase?) at the Grand Reef mine. At places close to the veins, the dark rock contains fragments of the porphyry, as breccia. On the other, or east side of the strip, there is the Silver Cable vein which will be described later.

The Dog Water vein material is light colored porphyry, quartz and light colored porphyry breccia. At the mine workings, brecciation

is only slight, but at the Mountain Spring tunnel it is quite pronounced.

The mineralization, as shown by the shallow openings, is galena (high in silver), cerussite, small amount of copper as carbonates and silicate, and there maybe a silver mineral. Some wulfenite occurs where the vein is fractured and oxidized. This ore shoot is of special interest on account of the relatively high silver values. The galena carries more than one ounce, and as much as three ounces, silver per per cent lead. A little silver glance has been found with the galena. There is considerable flourspar with the ore.

WATER LEVEL

The water level is a few feet above the bottom of the gulch where it crosses the vein, and at about the same elevation as the One Hundred level of the Grand Reef mine. A small stream of water (about one gallon per minute) flows from the collar of the shaft in the gulch.

OPENINGS ON VEIN

There are three small openings on the vein; the Dog Water mine workings, the shaft in the bottom of the gulch and Mountain Spring tunnel, as shown by the sketch. The Dog Water mine workings were made by lessees, in 1920. The shaft in the gulch was sunk several years ago, for water, in connection with a small mill for ore from the Silver Cable mine, and the short Mountain Spring tunnel was run years ago.

At the Dog Water mine workings, a shoot of ore, 40 feet in length and 2 to 5 feet in width, has been developed for a depth of 70 feet below the outcrop, or to water level. The ore has good lead silver values as will be noted under "Shipments and Assays". It is semi-oxidized

and, as at the Grand Reef mine, the oxidation extends below the present water level. The ore near the outcrop is narrow, but widens to five feet at the water level. The last six feet of the tunnel is in fractured vein material with a scattering of wulfenite and low in silver and lead. The face shows some galena and from appearances, a few feet further advance should show a better grade of ore again. It is reasonable to expect that more ore will be found by continuing the tunnel south along the vein.

The writer has not seen the bottom of the shaft in the gulch, but he has been told by several responsible people that at the bottom there is three feet of ore similar to the ore in the Dog Water stope and that a sample of the galena assayed 60.0 Oz. Silver and 47.0% Lead. There are a few stringers of galena at the outcrop between the shaft and the tunnel.

At the Mountain Spring tunnel, the vein is eight feet wide and the vein material is more brecciated than at the other openings. The tunnel follows the foot or east wall. At the hanging wall side and near the end of the tunnel, there is a little lead ore, a sample of which assayed 67.7 Oz. Silver and 44.2% Lead. There are strong indications here of good ore and my experience on the property makes me feel that such will be found by advancing the tunnel twenty to thirty feet, and probably also by sinking the same distance.

SHIPMENTS AND ASSAYS

About 230 tons of ore has been shipped from the Dog Water mine at stope and drifts all since 1920. I am unable to give the average for all the shipments, as ore from other veins was mixed with part of them. Three lots (110 tons), in which there was no ore from other workings, averaged, according to the smelter sheets; 31.2 Oz. Silver and 28.2% Lead.

The amount of copper was not given as it was less than one per cent. The lessees did very little sorting for these shipments other than breaking the waste separate from the ore in mining.

A number of specimens and "pick samples" were taken, but except for the short drift at the water level, the workings have not been systematically sampled. Eight cut samples, carefully taken by the writer, from the floor of the drift at water level, and representing 3.8 feet average width and 35.0 feet in length of ore, the full width and length of the drift, averaged: 13.5 Oz. Silver and 16.6% Lead. The samples were not assayed for copper as the amount would be negligible. The average obtained is about what the writer would expect for the average of the ore developed.

Other samples assayed as follows:

5 ft. across vein, 5 ft. below tunnel	36.6 Oz. Silver	31.5% Lead.
General grab from 20 tons shipping ore	71.6	40.9 "
Galena specimen (Wavy)	216.1	80.1 "
" " (fine grain)	80.4	65.2 "
" "	176.1	33.1 "

The galena is exceptionally high in silver for lead ores of the district.

The silver may be in part due to a silver mineral with the galena.

REMARKS AND RECOMMENDATIONS

The showings, for the little development that has been done, are promising, and it is probable that equally favorable showings will be found by uncovering other parts of the outcrop. The ore at the shaft in the gulch may be part of the same body as the ore in the stope. The outcrop between the two places is well mineralized, and above the stope,

the ore outcrops as a mere stringer, the same as can be found at other places between there and the shaft. If the ore is continuous between these two parts, a little development at depth will uncover a shoot three to four hundred feet in length.

Although there has been considerable brecciation of the vein filling at the Mountain Spring tunnel, the general character of the vein is more like the hanging wall veins at the Grand Reef and the Aravaipa mines than the deposit in the breccia at the Grand Reef.

The average obtained by sampling at water level (13.5 Oz. Silver and 16.6% Lead) shows very good milling ore and if much ore of the same grade can be developed, it will be a good milling proposition in connection with milling ore from the Grand Reef and Aravaipa mines.

The amount of water in the vein can only be determined by development, but I do not expect a great amount will be encountered for the first two hundred feet.

As with the other mines, I believe that copper and not lead ore will be found at depth, but I do not expect much change for the first one or two hundred feet in depth. There is less copper with the galena exposed here than there is at the outcrop of the Grand Reef vein.

The vein should be first prospected by shallow openings, and then at depth, below the most favorable showing.

In connection with the Grand Reef mine, I mentioned a tunnel which would enter the vein at the Dog Water mine, 1800 feet from its portal. The tunnel would tap the vein where it crosses this gulch and about 200 feet below water level. For a reasonable amount of development to the 200 level, sinking will be cheaper than driving this long tunnel, but if the tunnel should be decided upon in connection with development

of the Grand Reef mine, as will be outlined in one of the plans suggested under General Remarks and Recommendations at the end of this report, it will afford an economical method for developing the Dog Water vein.

For a reasonable amount of sinking and drifting, to determine the extent and grade of ore for the first 200 feet in depth, about $30,000.00 will be required.

I recommend that developing the vein to the 200 level be considered in connection with developing the Grand Reef mine, with the idea of increasing the available tonnage of milling ore.

THE SILVER CABLE MINE

The Silver Cable mine is about 250 feet east of the Dog Water mine and on the Silver Cable claim. The vein is paralled to the Dog Water vein. The accompanying sketch of the Dog Water workings, shows the Silver Cable vein, in section. It is three to five feet in width and has a dip of about sixty degrees, east. The hanging wall rock is granite, and on the footwall side there is the belt of altered dark rock and porphyry as described in connection with the Dog Water mine. Silver Cable Gulch crosses the vein at an elevation about twenty feet higher than where it crosses the Dog Water vein.

The mine workings are on the south side of the gulch, and consist of a tunnel 530 feet in length, two shallow winzes, a raise on the vein, to surface (about 100 feet above the tunnel), and some stoping above the tunnel. The tunnel is at about the same elevation as the Dog Water tunnel. It starts from a point near the bottom of the gulch, a short distance below where the vein crosses, and enters the vein 130 feet from the portal. The work was done in 1917 and 1918, by lessees, mining molybdenum ore for which at that time there was a big demand. A small

mill was erected and some ore from above the tunnel was mined and milled. The writer has no record of the operations.

The vein filling is quartz and brecciated porphyry. There has been considerable oxidation and leaching in the parts developed. The mineralization that can be seen at the tunnel level and at the outcrop, consists of a small amount of galena and cerussite, with the quartz, copper stained in places, and a scattering of wulfenite (lead-molybdate) in the porphyry. The galena carries a fair amount of silver. One sample assayed 21.5 Oz. Silver and 67.6% Lead. No samples have been taken of the wulfenite ore, by the Aravaipa Leasing Company or by the writer, for the reason that the values are low and of very little importance considering the poor market for wulfenite.

North of the gulch, the outcrop of the vein has not been uncovered and a short tunnel from the gulch following the granite contact, shows very little mineralization.

The present water level of the vein is fifteen feet below the tunnel level and at about the same elevation as the water level at the Dog Water mine.

The vein is well defined, of good width (three to five feet) and probably extends to a considerable depth, but the part developed does not show as much mineralization as one would like to see for indications of a considerable amount of ore at a greater depth. However, it is possible that other parts of the vein, at the tunnel level, are better mineralized, and that ore will be found at a greater depth. Several Hundred feet south of the workings, there are surface indications, on the Blank claim, of cross faulting, and it is possible that the vein is more mineralized in the vicinity of the cross fault.

I do not recommend any immediate development of the vein.

After the Dog Water vein is developed to 200 feet below water level, it will be good prospecting to crosscut from that level to the Silver Cable vein and drift south on it to the cross faulting on the Blank claim. This will require about 800 feet of crosscutting and drifting. At the same time, it will prospect the belt between the Dog Water and Silver Cable veins, which may contain other veins.

The Aravaipa Leasing Company owns only three-quarters interest in the Silver Cable claim.

SOUTH END OF GROUP

Near the south end of the Silver Cable claim, there is an offset of about 1700 feet, east, in the line of the reef or main line of faulting. The Junction and the Varick claims are on this extension of the reef. Along the offset, there are croppings of a vein, running east. The Blank and Conundrum claims are on these croppings. The granite which forms the east wall of the Silver Cable vein, forms the north wall of the Blank and Conundrum vein, or cross vein as it is probably due to cross faulting, following the bend in the granite. South of the cross vein and east of the reef on the Junction and Varick claims, there is an area of schist and porphyry. West of the reef, there is light colored porphyry. Junction Gulch cuts across the Conundrum and Junction claims, and is at about the same elevation as Silver Cable Gulch.

Except for a few shallow pits and short tunnels, made as assessment work, no developing has been done at this end of the group.

The outcrop of the cross vein, is ten to fifteen feet in width and it is strongly iron stained, but there are no important showings of lead or copper ores at the outcrop or in the shallow openings. The writer has no record of any sampling of the outcrop.

The reef, on the Junction and Varick claims, is about ten feet in width at the outcrop, and projects as much as seventy five feet above the light colored porphyry on the west, or hanging wall side, forming a cliff, while on the east, or footwall side, it extends only a few feet above the schist and porphyry. The dip of the reef is about eighty degrees west, the same as at the Grand Reef mine.

The breccia of the reef is iron stained and shows the same character of rocks as at the Grand Reef and Aravaipa mines. On the hanging wall side, there is for about four hundred feet along the outcrop, a stringer of quartz, four to twenty inches in width and mineralized with lead ores. At places, there is very good ore in the stringer. Several small openings show low grade lead ore in the breccia, for three to four feet back of the quartz. Assays of the lead ore (principally galena) from different parts of the outcrop gave low silver values, four to five ounces silver for fifty per cent lead.

The schist, on the east side of the reef, appears to have been formed from rock similar to the footwall rock at the Grand Reef mine and the dark rock between the Dog Water and Silver Cable veins. It is iron stained and there are croppings of a few narrow stringers of lead ore and quartz. There is some brecciated material with one of the stringers.

In this section there are some good showings of mineralization, that warrant a limited amount of developing, but considering the more promising showings at other parts of the group, I advise first developing the other parts, as I have outlined, and letting the findings decide as to the possibilities in this section, the formations being similar.

GENERAL REMARKS AND RECOMMENDATIONS

The properties certainly warrant development, not only to depth

at the principal showings, but also at other parts of the vein. The principal showings, given in order of their relative, importance, are at the Grand Reef, Aravaipa and Dog Water openings. Developing through a shaft at the Grand Reef to about 800 feet below the tunnel level, in order to determine the character of ore at depth and the location of the sulphide zone, is the quickest and probably the most economical method of procedure considering that the findings at depth will give conclusive data for deciding the merits of the properties. If conditions at depth are found favorable, as the writer expects, it will then be in order to make plans for developing other parts of the vein, a railroad to the property and operations on a large scale. Such initial development will require a considerable outlay of funds, probably as much as $500,000.00, over a period of three years. The amount can probably be partly off set by profits from milling the ore already developed, but in undertaking the work, provisions should be made for funds to the extent of $500,000.00 and for continued operations during the period, developing rapidly so as to keep the pumping expense as low as possible for the amount of work accomplished. In connection with developing at the Grand Reef, it would be advisable to do some work at the Aravaipa and Dog Water openings, as is already outlined in this report.

Considering the fact that your company owns the property, and is not in the position of an optionee with a limited time for deciding as to its worth, and also that present conditions are not favorable for an extensive outlay of funds for mining, I recommend an alternative plan. That is, driving a drainage and working tunnel, as shown by the accompanying map, and putting the property on a small producing basis as soon as possible, milling the ore developed by the tunnel and that already developed.

I feel that under normal market conditions, the profits would more than offset the cost of the tunnel. Prospecting at depth, from the tunnel level, will be less costly than through a shaft from the surface, as there will be three hundred feet less lift for pumping water. Diamond drilling can be done from that level without a pumping expense. It may be that the findings in the tunnel will change the location for prospecting at depth. For extensive developing at depth, the saving in pumping will probably offset the cost of the tunnel.

A disadvantage is that prospecting at depth to prove the real value of the property, will be delayed until the tunnel is completed, but there are a number of advantages as stated above, and also the advantage that the funds required for the firsttwo years while driving the tunnel, will be less, and the tunnel work can be done intermittently if so desired, without a loss due to extra pumping costs.

The total length of the proposed tunnel is approximately 5280 feet, or one mile; 3330 feet, or three-fifths of the total length will be in the vein at a minimum depth of 200 feet and a maximum of 750 feet below surface at the line of the outcrop.

My estimate for the time to complete the tunnel, develop the Dog Water mine above that level and run short crosscuts in the vein at 200 ft. intervals, is twenty one months. The costs will be $200,000.00 ($38,000.00 for the first three month period, and $27,000.00 for three month period thereafter). An estimate in detail is attached to this report.

As to the location for a mill: For operating through shafts, without the tunnel, there is a good millsite on the ridge at the north end of the Chicago claim (see tunnel map), to which location the different working places can be connected by aerial tramways. For operating through the tunnel, the mill should be placed near the center or on thesouthwest

quarter of section 32, which is from 50 to 75 feet below the level of the tunnel portal, and about 1700 feet from the portal. Motor haulage can be used for transporting the ore to this location. Section 32 is State School Land and can probably be purchased.

It is probable that the mines will furnish enough water for milling purposes, but water from the Aravaipa Valley will be needed for domestic use and as for this a pumping plant and pipe line will be required, it will be better to install a plant of sufficient capacity to also supply mill water if needed. Mr. MacKay installed a steam pumping plant on the southwest quarter of section 6 (see tunnel map) and a four inch pipe line from the plant to the Grand Reef mine. The plant has been removed, the wall caved and part of the pipe line has been taken up for use at the Grand Reef mine.

I recommend rebuilding the pipe line, digging a new well (about 60 feet) and installing a 100 GPM belt driven pump, using the company's 40 HP oil engine for power. There is a 30,000 gallon water storage tank at the Grand Reef mine and for domestic use only it will not be necessary to pump water more than a few hours each week, and that will be required for only about six months of the year as there is a gravity pipe line from Laurel Canon back of the Reef, to the tank and water flows through the line during part of the year. My estimate for the tunnel project includes installation of the pumping plant and pipe line.

For living quarters, I recommend using the Grand Reef camp for the Americans and the Dog Water camp for the Mexicans, during the developing period, and adding new buildings as required. Later, after the mine is fully proven, and plans are made for operating on a large scale, a townsite should be established either on the southwest quarter of section 32, if all of the space is not required for milling, or on the southwest quarter of section 6.

Good living quarters and a club room should be provided even during the development campaign. The summers are warm and efforts should be made to have the camp as comfortable as possible by installing an electric lighting system and a small refrigerating plant. These improvements have been included in my estimate for the tunnel project.

2.94 RT For transportation between the railroad (Cork) and the mine 940 miles), I recommend 2-ton heavy duty trucks with trailers, and that the company should purchase the trucks and hire the drivers, rather than contract the hauling. I believe it will prove more satisfactory and considerably cheaper.

Respectfully submitted,

C. E. Minor

KLONDYKE, ARIZONA

JANUARY 1921

LIST OF SHIPMENTS FROM GROUP

The following is a list of shipments, as shown by the Aravaipa Leasing Company's records. The ones prior to June 1919, are taken from a statement giving the average of smelter receipts, by months. In all cases, the weights given, are in "Dry Tons", that is, tons shipped less at least one per cent for moisture.

Ore from Grand Reef Mine

DATE 1915	DRY Tons	GOLD Oz.	SILVER Oz.	LEAD %	COPPER %	INS. %	FE. %	CAO. %	ZN. %	S. %
Aug.	27	.01	20.1	46.0	1.5	24.7	1.3	4.0	2.3	5.7
Sept.	15		17.2	61.5	4.8	13.7	0.7	3.8	0.5	8.4
Oct.	19		13.4	56.5	0.7	19.2	1.5	6.5	1.7	6.2
1916										
Jan.	48		9.7	41.9	0.8	25.6	1.7	11.6	0.8	3.8
Mar.	85		18.2	49.6	2.1	16.4	2.8	0.8	2.7	5.5
Apr.	9		21.0	54.7	1.4	20.3	1.8		1.7	8.4
May	5	.01	20.9	40.4	2.3	34.4	2.0			6.8
Sept.	32		23.5	41.7	2.9	20.4	4.2	1.2	1.5	6.0
Oct.	36	.01	23.5	45.0	2.9	20.2	4.6	2.8		6.0
Nov.	32		26.5	47.8	2.7	27.8	1.4	1.6		8.4
1917										
Jan.	8	.01	11.6	40.8	0.1	22.4	2.6	.0		2.2
Mar.	17		16.8	41.0	1.3	25.8	2.4	2.6	0.7	5.2
May	100	.01	14.5	36.8	1.6	24.7	3.1	9.0	2.1	4.2

DATE	DRY Tons	GOLD Oz.	SILVER Oz.	LEAD %	COPPER %	INS. %	FE. %	CAO. %	ZN. %	S. %
1917										
June	125 30		33.1	45.2	2.7	28.7	1.6	3.4	0.9	7.7
July	89	.01	26.0	46.8	2.8	25.4	2.2	1.5	1.2	7.2
Aug.	54	.01	16.1	46.1	1.3	26.3	1.3	1.4	1.0	6.4
Sep.	48	.01	22.3	40.1	3.1	32.5	1.9	1.9	0.9	7.2
Oct.	25		6.2	39.7		28.6	1.2	5.2		2.6
"	21		12.5	29.3	1.5	45.5	4.5	1.7		3.4
Nov.	87	.01	18.9	38.1	2.2	38.7	3.6	1.9	1.9	6.4
Dec.	44	.01	22.0	39.6	2.7	36.0	1.3	2.3	1.4	6.8
	523									
1918										
Jan.	25	.01	21.1	38.7	3.1	36.6	2.1	2.0	2.8	5.2
Feb.	78	.01	27.0	46.7	4.02	27.6	2.3	1.5	0.1	8.3
Mar.	40		30.3	47.0	4.3	26.8	1.7	1.4	0.1	8.2
June	17	.01	23.2	42.4	2.2	29.0	1.4	6.0	1.7	7.0
July	34		11.0	31.6	1.36	30.5	2.0	7.7	2.0	6.3
Aug.	46		12.8	29.8	1.40	39.6	1.9	10.5	2.5	4.4
Sept.	26		31.6	42.4	3.64	31.9	1.4	2.4	2.0	7.8
Oct.	59		20.1	35.6	2.50	32.0	2.0	5.2	1.1	5.4
Nov.	16		14.3	51.1	.95	20.8	1.2	6.5	0.2	6.1
	340									
1919										
Jan.	29		52.5	55.3	40.3	19.2	1.5	1.4	0.1	8.9
Feb.	58		24.3	38.1	30.9	33.0	1.7	0.5	1.7	6.6
Mar.	85		13.4	19.3	4.20	51.0	3.1	4.2	0.6	3.5
"	16		13.4	19.7	4.22	50.0	3.4	4.4	2.4	3.7
April	30		36.3	48.4	3.56	22.8	1.2	2.7	0.5	10.6
May	26		17.0	46.4	1.37	24.7	0.9	5.9	0.6	7.3
1920										
Aug.	42		17.6	35.6	1.5	37.1	1.6	1.2	0.6	6.0
Sept.	33		12.5	38.6	0.7	30.7	2.0	0.6	0.6	2.0

Concentrate from Grand Reef Mine

DATE	DRY Tons	GOLD Oz.	SILVER Oz.	LEAD %	COPPER %	INS. %	FE. %	CAO. %	ZN. %	S. %
1915										
Aug.	32	.01	25.0	54.7	3.0	11.1	2.5	3.1	3.1	6.7
Sept.	46		17.8	51.7	2.0	12.8	2.5	6.3	1.3	4.4
Oct.	32		13.6	50.7	1.5	12.8	4.0	6.5	2.7	4.5
1916										
April	87		16.6	52.0	2.1	12.7	3.5	0.7	2.8	4.3
May	150	.01	22.3	45.9	2.7	20.1	3.1			6.1
Sept.	36		23.3	44.2	2.8	17.6	3.8	1.4	2.0	6.4
Oct.	31	.02	23.0	46.7	2.9	19.8	5.0	2.4	2.0	6.2
Nov.	58		21.7	47.5	2.8	18.7	4.7	2.3		6.2
Dec.	30	.01	22.0	48.0	2.9	18.2	4.0	2.2	2.4	6.8
1917										
Jan.	17		19.2	48.8	2.2	17.2	3.6	4.4		6.0
Feb.	35	.01	22.0	52.2	2.8	12.6	3.0	3.4		5.4
Mar.	16	.01	22.4	28.1	2.8	16.8	4.0	2.8	1.0	5.8
June	75	.01	16.8	39.2	2.3	22.9	3.8	6.7	1.7	5.3
July	62		14.6	33.3	2.1	24.9	4.8	1.0	1.9	4.0
Aug.	88	.01	12.6	34.4	1.3	22.0	4.0	1.0	3.3	3.6
Sept.	110	.01	21.2	40.2	2.3	22.6	5.1	4.2	1.0	4.3
Oct.	89	.01	21.0	41.3	2.6	23.4	6.2	3.1	0.8	4.7
Nov.	172	.01	20.8	41.5	2.4	24.5	8.7	2.2	2.1	5.5
Dec.	177	.01	26.8	52.0	2.9	14.8	4.2	1.9	1.6	5.4
1918										
Jan.	140	.01	23.5	46.0	2.9	20.2	4.9	2.6	1.3	4.9
Feb.	193	.01	22.6	48.3	2.42	21.3	4.3	2.1	0.1	3.7
Mar.	113		23.5	49.3	2.53	18.3	3.8	2.6	0.1	3.8
May	78	.01	17.1	48.3	1.85	18.5	2.0	6.1	1.6	4.2
June	88		21.9	46.2	2.39	19.9	3.9	3.8	1.1	4.5

DATE 1918	DRY Tons	GOLD Oz.	SILVER Oz.	LEAD %	COPPER %	INS. %	FE. %	CAO. %	ZN. %	S. %
July	70		25.2	46.1	2.59	19.4	3.7	3.2	0.7	4.4
Aug.	63		22.4	44.5	3.09	22.7	3.6	2.3	3.6	7.4
Sept.	50		20.1	48.5	2.50	18.1	3.8	2.9	2.0	3.9
Oct.	46		22.2	45.0	2.69	19.7	4.5	3.8	0.9	4.9
Nov.	17		24.2	52.0	2.45	15.4	3.0	2.7	2.7	6.0
Dec.	27		22.7	47.5	2.57	18.8	2.7	2.5	2.2	6.6
1919 Jan.	5		25.6	50.9	2.48	17.8	2.2	3.0	2.5	8.0
Sept.	25		17.2	35.8	2.23	32.0	4.1	5.2	2.4	5.2
Mar.	70		22.1	50.3	2.63	17.7	3.5	2.6	0.3	3.9
April	174		22.1	44.5	2.99	23.4	3.3	4.0	1.2	4.5
May	111		17.3	39.8	2.39	23.7	3.1	7.4	1.7	4.2
From Aravaipa Mine										
1920 Mar.	37		8.8	35.1		25.7	3.0	1.0		1.8
April	24		8.9	35.2		29.7	3.0	1.5		2.1
April	28		9.0	35.0		26.8	2.4	0.5		1.4
From Dog Water Mine										
1920 May	36		38.1	31.5		26.7	1.3	1.5		2.2
May	44		27.9	26.2		30.7	1.6	0.7		1.4
June	30		28.4	27.4	0.3	28.5	1.4	17.8	0.7	1.5
Oct.	17		25.9	32.5	0.5	21.3	2.0	1.1	1.8	2.0 (a)
Nov.	6		34.0	31.8	0.3	26.1	1.2	1.0	2.1	2.1 (a)
Nov.	27		22.2	29.4	0.2	20.9	2.7	1.2	2.1	2.1 (b)
Mixed Ore, Grand Reef, Aravaipa and Dog Water Mines										
1920 Feb.	13		17.6	41.7	1.2	22.6	2.0	2.2		3.2

DATE 1920	DRY Tons	GOLD Oz.	SILVER Oz.	LEAD %	COPPER %	INS. %	FE. %	CAO. %	ZN. %	S. %
Sep.	19		26.6	22.5	0.2	35.1	1.7	1.2	1.6	1.8
Oct.	21		26.7	24.7	0.4	34.1	1.5	1.0	2.9	2.2
Oct.	26		21.9	25.7	0.4	36.7	1.2	1.5	2.8	2.7
Oct.	38		19.2	26.8		39.9	2.0	1.3		3.2

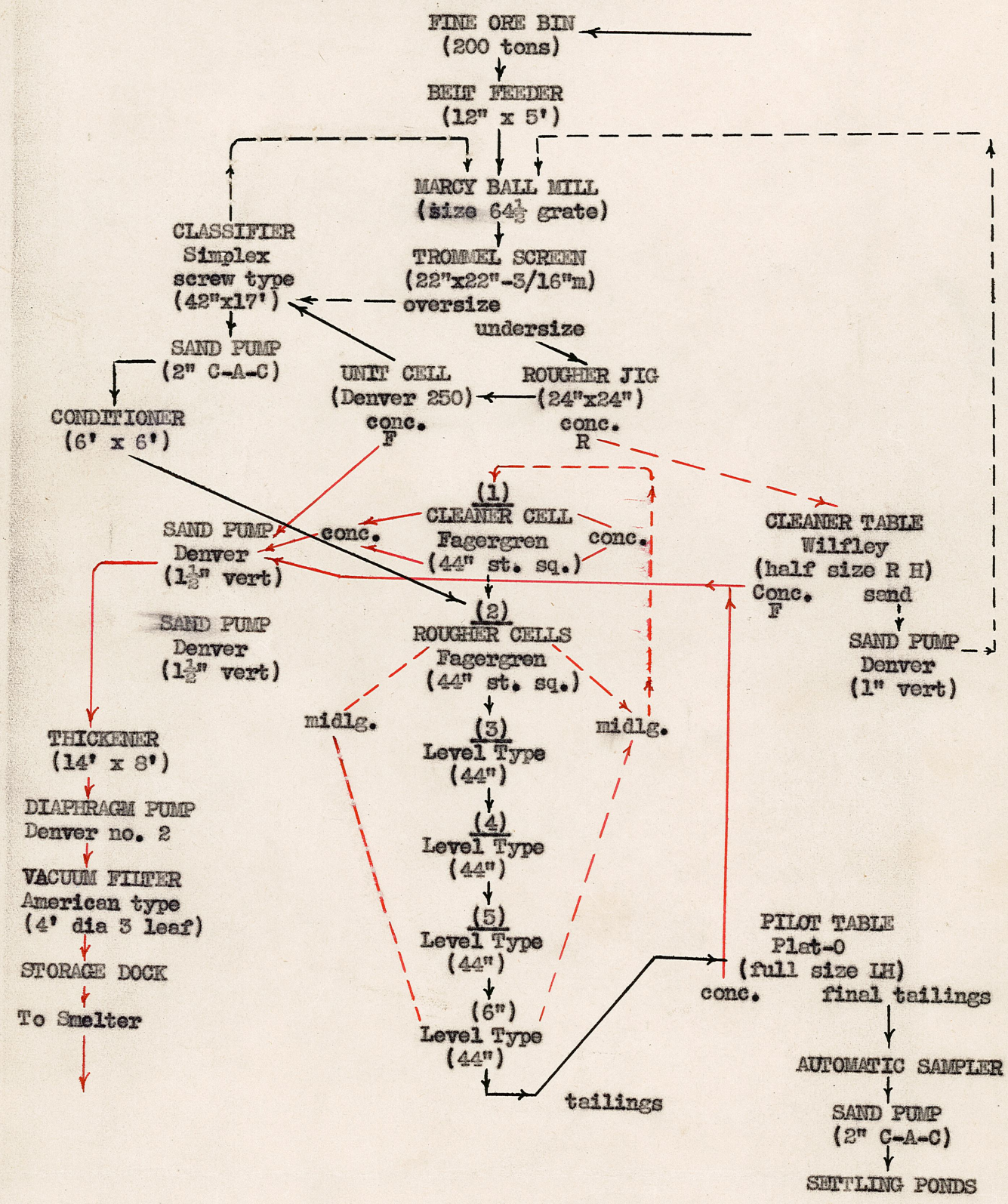
(a) Hand-jig concentrates
(b) " " hutch products

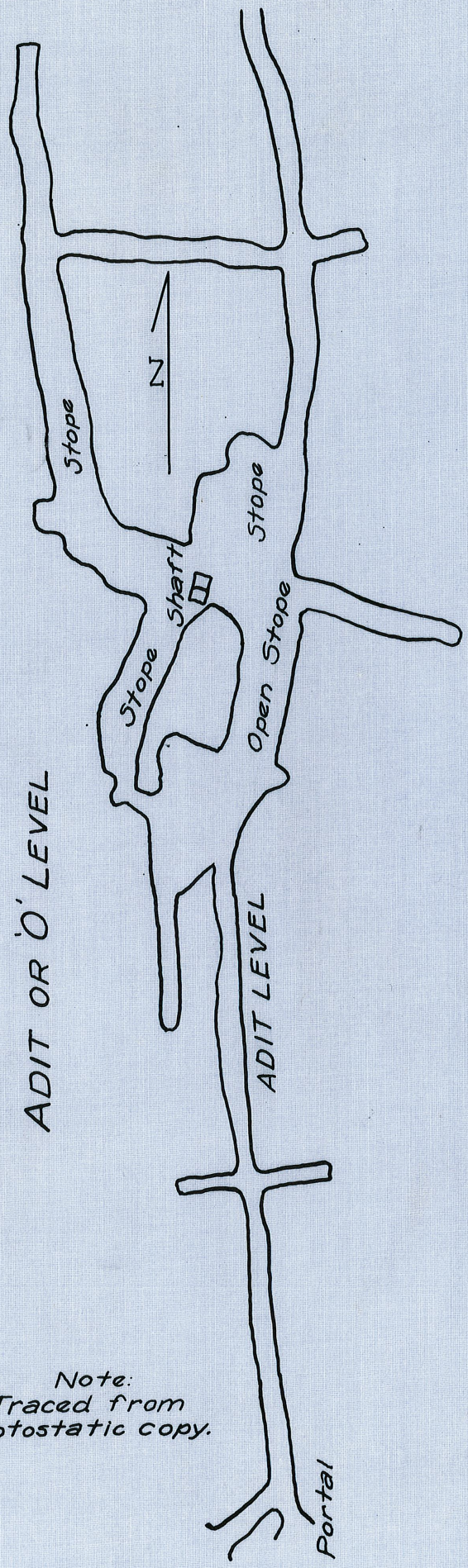
CALISTOGA MINING & DEVELOPMENT CO.

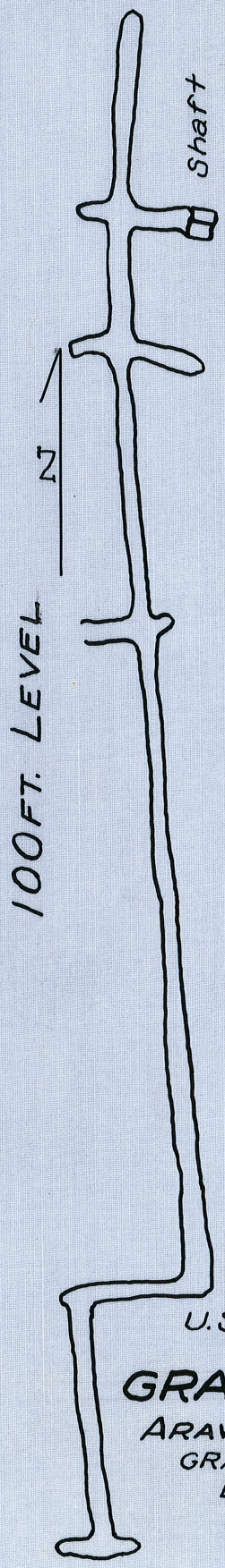
Grand Reef Mine, Klondyke, Arizona — March 20, 1942

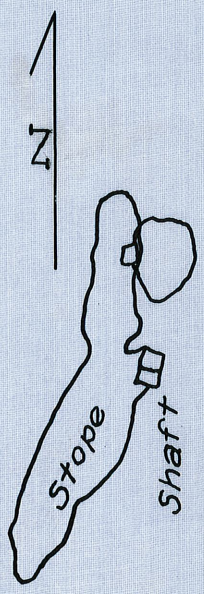
JRC.

PROPOSED MILL FLOWSHEET









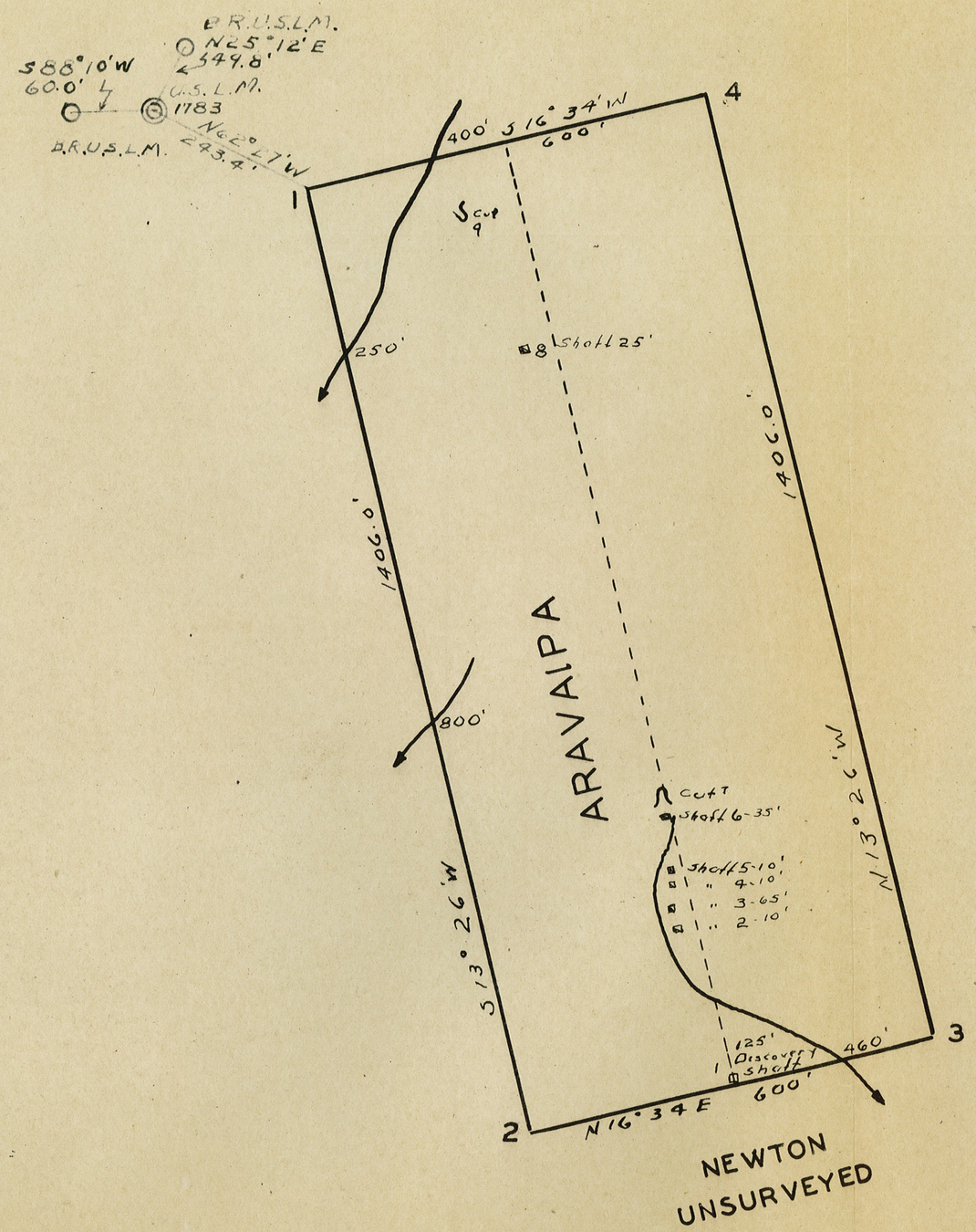
Note:
Traced from
photostatic copy.

U.S. BUREAU OF MINES

GRAND REEF MINE

ARAVAIPA MINING DIST.
GRAHAM CO., ARIZONA
ENG'R. W.R. STORMS
JUNE, 1942
SCALE: 1" = 33 1/3' Fig. 4

LGT



ARAVAIPA CLAIM

SEC. 17 T 6 S R 20 E

GRAHAM CY., ARIZ.

SURVEYED 4 23 1903

PATENTED 4 19 1905

TRACED 3 28 1947

200' = 1" VAR. 13° E

LOC. 1, 1, 1892 ED. C. PLATT

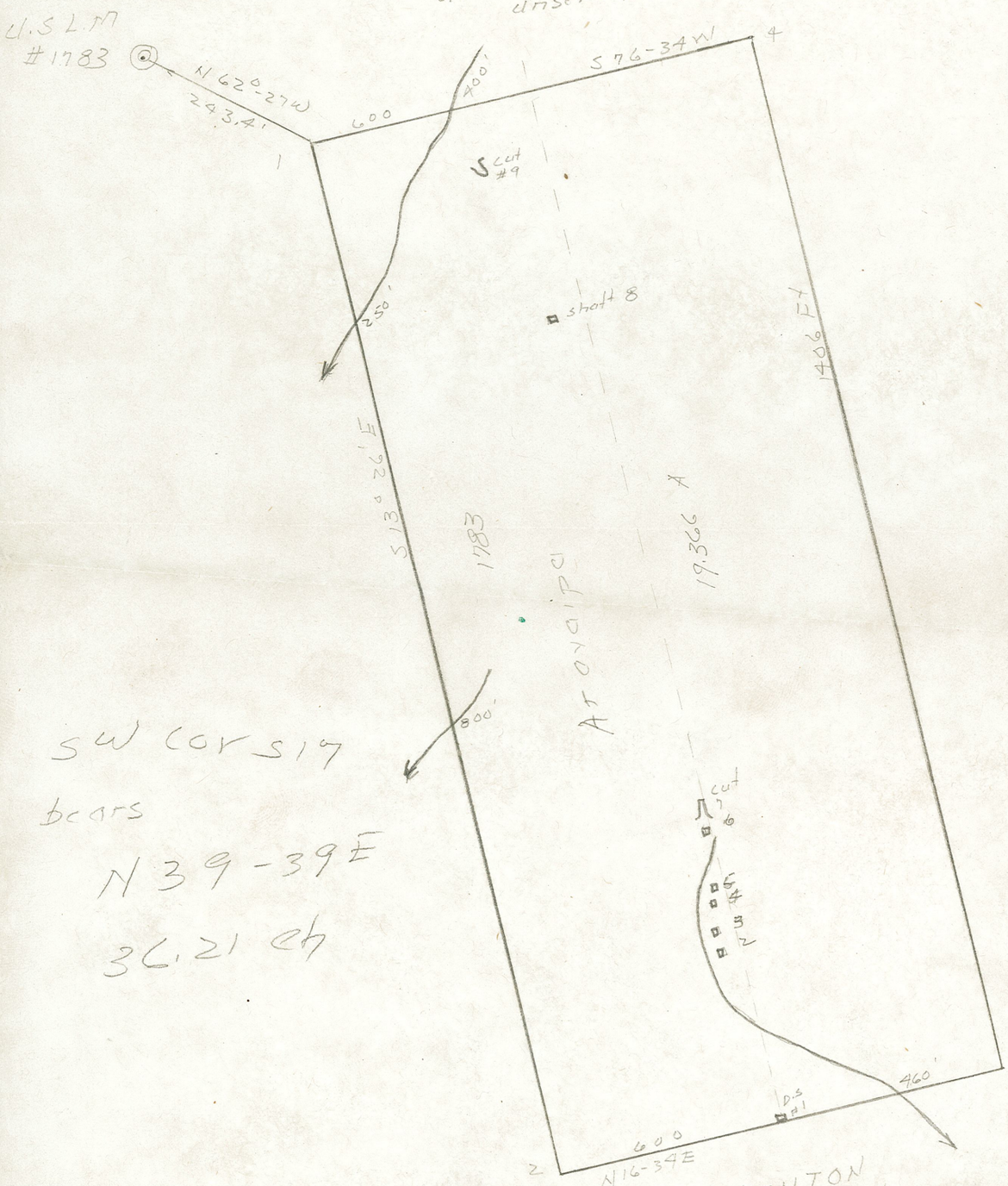
M.R.

A cross (X) & BR USLM No 1783
Corn 3 + 5 x 6 above ground
Corn S 88°.10' W 60'

A cross (X) and BR USLM No 1783
4 + 6 x 8 showing above ground
bears N 25°-12' E 49.8'

SW4 Sec 17
T65 R 20E
Unsurveyed

Unknown claim
unsurveyed

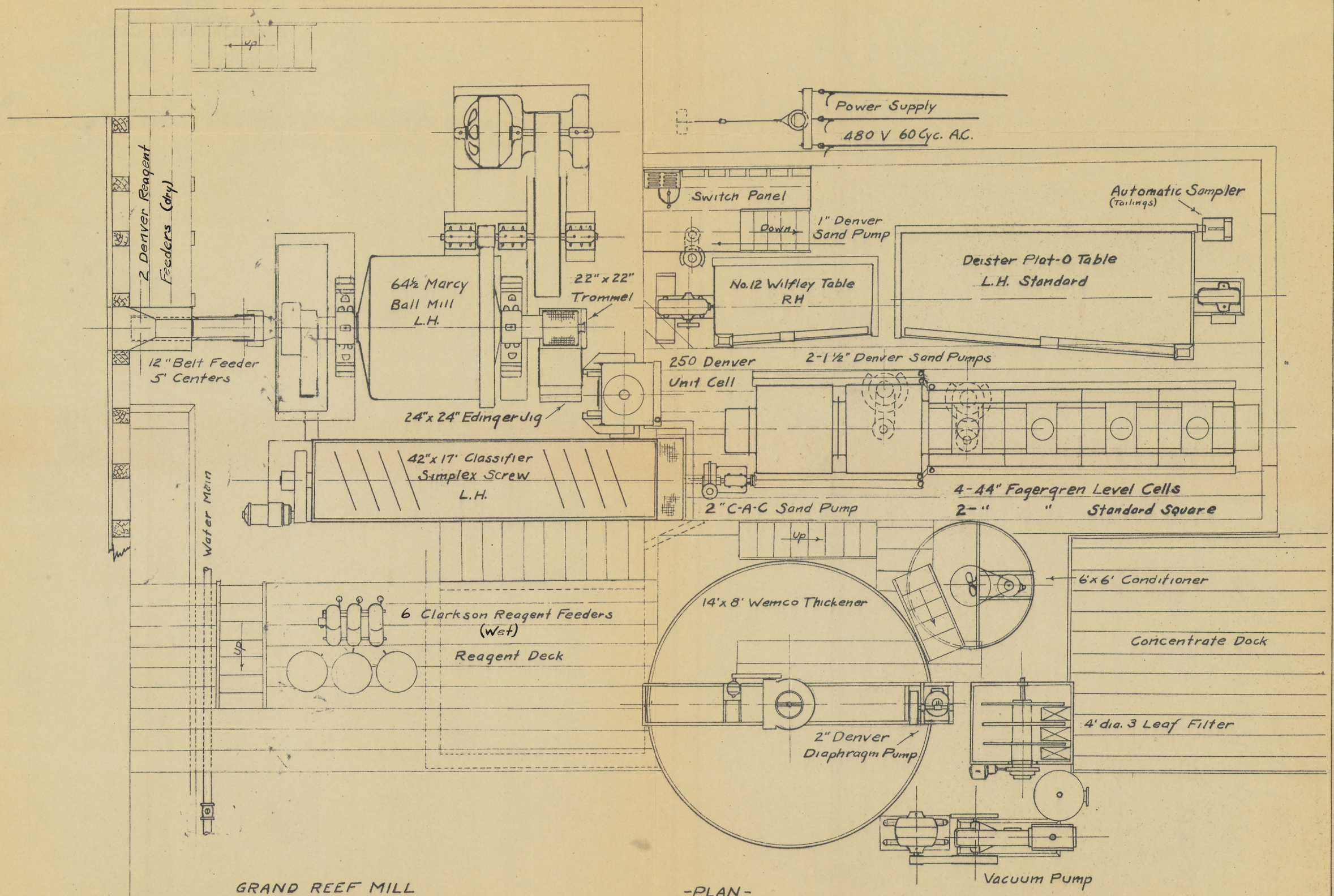


200'=1"
Var. 13° E

SW cor S17
bears
N 39-39E
36.21 ch

NEWTON
unsurveyed

Surveyed
4-2,3,03



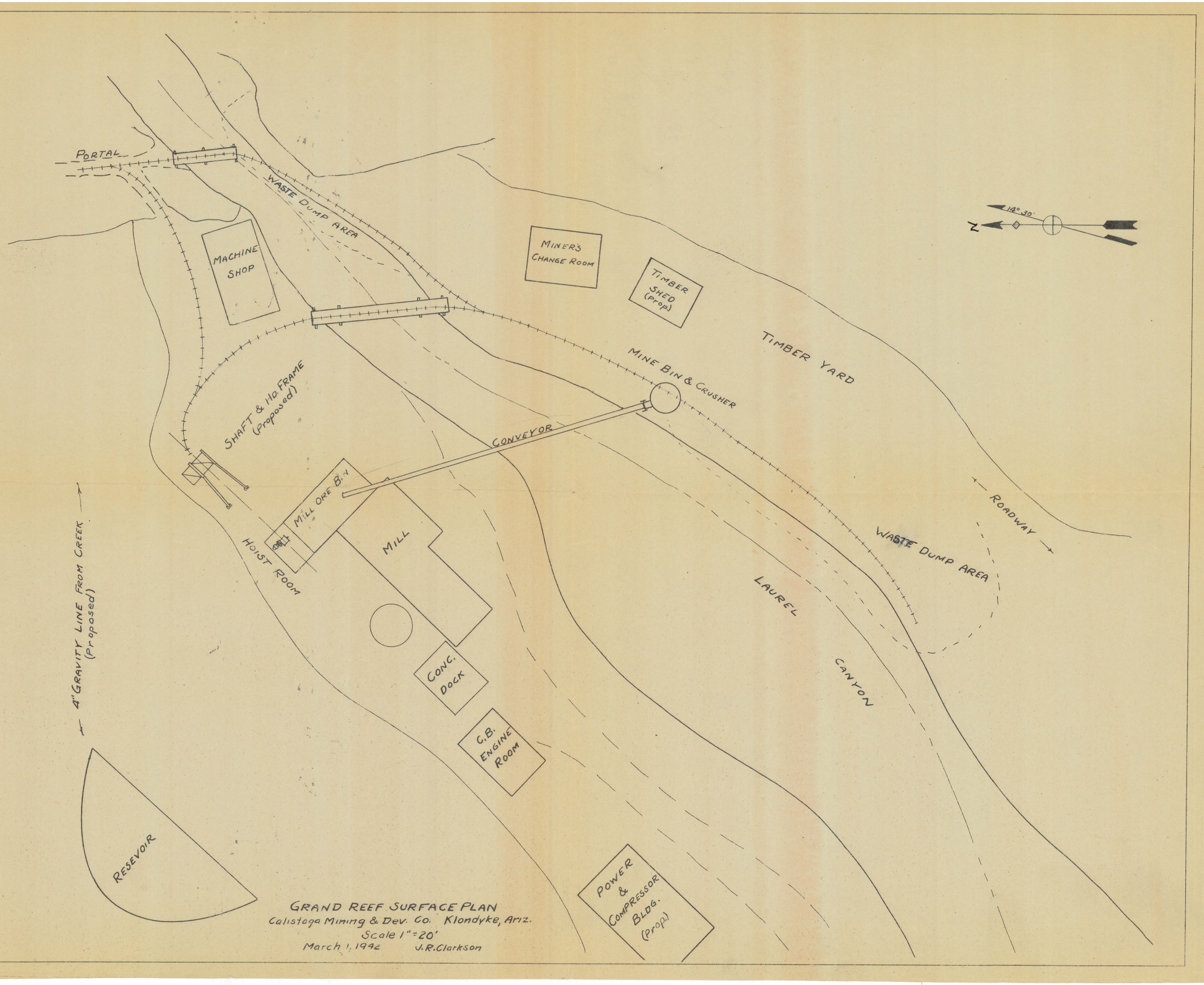
GRAND REEF MILL

Calistoga Mining & Dev. Co. Klondyke, Ariz.

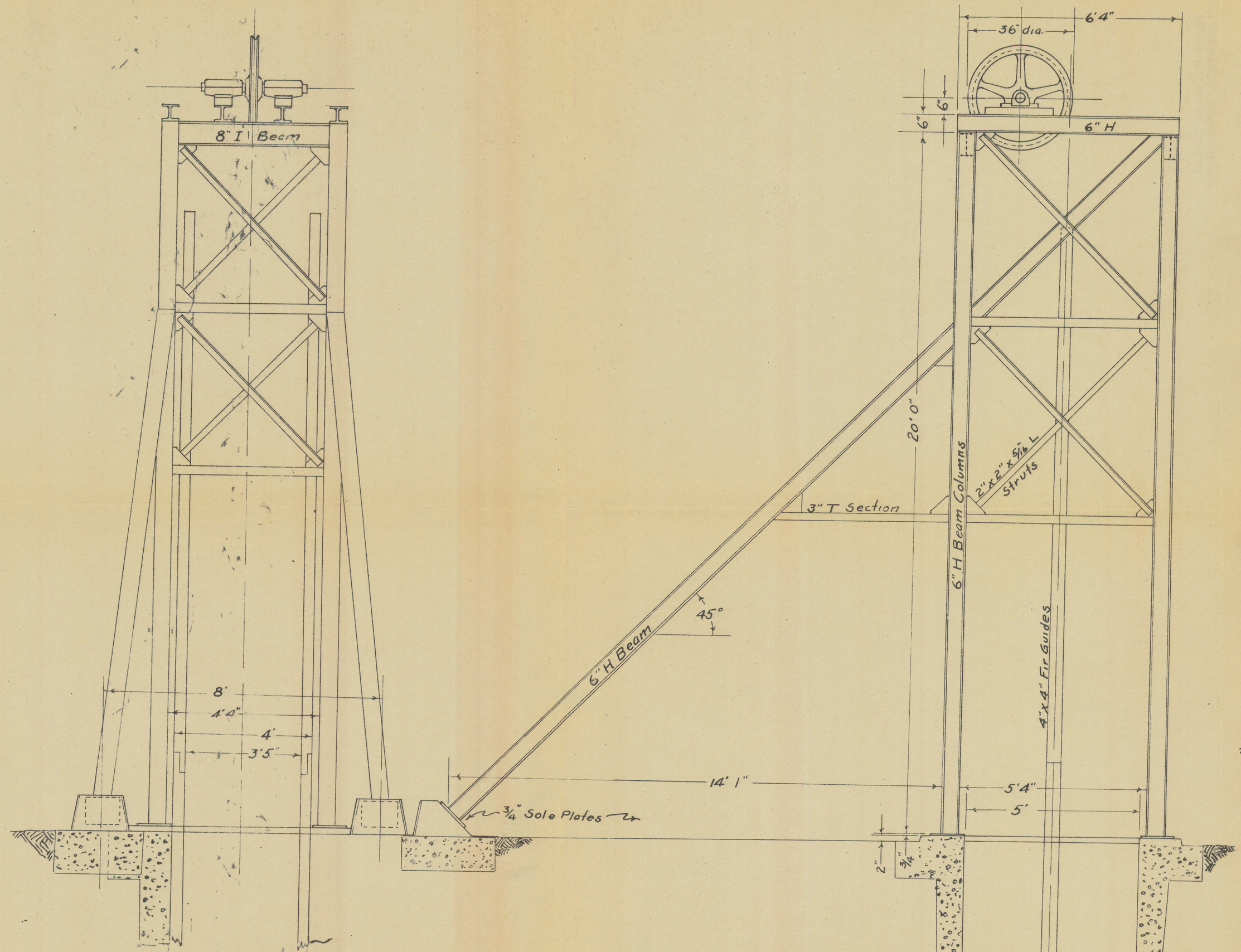
Scale ¼" = 12"

Feb. 20, 1942 J.R. Clarkson

-PLAN-

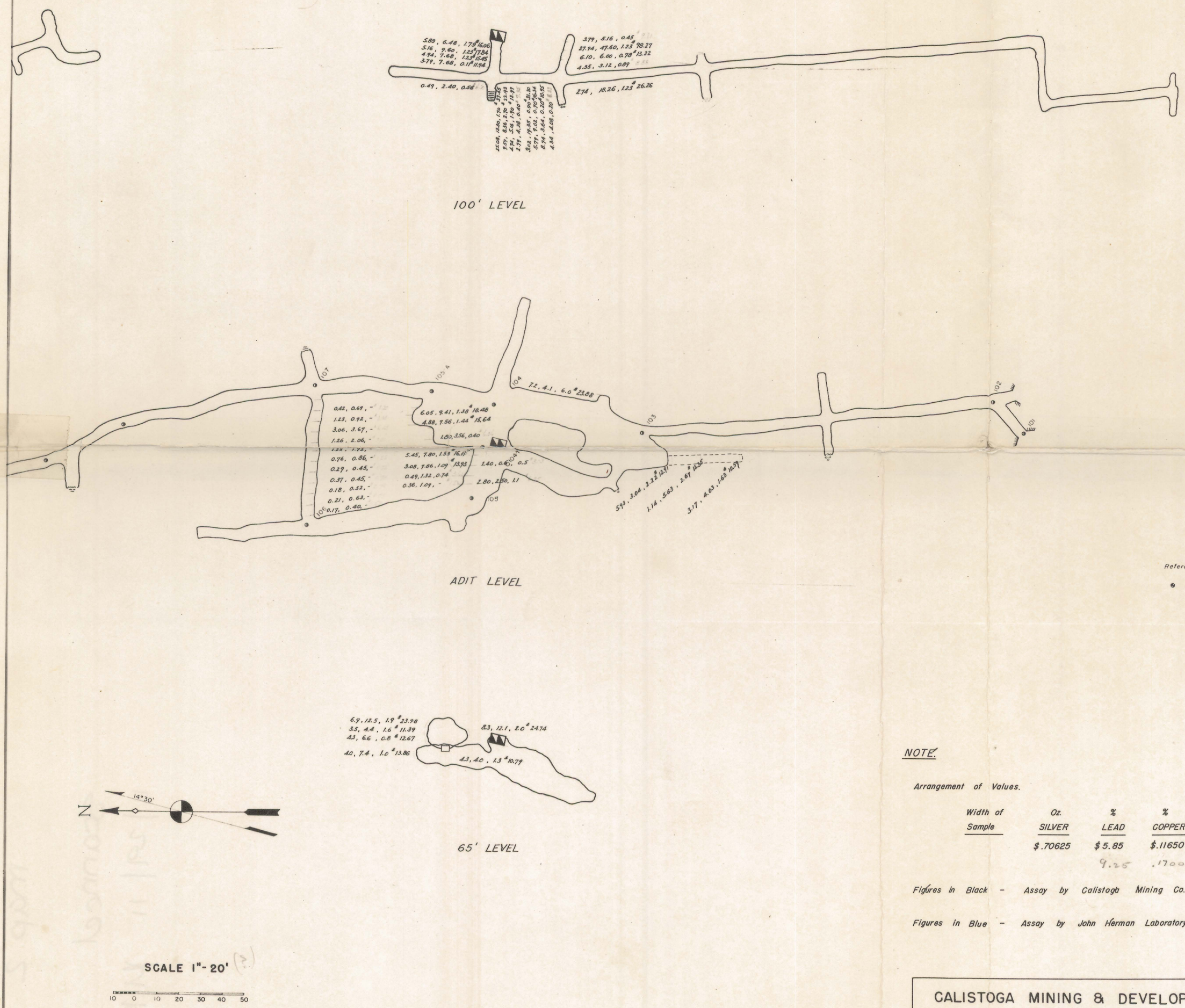


GRAND REEF SURFACE PLAN
Calistoga Mining & Dev. Co. Klondyke, Ariz.
Scale 1" = 20'
March 1, 1942 J.R. Clarkson



For proposed development new access Shaft

GRAND REEF HEADFRAME
Calistoga Mining & Dev. Co. Klondyke, Ariz.
Scale 1/2"=12"
Feb. 28, 1942 J.R. Clarkson



NOTE:

Arrangement of Values.

Width of Sample	Oz. SILVER	% LEAD	% COPPER	Total Value
	$.70625	$5.85	$.11650	
		9.25	.1700	

Figures in Black - Assay by Calistoga Mining Co.

Figures in Blue - Assay by John Herman Laboratory. Los Angeles, Calif.

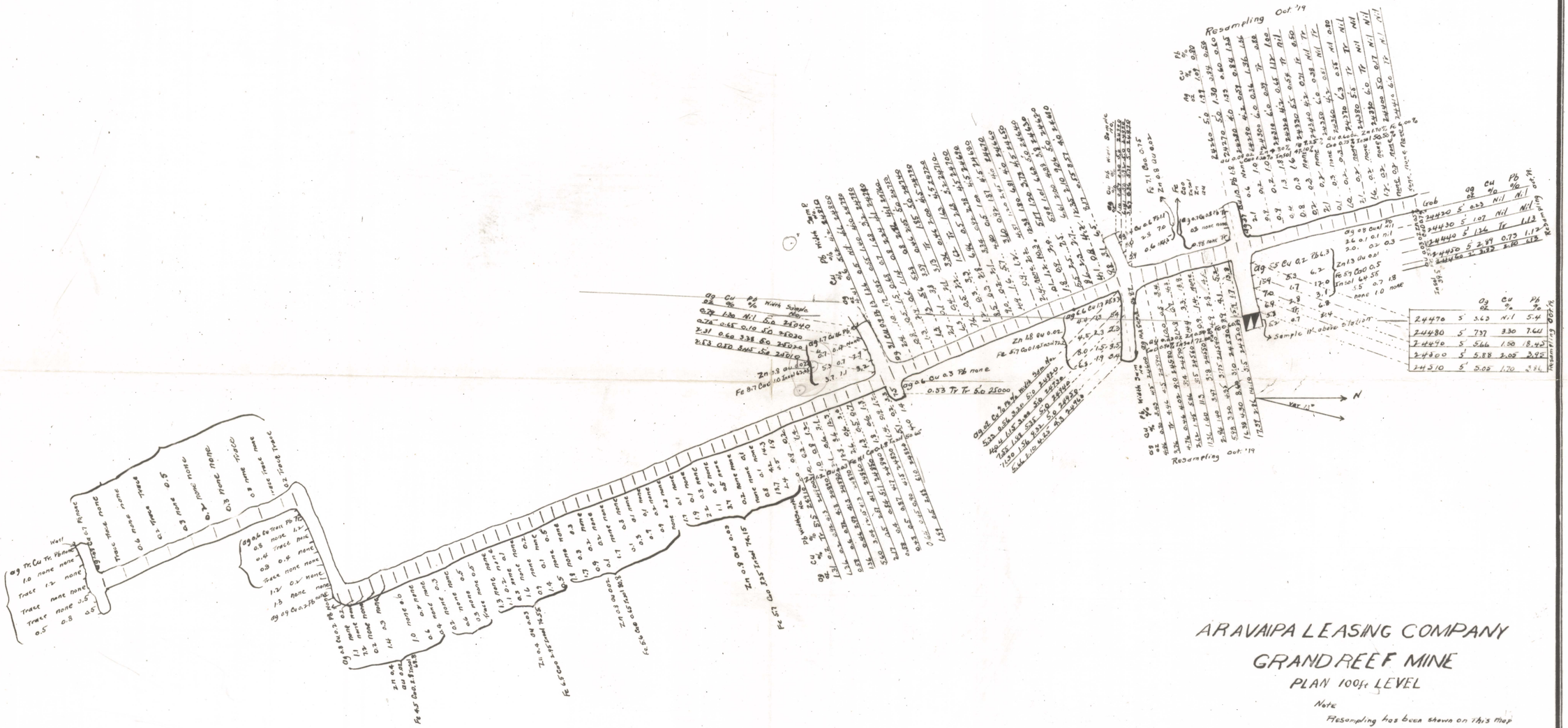
CALISTOGA MINING & DEVELOPMENT CO.

LOS ANGELES, CALIF.

GRAND REEF MINE.

KLONDYKE, ARIZONA.

SURVEY by J. STROHL	ADIT LEVEL	REVISIONS
DWN. by D.R.K.		DATE. BY
CHECK by		3-10-41 D.R.K.
APP'D by		



		Ag oz	Cu %	Pb %
24470	5'	3.63	Nil	5.4
24480	5'	7.37	3.30	7.61
24490	5'	5.66	1.50	18.45
24500	5'	5.88	2.05	3.95
24510	5'	3.05	1.70	3.16

Resampling Oct. '19

Grab		Ag oz	Cu %	Pb %
24420	5'	0.23	Nil	Nil
24430	5'	1.07	Nil	Nil
24440	5'	1.26	Tr	1.13
24450	5'	2.84	0.73	1.12
24460	5'	3.33	2.40	1.13

Resampling Oct. '19

ARAVAIPA LEASING COMPANY

GRAND REEF MINE

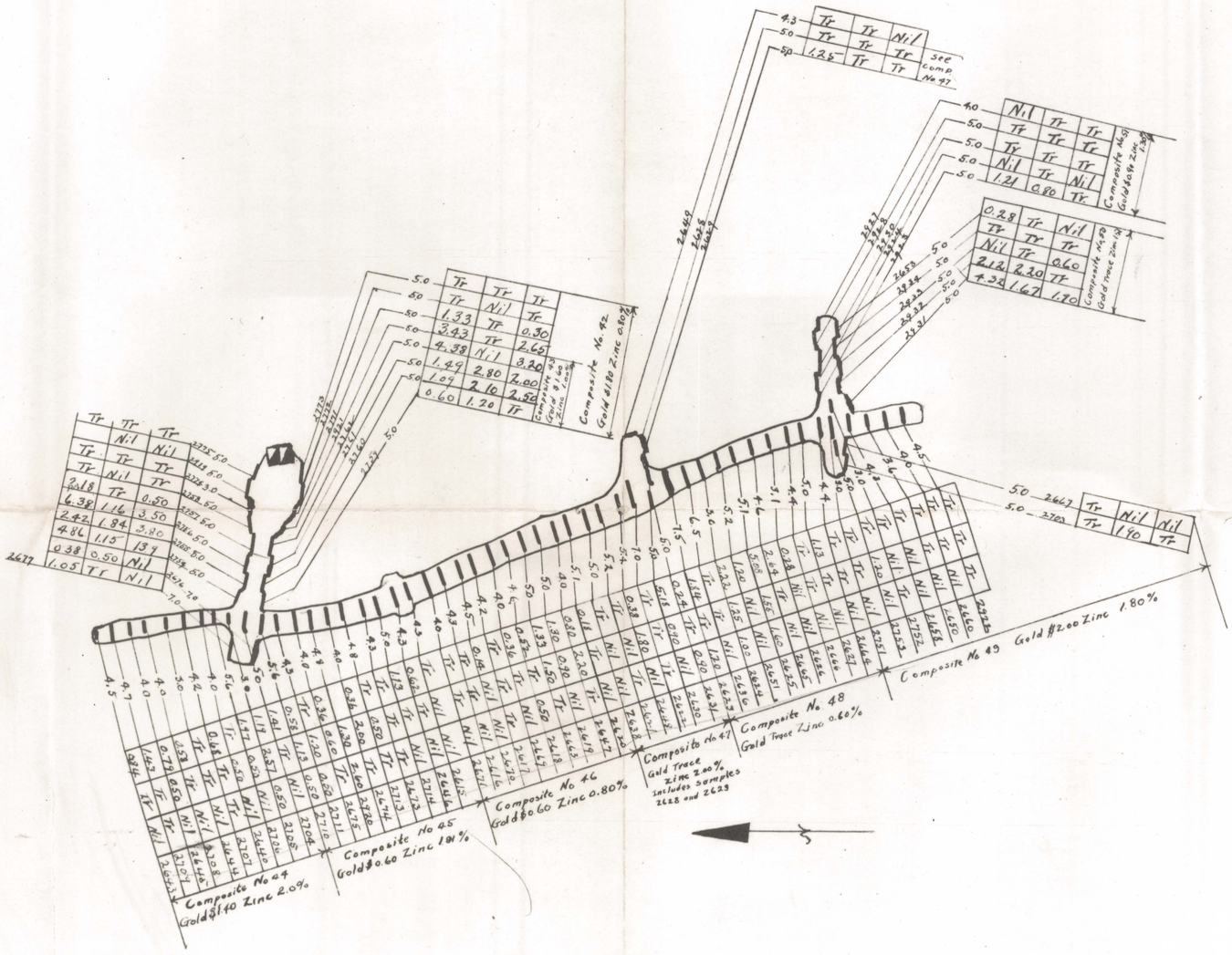
PLAN 100ft LEVEL

Note

Resampling has been shown on this map to make comparisons easy. A new map will be made showing Resampling only.

AMERICAN ZINC COMPANY OF TENNESSEE

NUMBER	DRAWN BY
DATE	TRACED BY
SCALE ~~1in = 20 ft~~	APPROVED



Note:
Repeat assays of Composites Nos 42-43 & 44 are as follows
No. 42 Au. $1.00
" 43 " 1.00
" 44 " 0.80

ARAVAIPA LEASING COMPANY
GRAND REEF MINE
300 FOOT LEVEL
ASSAY PLAN
Scale 1 in = 20 ft.
Date Sept 1919

Legend

Number	Length	Oz. Ag	% Cu.	% Pb	Number

Cut in Roof or Side
Cut in Floor
Vertical Cut

AMERICAN ZINC COMPANY
OF TENNESSEE

NUMBER
DRAWN BY
DATE Sept 1919
TRACED BY H.S.K.
SCALE 1 in = 20 ft
APPROVED