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A GEOLOGIC APPRAISAL
OF
THE ANTLER COPPER-ZINC MINE
MOHAVI COUNTY, ARIZONA

By
J. F. Wolff, Mining Engineer & Geologist
Duluth, Minn.

Oct. 7, 1952

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INTRODUCTION

The following report presents a summary of an investigation of the Antler Copper-Zinc Mine made August 26th to 28th, inclusive, at the request of President Thomas Bardon of the Shattuck-Denn Mining Corporation, transmitted to the writer by Mr. R. J. Higgins, Assistant to the Vice President of that company.

The request was for a geologic appraisal of the prospects of finding an orebody worth mining on this property, but not for a commercial study as to the profitability of such a mining project on it.

The report will be presented under the following captions:

I Location of Property.

II Conclusion and Recommendation.

III Geology of Area and orebody.

IV Mine Workings and Explorations.

V Possible Tonnage.

VI Exhibits - Maps and Cross-sections.

VII Proposed Drilling.

VIII Proposed Shaft sinking following Successful Drilling.

IX Future of Copper-Zinc-Lead Market.

I. LOCATION OF PROPERTY.

The Antler Mine is located in the Cedar Valley mining district, in Secs. 3, 4 & 9, T. 17 N., R. 16 W., Mohavi County, Arizona. It is 12 miles by well-graded gravel road east of Yucca, which is 23 miles by well improved and surfaced highway southwest of Kingman. Both towns are on the A. T. & Santa Fe Ry. There are no excessive road grades. Ore is trucked from mine to railroad at Yucca.

The mine is in a desert valley with no local vegetation or timber. Average rainfall is 11 inches. Mean average temperature is 61° and winter snow never remains on the ground. Summers are hot. Water is piped a considerable distance from valley wells.

Two original claims were patented, the Antler and Spuyten Duyvil, and fourteen additional full-size claims and nine fractional ones have been staked. The mine is entirely on the Antler Claim. See attached claim map, Exhibit 2.

II. CONCLUSION AND RECOMMENDATION.

The amount of sulphide mineralization, principally of zinc and copper with minor amount of lead, is very impressive for the present extent of mine development and the accessory drill exploration done by the U. S. Bureau of Mines in 1947, much more so than probably was the Iron King prospect at a similar stage in its history.

The geologic conditions are even more favorable than were evident at Iron King. The Antler formation is a series of siliceous schists, probably old quartz-slates, caught in a great granite intrusive from which thin pegmatite dikes have cut into the schists in which shear-zones have been developed (by the granite intrusion), making channels up which the sulphide solutions have found access. The geology is ideal for the development of vein or fissure-filled type orebodies. At the Iron King the mineralizing intrusive granite is probably a mile or more away, while at the Antler it encloses the sulphide-bearing schists only a few hundred feet away on either side. The thin pegmatite dikes have altered the schists to an asbestos-like silicate (anthophyllite) and other silicates and some garnet, and may have contributed to bringing in the sulphides.

Each of the two main veins (foot-wall and hanging-wall) varies in width from a fraction of a foot to 12.75 feet. In one place a stope including both veins

is 40' wide. There are swells or "pods" and pinches in the veins. The length of minable veins now proven by drilling and mine workings is 1100' and the combined average width shown in five drill holes in this length (including pinches) is 9.6', averaging 3.37% Copper, 7.64% Zinc, 0.71% Lead, .0149 oz. gold and .957 oz. silver per ton. Contamination by mining undoubtedly will dilute these analyses somewhat as average current mill feed contains 2.9% copper, 6.8% zinc. There is a possibility of more than 800,000 tons of ore within the explored length and down to 1000 ft. depth (see Caption V, Possible Tonnage).

Immediate shaft-sinking for explorations has been suggested, but in advance of that I recommend drilling four holes and deepening another, totalling about 2,450 feet, estimated to cost $19,600.00. One hole would undercut the main mine stopes about 300 feet, below the bottom 5th level, one hole would be 400 feet northeast of D.H. 6, the most northeasterly hole, and two others would be 500 feet and 1,000 feet respectively southwest of D.H. 5, the last hole southwest of the main shaft. D.H. 4 is capped and should be deepened to cut another vein. See Exhibit 6. This drilling plan would extend explorations to a length of 2,600 feet of possible mineralized area. See Caption VII for Proposed Drilling.

I consider this prospect well worth this expenditure, and if the drilling results, especially of the first hole, are satisfactory, the sinking of a new shaft to a depth 300 feet below the present 5th level or to Elev. approximately 2700 would be warranted. This latter step should depend upon the judgment of your directors as to the future of the Copper-Zinc-Lead market (see Caption IX) and commercial estimates of your operating department as to profitability of this operation.

III. GEOLOGY OF AREA AND OREBODY.

The geologic association has been presented briefly in the above and has been described in more detail in U. S. Bureau of Mines Report of Investigations 4214

March 1948, by T. N. Romslo, with which you undoubtedly are familiar, so I will not include a general geologic description.

The schists or slates strike N. 20° - 23° E. and dip 65° - 80° N.W., having a cleavage approximately parallel to the bedding. The mineralization follows shear-zones which have been called faults, but there is no very clear evidence of faulting following the cleavage. There are two prominent cross-faults, the Saguaro, which offsets the veins 45' to the N.W., and the Ocotillo, which offsets one vein 80'. Other transverse faults have been mapped on surface but not identified underground.

A third vein southeast of the main footwall vein containing copper-sulphate is recognized southwest of No. 2 Shaft, and has been cut by an adit, as has the main hangingwall vein which was followed for 420' by a cross-cut from the adit (See Exhibits 3 & 6). The mineralization therefore is not confined to only two shear zones. It may pinch in one shear and recur en echelon in another parallel one as occurs in the Iron King Mine.

An important feature was noted on the 4th level and in the sump below the 5th level, in that the sulphide ore cuts sharply across the schist and into the footwall. See Exhibit 5, cross-section of Antler Shaft, below 5th level. Such occurrence is responsible for the wide stope such as occurs in the shaft area on the 3rd level. See Exhibit 9.

The area of Claims shown on the claim map, Exhibit 1, covers the schist area, east and west of which are granites. That on the west rises to jagged peaks several hundred feet high, while that to the east of the northerly claims is only one or two hundred feet high. The area east and south of the Antler and Spugten Duyvil claims is low topography and talus and alluvium covered. The claims northeast of Antler are largely covered by coarse granite talus material. Both of these areas are hard to explore because of this detrital cover on the ledge rocks, but

the areas northeast and southwest of Antler claim deserve further exploration.

IV. MINE WORKINGS & EXPLORATIONS.

The mine has been opened on five levels at depths of 25', 65', 112', 180' and 235' below the collar. Exhibits 7 to 11 incl. show the outline of workings on the five levels, and Exhibit 3 shows a composite map of the different levels, the adit, vertical projection of the stopes and locations and records of the six drill-holes. The mine workings show veins varying from a fraction of a foot to a stope 40 feet wide which contains both foot and hanging-wall veins. The workings from the Antler shaft have a length of 572 feet and a bottom level vertical depth of 235' below shaft collar.

To the northeast the drifts from the shaft stop at the Ocatillo Fault, while in those to the southwest the veins pinch, the footwall vein appearing to have become blank. One drift follows another shear-zone. Footwall veins apparently have been found again in D.H.'s 4 and 5 to the southwest of the mine workings on 5th level. See Exhibit 3 which shows the adit and its relation to D.H.'S 4 and 5, and also a narrow vein in D.H. 6 northeast of Ocotillo fault. This vein may be hanging-wall vein, the hole apparently being not deep enough to cut the footwall vein.

Gen. Mgr. H. J. Dalton, of the Antler Mine, has reported verbally to Mr. R. J. Higgins the finding of another ore lense or vein and the writer's written request to Mr. Dalton for specific information regarding this has not been answered to date.

V. POSSIBLE TONNAGE.

The following tabulation shows the widths and analyses of ore material cut in both footwall and hangingwall veins by the five drill holes within the 1100 ft. length of minable veins.

D.H.	F. W. Vein	H. W. Vein	% Cu.	% Zn.	% Pb.	Oz./Ton Au.	Oz./Ton Ag.
1	8.0'		0.70	6.82	.07	.0085	.23
1		12.75	3.63	7.30	1.21	.017	.92
2	3.8		13.72	5.50	0.10	.03	1.30
2		8.5	2.03	5.79	0.67	.02	.75
3	0						
3		2.30	5.46	8.40	1.28	.02	1.60
4	3.0		3.99	9.15	0.77	.007	1.10
4		5.40	1.83	10.00	1.16	.01	1.00
5		0					
5	4.25		1.37	11.00	0.10	.005	0.20
	19.05	28.95					
Av.	3.81		3.96	7.85	.191	.0117	.975
"		5.79	2.96	7.50	1.04	.0168	.94
Total	9.60		3.37	7.64	.71	.0149	.957

Attention is called to the 9.6 feet of combined vein width analyzing 3.37% Copper, 7.64% Zinc, and .71% Lead, .0149 oz. gold and .957 oz. silver per ton.

Using only a 9 ft. width the possible ore to 1000' depth in the shaft and below the bottom 5th level is

$$\frac{(1000' - 235') \times 9' \times 1100' \text{ long}}{9 \text{ cu. ft./short ton}} = \quad 841,500 \text{ short tons}$$

= Add Ore above 5th Level, Use - 33,500 " "

Total = 875,000 " "

The tonnage to a depth of 300 feet below the 5th level =

$$\frac{300' \times 9' \times 1100'}{9 \text{ c.f./short ton}} = \quad 330,000 \text{ short tons}$$

= Add above 5th Level, Use - 35,000 " "

Total = 365,000 " "

The above possible tonnages do not include the unusual large swells or "pods" in the veins, none of which was cut by a drill hole.

= Gen. Mgr. R. J. Dalton of the Yucca Mining & Milling Co. (operators of Antler Mine) estimates 65,000 tons of ore above the 5th level. Data are insufficient to check this figure, but the tonnages here used seem reasonably certain.

VI. EXHIBITS - MAPS & CROSS SECTIONS.

Exhibit 1 - Map of Mine Surface Area showing Geology.

" 2 - Map of Claims showing also Drill Holes, Veins and Faults, etc.

" 3 - Composite Level Map & Vertical Projection of Mine Workings.

" 4 - Cross-Sections of Drill-holes 1, 3, 5 & 6.

" 5 - Cross-Section of Shaft, D.H. 2 and Proposed Drill-Hole 7.

" 6 - Cross-Section of D.H. 4 and Proposed Extension, and Map of Adit and S.W. end of 5th Level.

" 7 - Map of 1st Level.

" 8 - Map of 2nd Level.

" 9 - Map of 3rd Level.

" 10 - Map of 4th Level.

" 11 - Map of 5th Level.

" 12 - E. & M. Journal Metal Prices 1897 - 1951.

The maps available at the mine were in only fair condition and the above exhibits are the best possible to prepare from them without redrafting.

VII. PROPOSED DRILLING.

The proposed drilling is mentioned in the Recommendations above and the locations of proposed holes are shown on Exhibits 2 & 3. The proposed extension of D.H. 4 is shown on Exhibit 6.

The following is pertinent data as to the proposed drill-holes:

	Total Depth
D.H. 7 - Elev. 3310 Location 5275 N., 4275 E. L. 74°. Direction S-61° E. To cut vein @ 634'-650' and about below middle of main stoped area above 5th Level.	675'
D.H. 8 - Elev. 3200 Location 6025 N., 4650 E. L. 68°. Direction S-65° E. To cut F.W. vein @ 325' For X-Sec. see Exhibit 4.	450'
D.H. 9 - Elev. 3190 Location 4215 N., 3700 E. L. 50°. Direction S-51° E. To cut F.W.Vein @ 320', H.W.Vein @ 250', Copper Vein @ 503'.	550'

D.H. 10 - Elev. 3170 Location 3820N., 3390 E. 500'
L. 50°. Direction S-51° E.
To cut H.-W. Vein @ 226', F.W. Vein @ 297' and
Copper Vein @ 480'.

For X-Sec. of D.H.'s 9 & 10, See Exhibit 4.

Deepen D.H. 4 from 430' to 700' 270'

Total - 2,445'

Use - 2,450'

Estimated Cost - 2,450' @ $8.00 = $19,600.00

The reported cost of contract drilling for U. S. Bureau of Mines in 1947 was $6.00 per foot.

VIII. PROPOSED SHAFT SINKING FOLLOWING SUCCESSFUL DRILLING.

If the drilling is reasonably successful and particularly if D.H. 7 finds the continuation of either or both veins with minable width of ore, the sinking of a new vertical shaft would be warranted from which to continue underground exploration at say 300 feet below the 5th level, or at Elevation 2700. This shaft would become a permanent hoisting shaft and its location would depend on ore found in the other proposed drill-holes. An additional drill-hole might be wanted between D.H. 6 and D.H. 8. The latter is located to be at the toe-of-slope of the hill on which D.H. 6 is located, so as to start in solid schist and not in granite and schist talus boulders where drilling would be impossible.

If D.H. 7 does not find suitable ore another deep hole 150' northeast or 200' southwest of D.H. 7 might be desirable before abandoning this prospect.

IX. FUTURE OF COPPER-ZINC-LEAD MARKET.

The officers and directors of the Shattuck-Denn Mining Corporation undoubtedly are close observers of the metal markets, but for convenience in appraising the probable future prices for zinc, copper and lead metals over the next ten years, the major portion of the immediate future life of the Antler Mine, a chart of

the E. & M. Journal Metal Prices is attached as Exhibit 12.

Having in mind the inflation since 1940 and the relative supplies of zinc, lead and copper, if costs of labor and supplies do not recede appreciably, the writer would suggest the following prices per pound at which metal prices may stabilize after the recent short supply has ceased:

Zinc - 15¢-16¢ - In short supply in N. America.
Copper - 18¢-20¢ - In ample world supply.
Lead - 13¢-14¢ - In moderate supply in N. America.

Prices will depend much on the artificial stimulation which military preparedness produces, but the present peak prices cannot be expected to continue long without it. Whenever foreign competition again becomes strong in world markets, a recession in commodity prices can be expected. Note secondary post-World War I recession (1930-1932) on Chart Exhibit 12.

The speculation as to market prices and the spread between them and costs is even a greater one than the hazard as to extent of orebodies. However, the first problem is finding sufficient ore to warrant mine development and the present prospect amply justifies the exploration expenditure proposed herein, if mutually satisfactory negotiations can be concluded as to an option.

Respectfully submitted,

J. F. Wolff Sr.

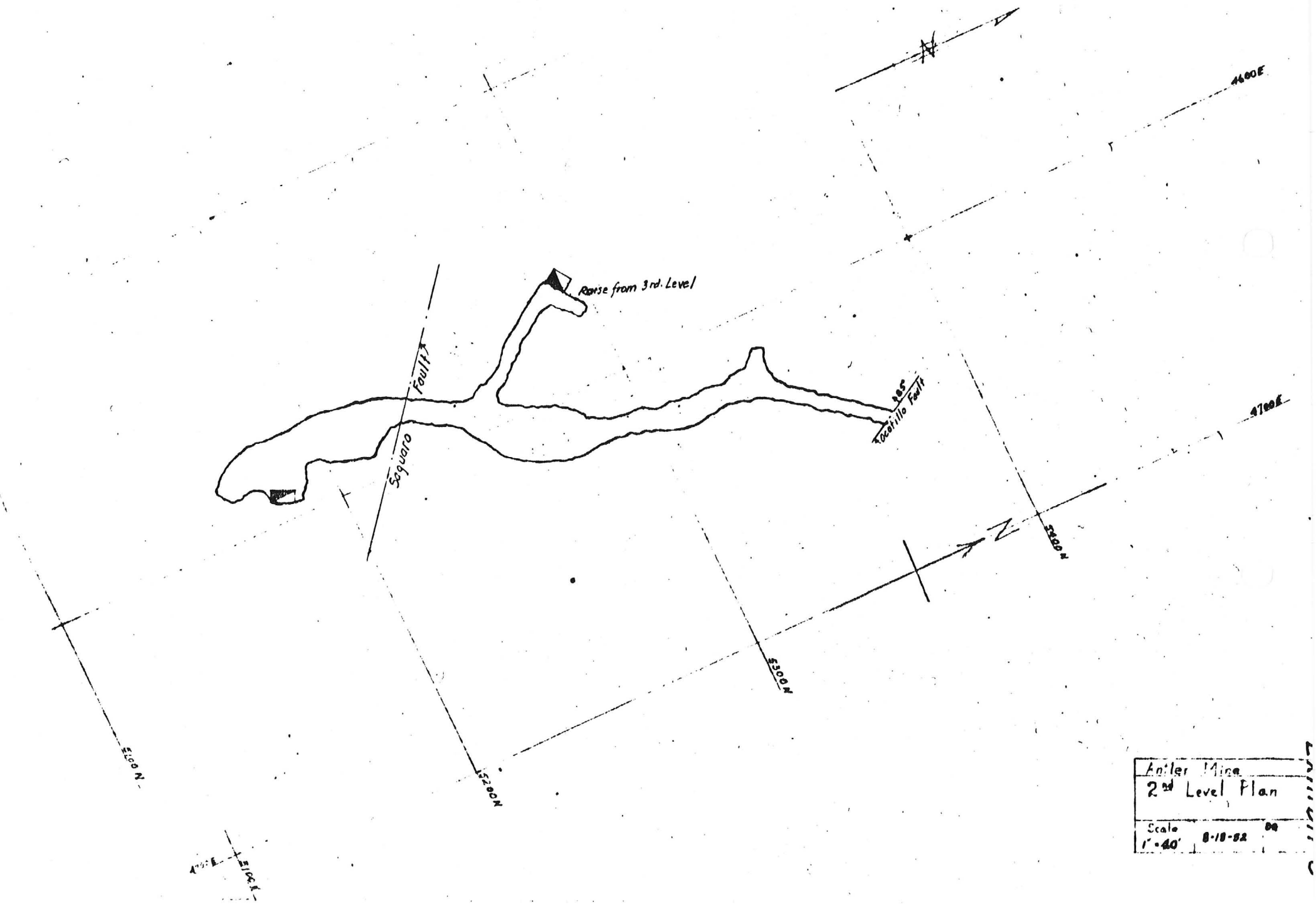
Mining Engineer & Geologist

Duluth, Minn.
Oct. 7, 1952.

EXHIBIT 7

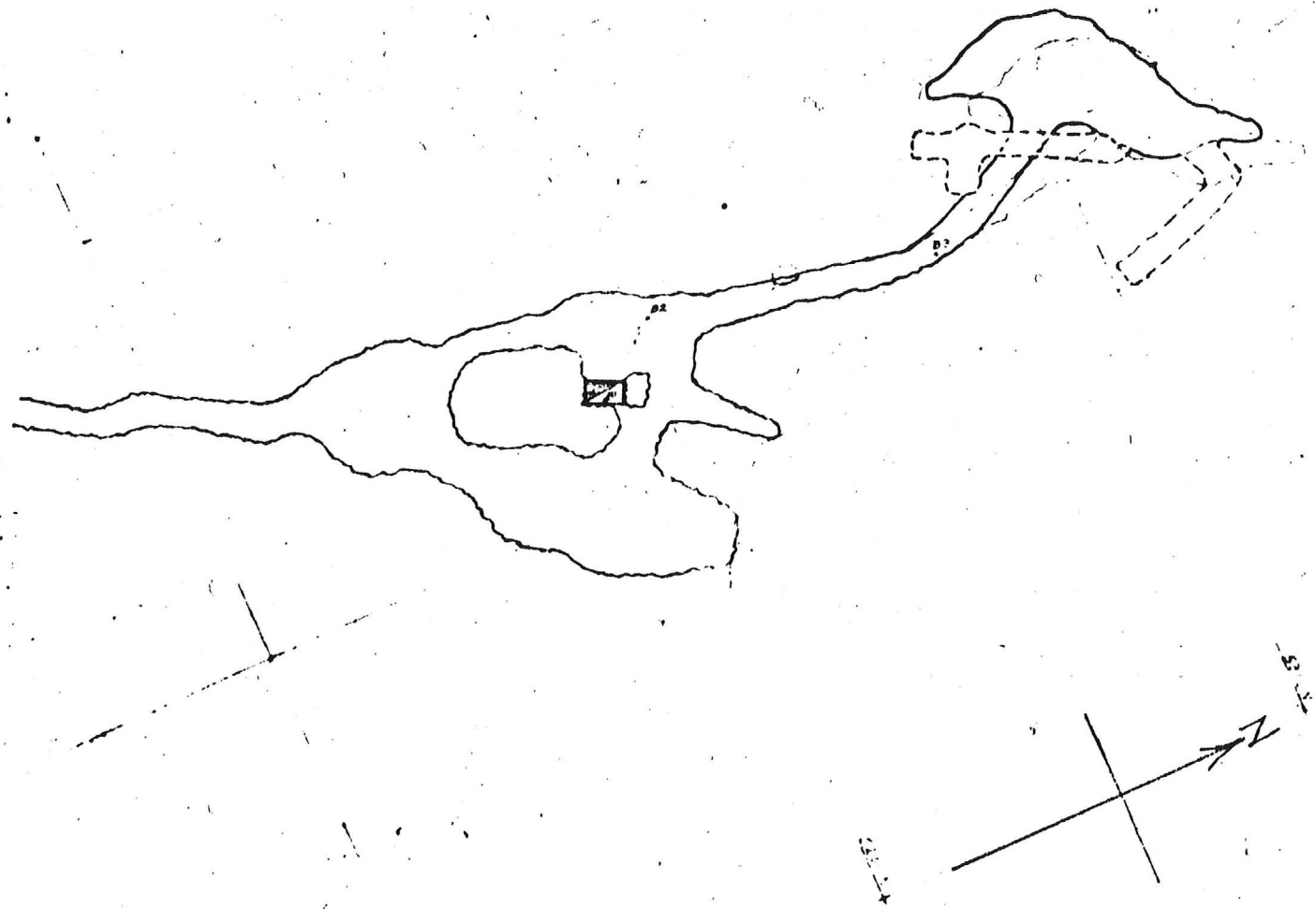
MAP OF 1ST LEVEL IS NOT AVAILABLE

Exhibit 8



Antler Mine
2nd Level Plan
Scale 1" = 40'
8-18-82

Exhibit 9



Antler Mine
3rd Level

1" = 40'

Exhibit 9

E[illegible]it 10

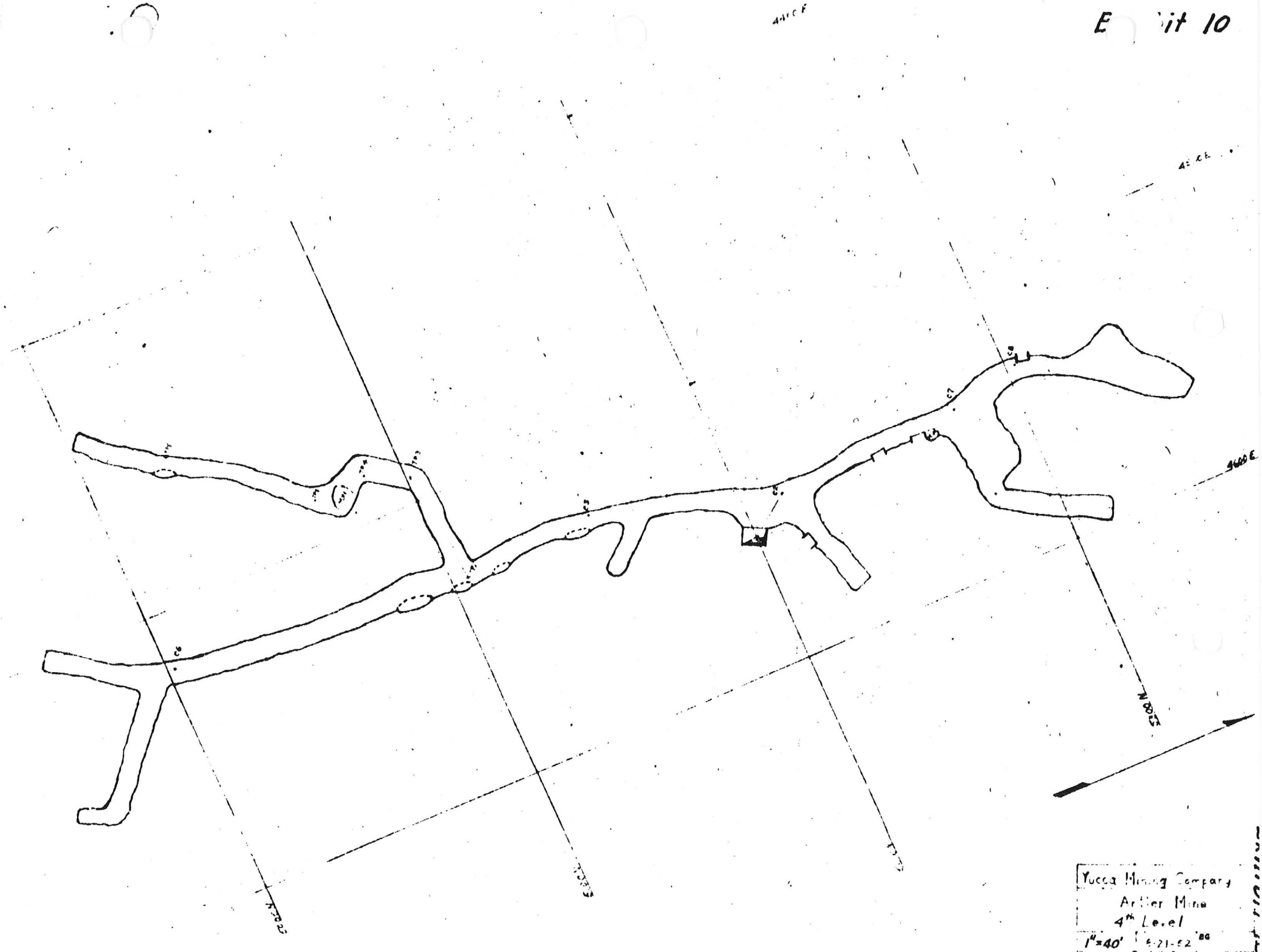


Exhibit 12

E & M J Metal Prices

As Published in Engineering and Mining Journal and E & M J Metal and Mineral Markets

McGraw-Hill Publishing Company, Inc., New York

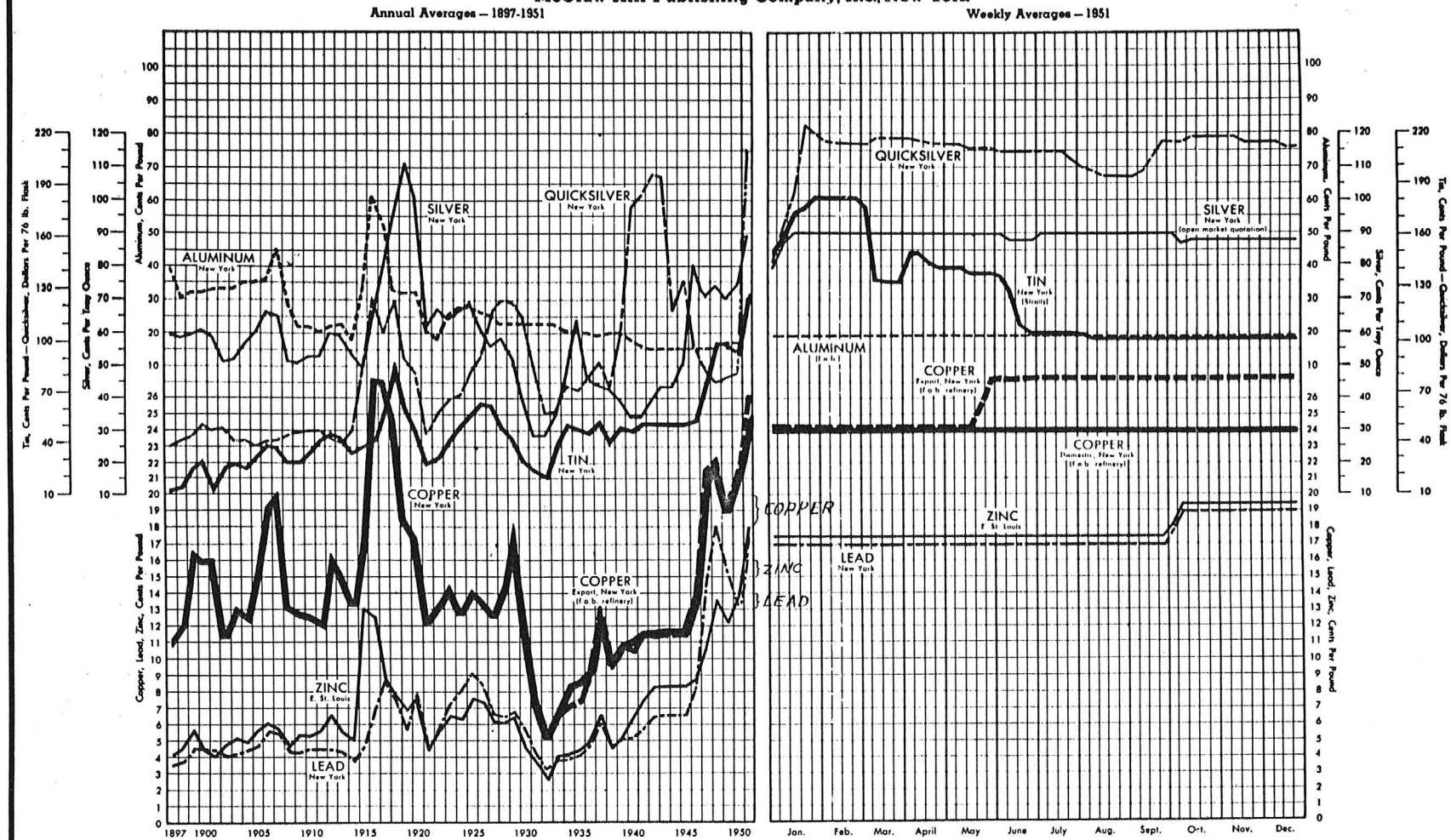
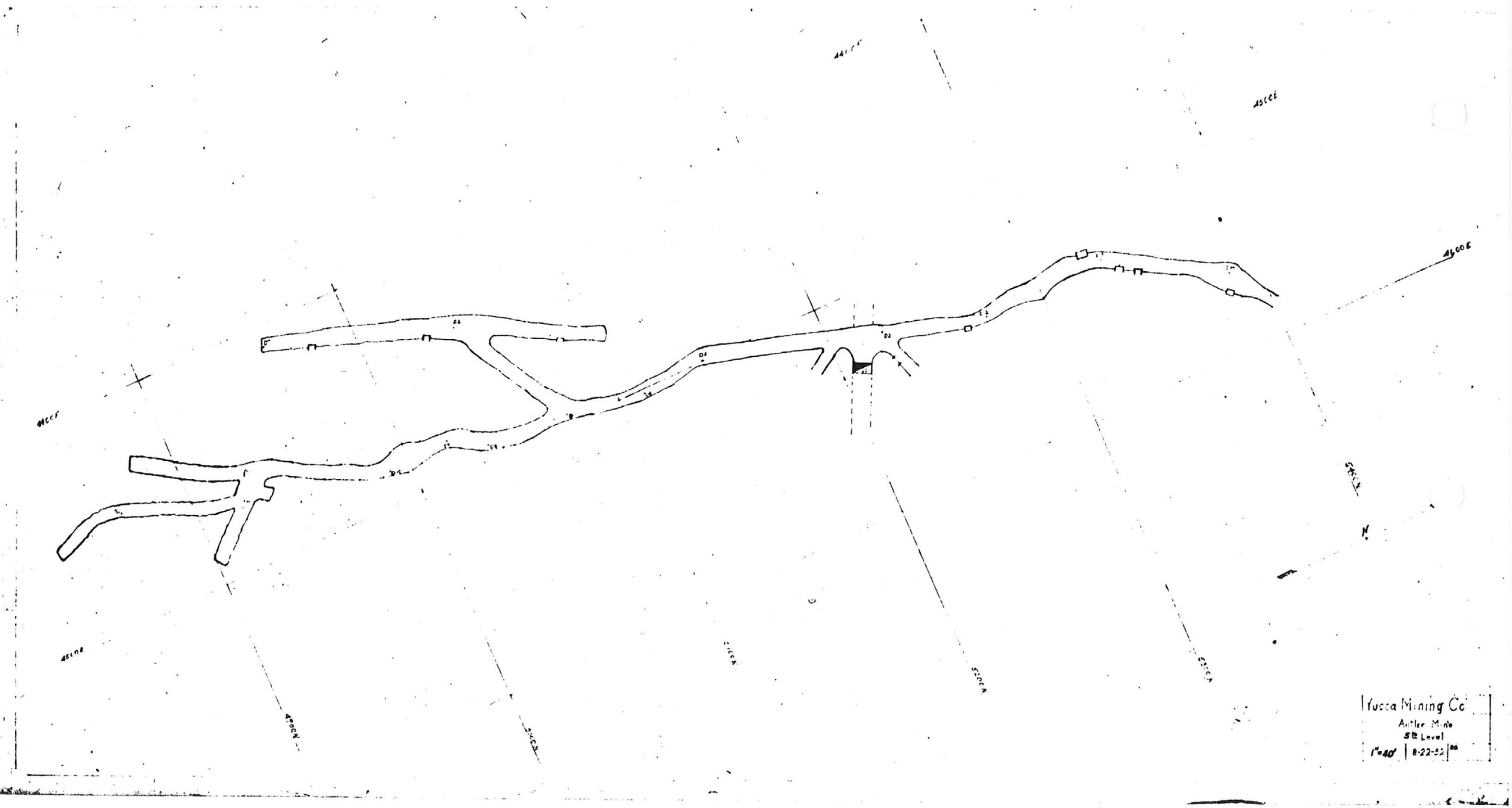


Exhibit 11



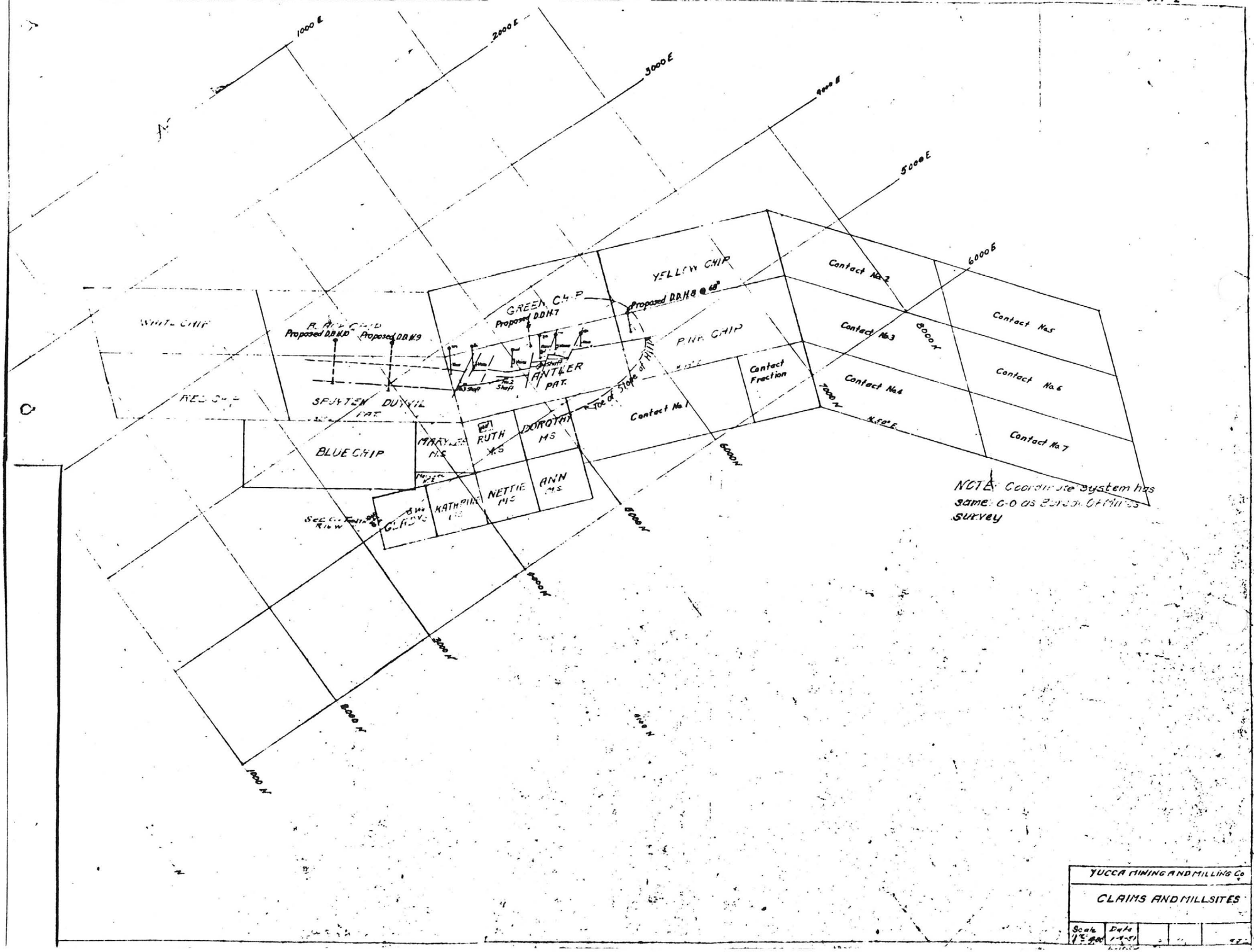


Exhibit 2
1000 E
2000 E
3000 E
4000 E
5000 E
6000 E
WHITE CHIP
RED CHIP
BLUE CHIP
GREEN CHIP
YELLOW CHIP
PINK CHIP
Proposed D.D.H.7
Proposed D.D.H.8 @ 68°
Proposed D.D.H.10
Proposed D.D.H.9
ANTLER PAT.
SPUYTEN DUYVIL PAT.
MARYLEE M.S.
RUTH M.S.
DOROTHY M.S.
NETTIE M.S.
ANN M.S.
KATHRINE M.S.
GLADYS
Toe of Slope of Hill
Contact No. 1
Contact Fraction
Contact No. 2
Contact No. 3
Contact No. 4
Contact No. 5
Contact No. 6
Contact No. 7
8000 N
7000 N
6000 N
5000 N
4000 N
3000 N
2000 N
1000 N
N 50° E
NOTE: Coordinate system has same C-O as Bureau of Mines survey
YUCCA MINING AND MILLING Co
CLAIMS AND MILLSITES
Scale
Date

EXHIBIT 3

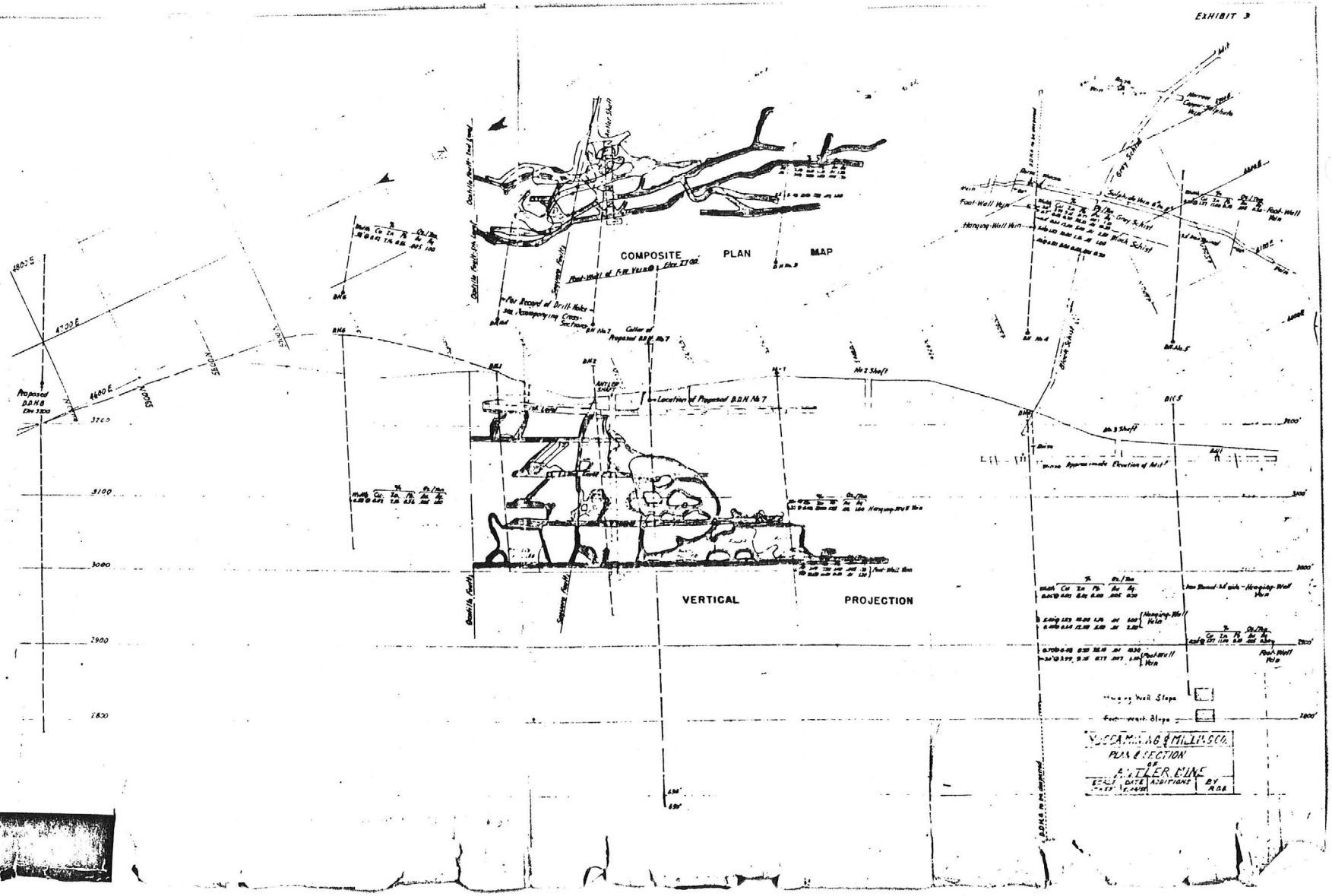

COMPOSITE PLAN MAP
VERTICAL PROJECTION
Foot-Wall Vein
Hanging-Wall Vein
Gray Schist
Black Schist
Sulphide Vein
Location of Proposed D.D.H. No 7
Proposed D.D.H. 8
Hanging-Wall Slope
Foot-Wall Slope
PLAN & SECTION OF ANTLER MINE
ADDITIONS
BY

EXHIBIT 4

ANTLER MINE

CROSS-SECTIONS OF DRILL-HOLES & MINE-WORKINGS

LOOKING NORTH-EAST

SCALE - 1" = 40'

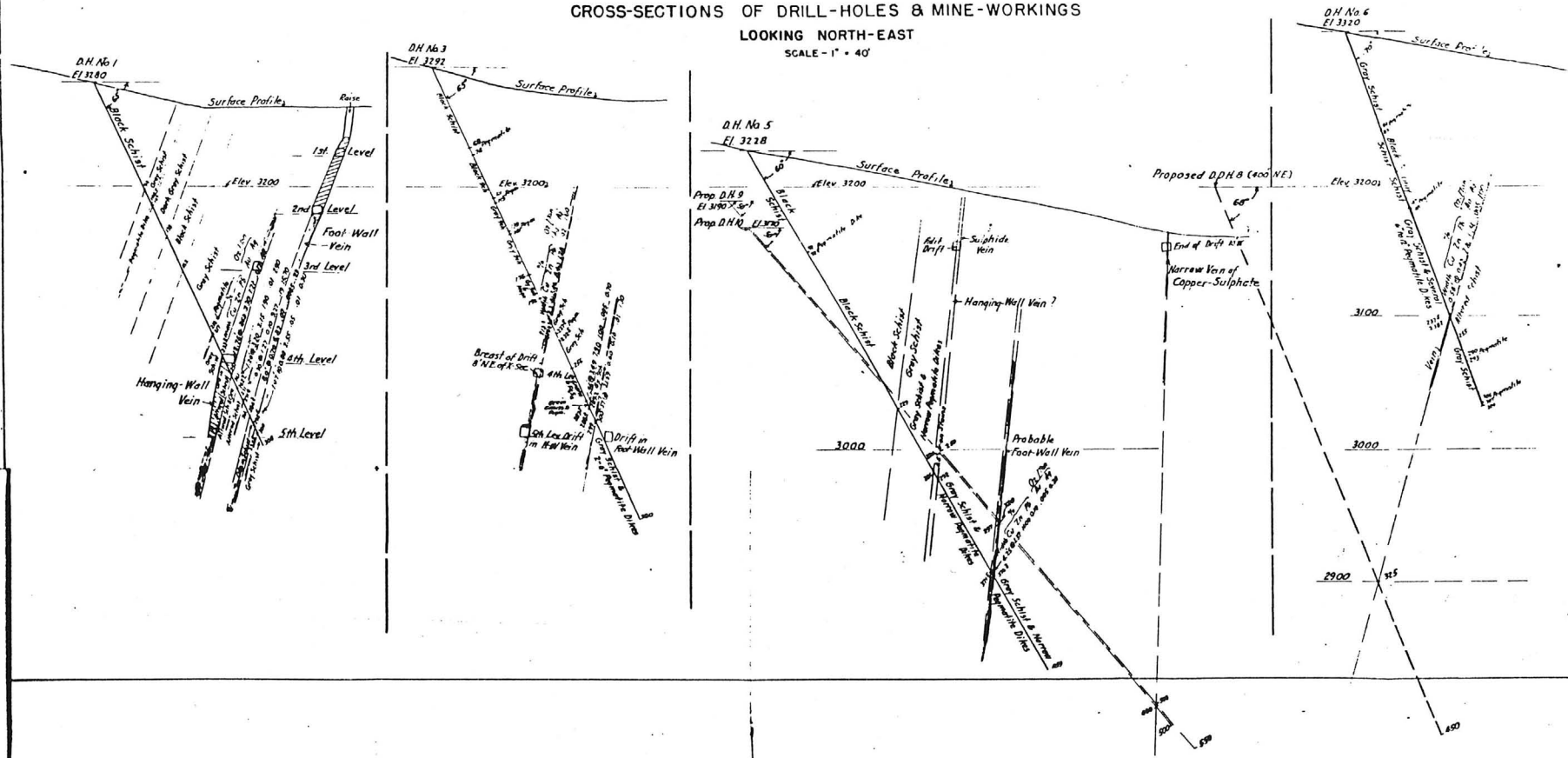
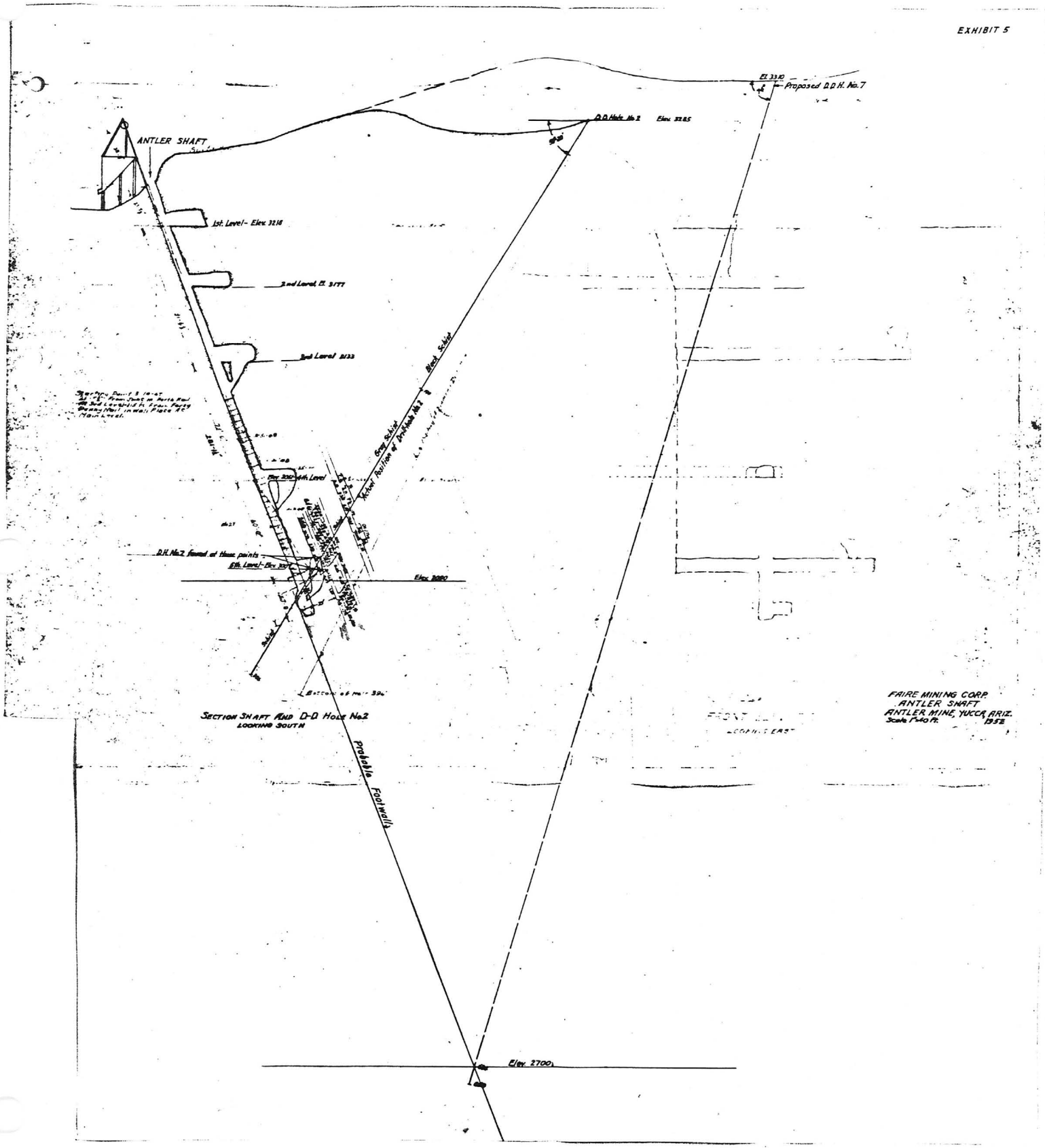
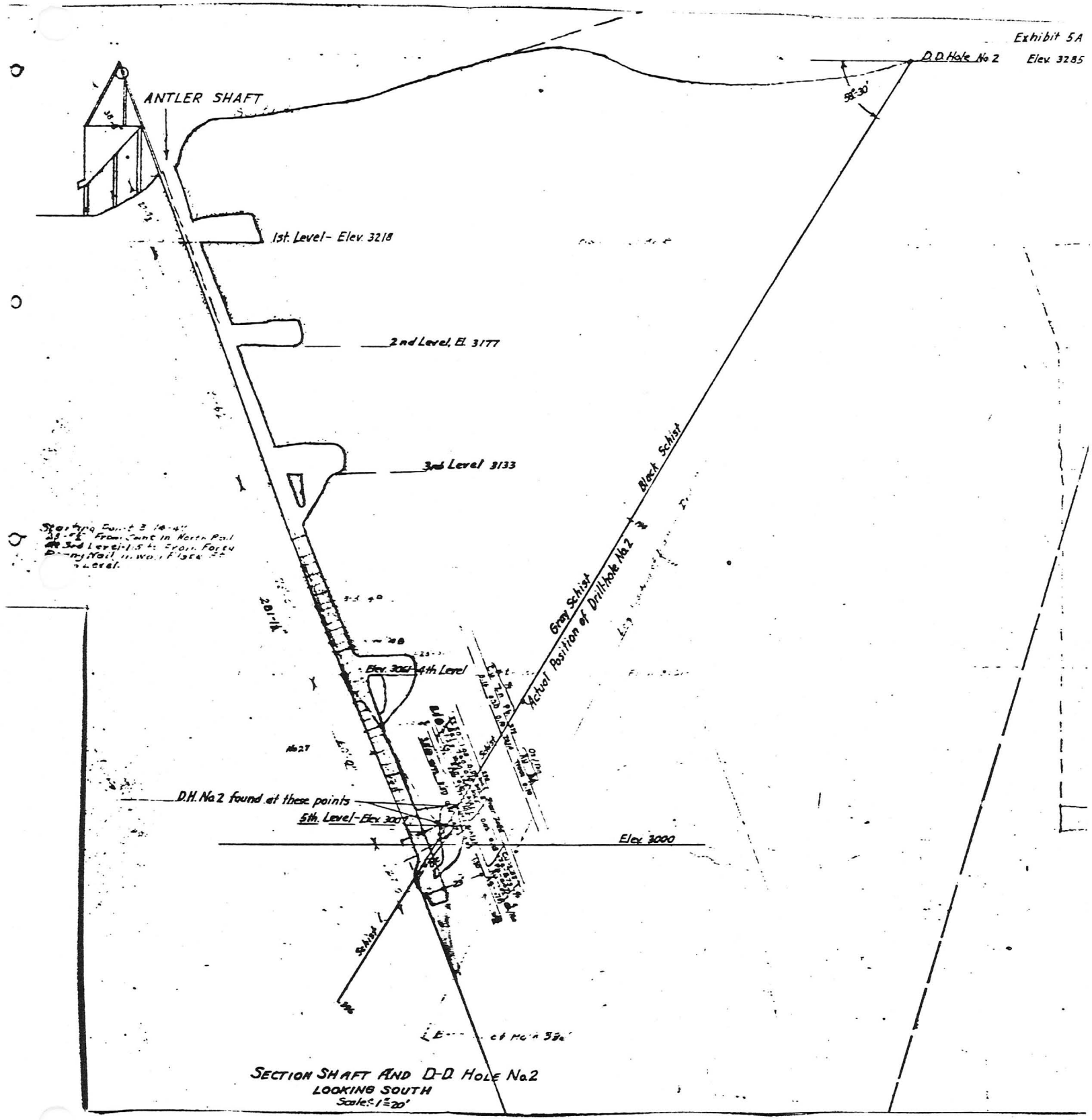


EXHIBIT 5

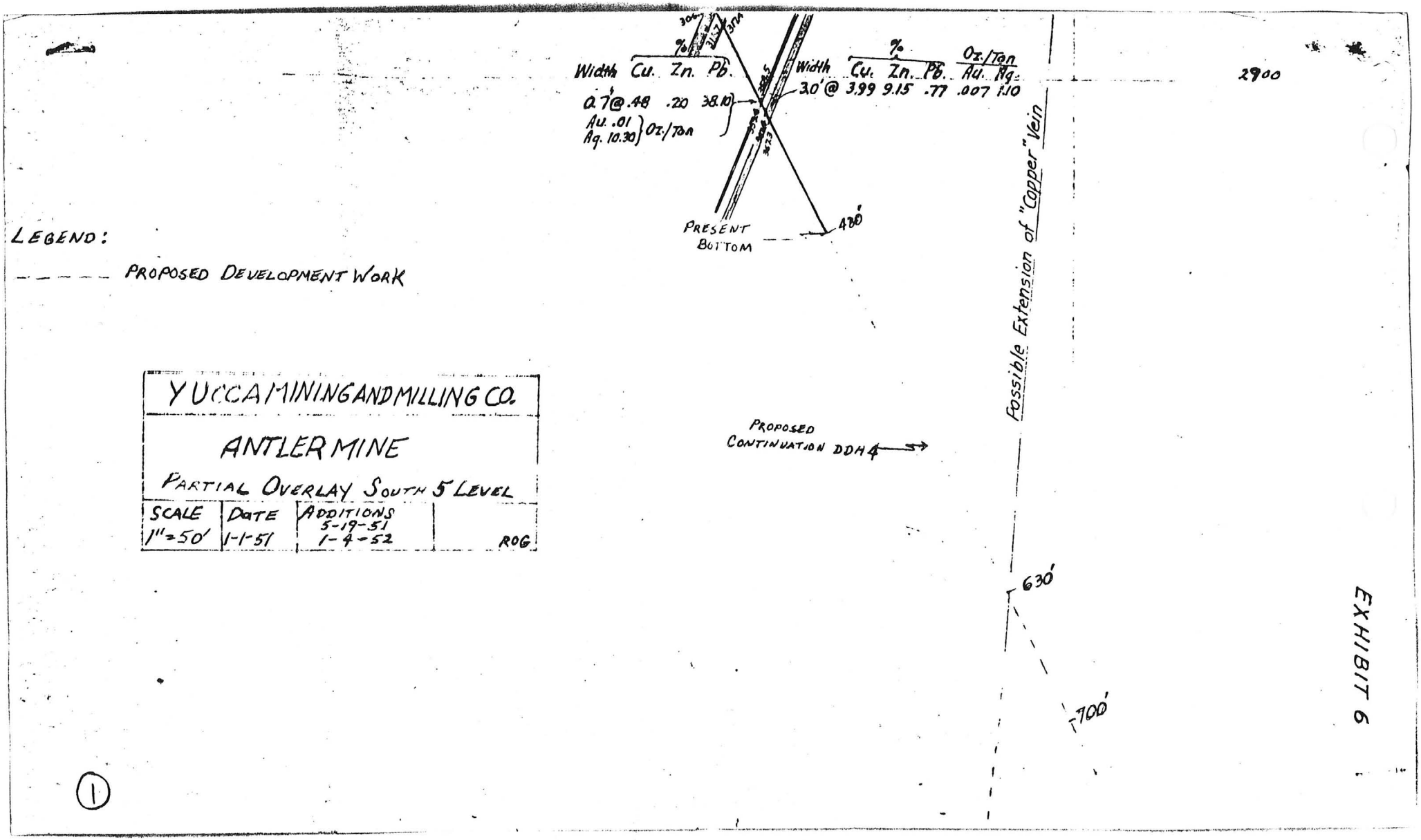


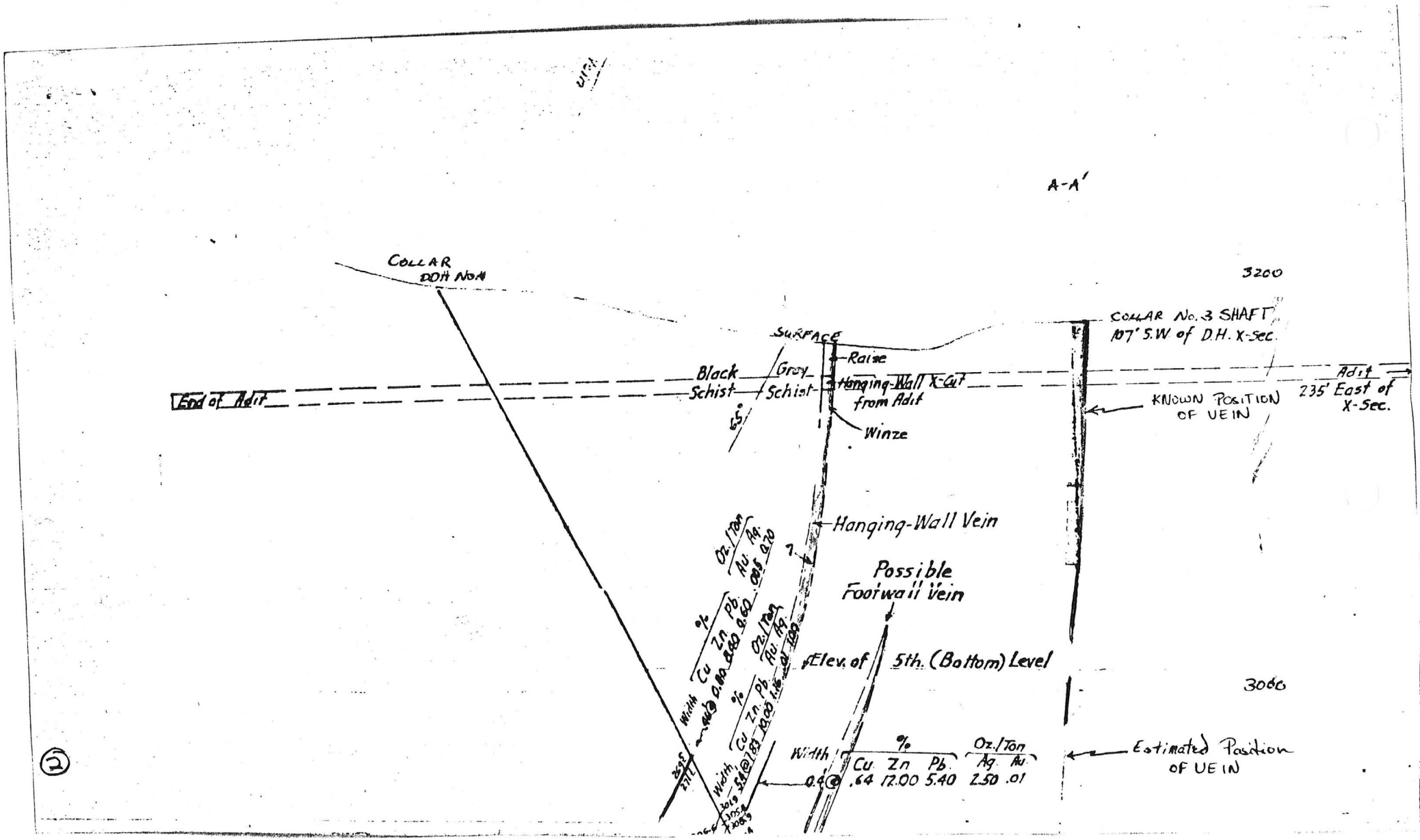
El. 3310
Proposed D.D.H. No. 7
D.D. Hole No. 2
Elev. 3285
ANTLER SHAFT
1st. Level - Elev. 3216
2nd Level El. 3177
3rd Level 3133
Black Schist
Gray Schist
Actual Position of Drillhole No. 2
4th. Level
D.H. No. 2 found at these points
6th. Level - Elev. 3000
Elev. 3080
Bottom of Hole 394'
SECTION SHAFT AND D-D HOLE No. 2
LOOKING SOUTH
Probable Footwall
Elev. 2700
FAIRE MINING CORP.
ANTLER SHAFT
ANTLER MINE, YUCCA, ARIZ.
Scale 1"=40 ft.
1952

Exhibit 5A



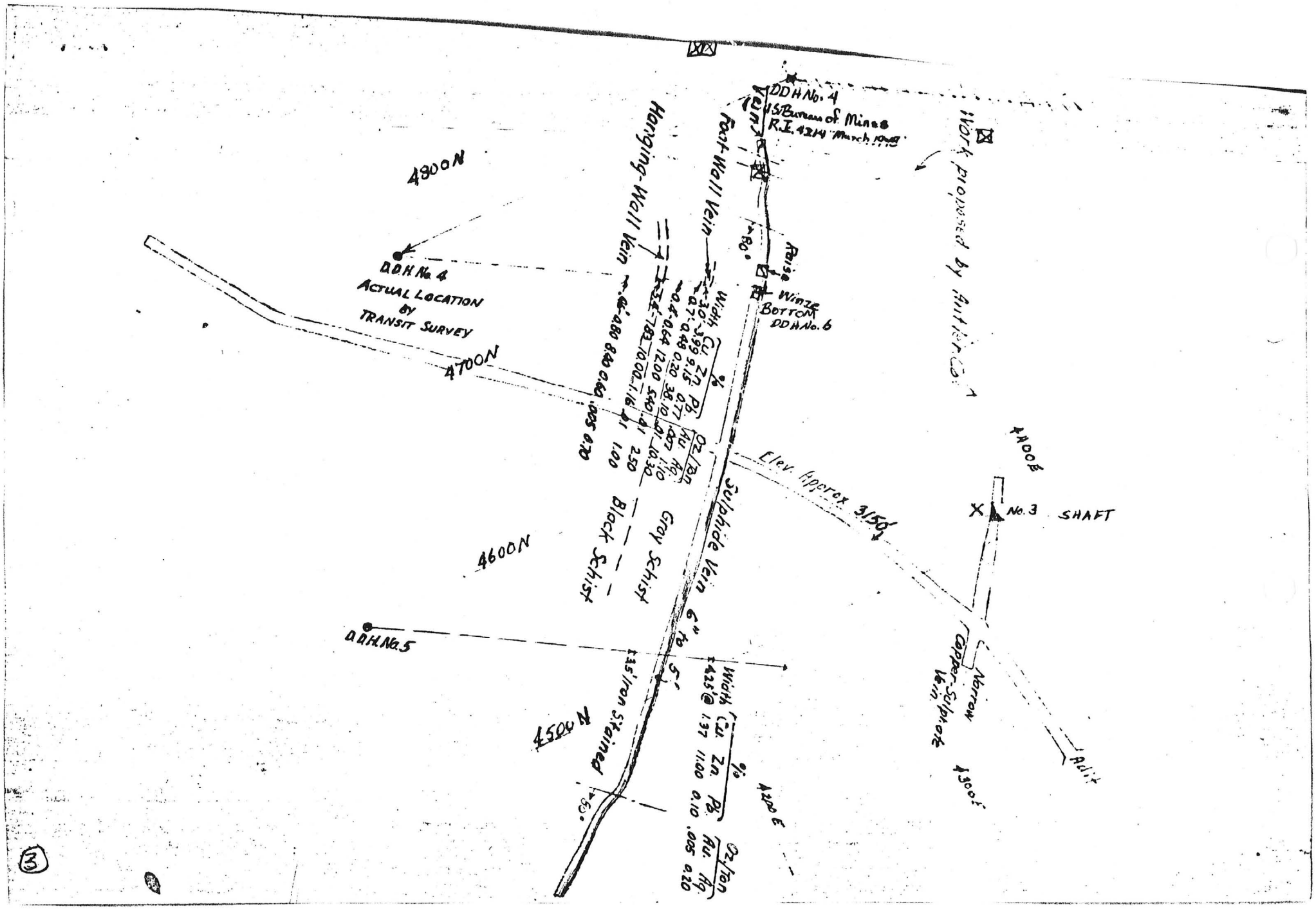
SECTION SHAFT AND D-D HOLE No 2
LOOKING SOUTH
Scale: 1" = 20'


Width Cu. Zn. Pb.
%
0.7'@ .48 .20 38.10
Au. .01
Ag. 10.30 Oz./Ton
Width Cu. Zn. Pb. Au. Ag.
%
Oz./Ton
3.0'@ 3.99 9.15 .77 .007 1.10
2900
PRESENT BOTTOM
420'
Possible Extension of "Copper" Vein
PROPOSED CONTINUATION DDH 4
630'
700'
LEGEND:
PROPOSED DEVELOPMENT WORK
YUCCA MINING AND MILLING CO.
ANTLER MINE
PARTIAL OVERLAY SOUTH 5 LEVEL
SCALE 1"=50'
DATE 1-1-51
ADDITIONS 5-19-51 1-4-52
ROG
EXHIBIT 6
1



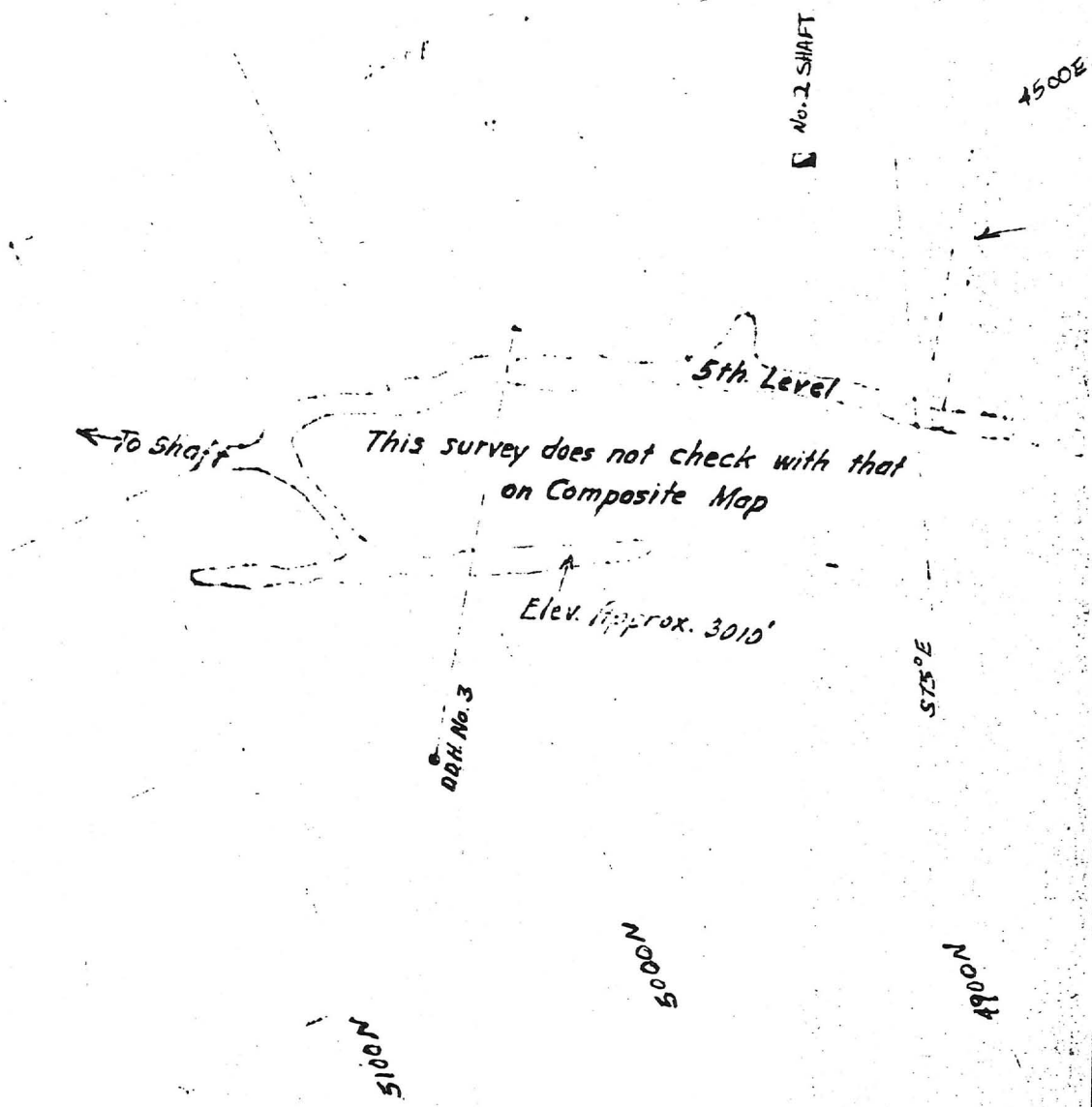
A-A'
COLLAR
DDH No.4
3200
COLLAR No. 3 SHAFT
107' S.W. of D.H. X-Sec.
SURFACE
Raise
Black Schist
Gray Schist
Hanging-Wall X-Cut from Adit
Adit
235' East of X-Sec.
End of Adit
KNOWN POSITION OF VEIN
65°
Winze
Hanging-Wall Vein
Possible Footwall Vein
Elev. of 5th. (Bottom) Level
3060
Width
%
Cu Zn Pb
Oz./Ton
Ag. Au
0.4 @ .64 12.00 5.40 2.50 .01
Estimated Position OF VEIN

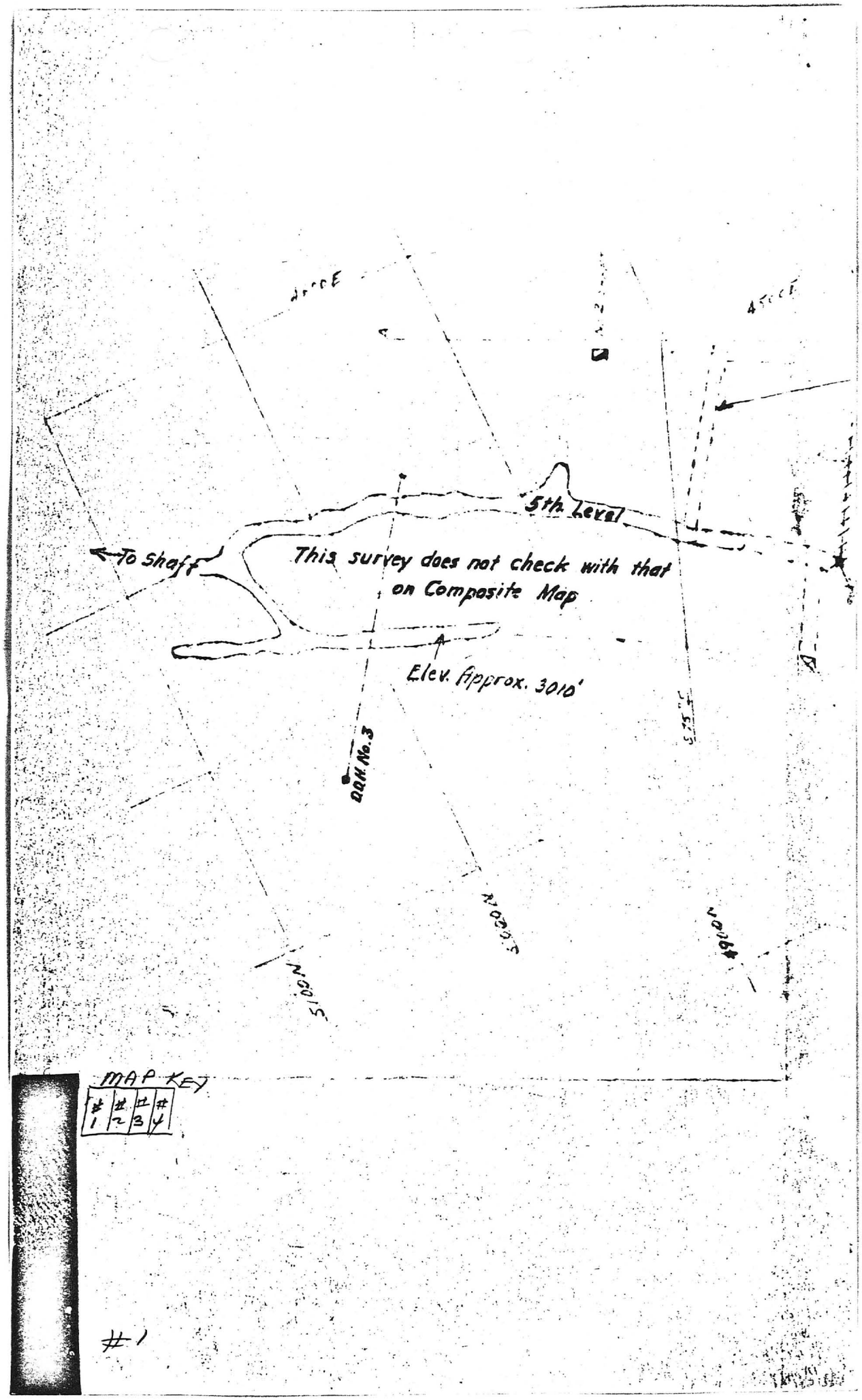
2



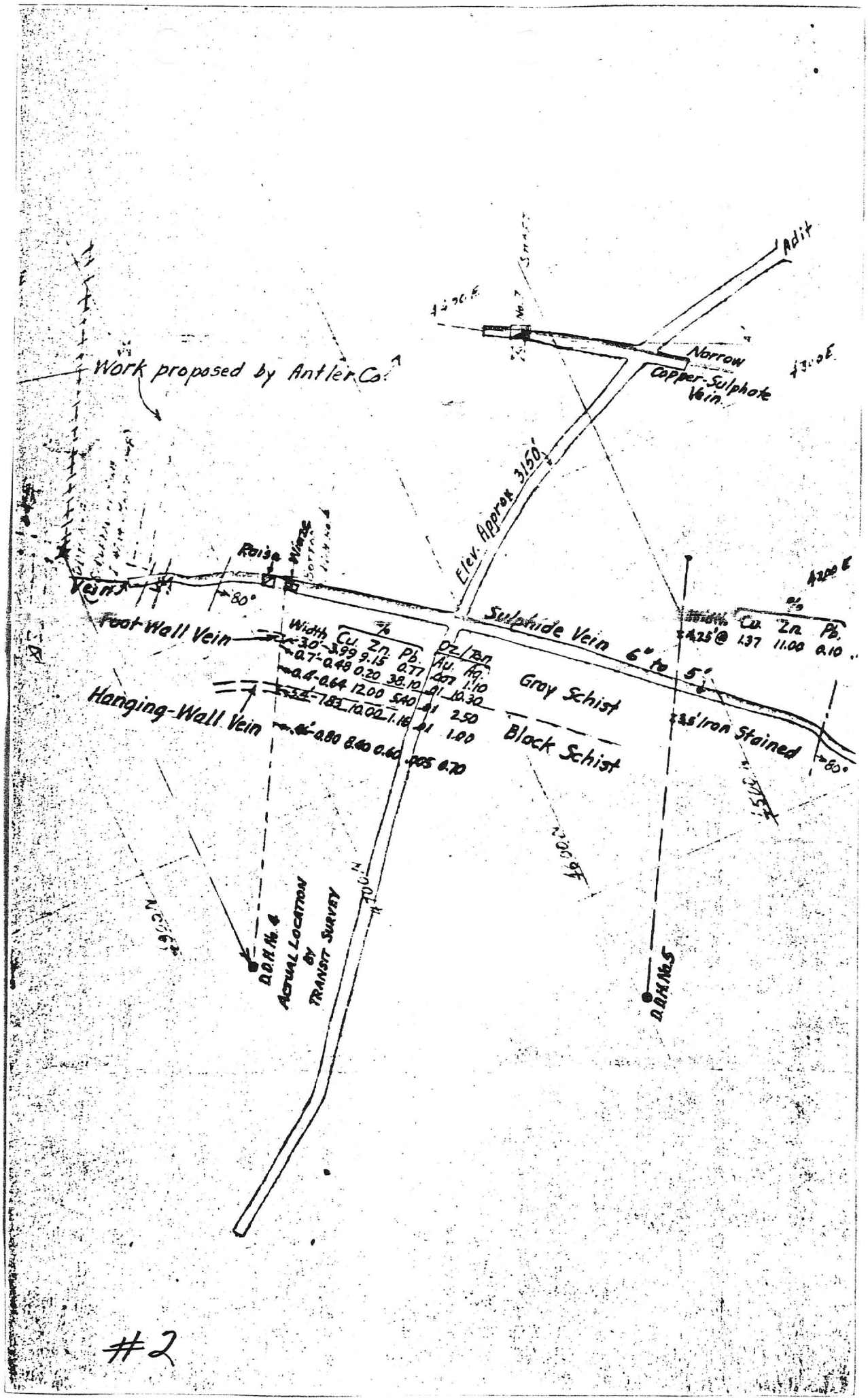
DDH No. 4
U.S. Bureau of Mines
R.I. 4214 March 1948
Work proposed by Antler Co.
Foot-Wall Vein
Hanging-Wall Vein
Raise
Winze
BOTTOM
DDH No. 6
4800N
DDH No. 4
ACTUAL LOCATION
BY
TRANSIT SURVEY
4700N
Elev. Approx 3150'
4400E
No. 3
SHAFT
Sulphide Vein
Gray Schist
Black Schist
4600N
DDH No. 5
Narrow
Copper-Sulphide
Vein
Adit
4300E
4500N
35' Iron Stained
4200E

3


4500E
No. 2 SHAFT
5th Level
To Shaft
This survey does not check with that on Composite Map
Elev. Approx. 3010'
DDH No. 3
S75°E
4900N
5000N
5100N

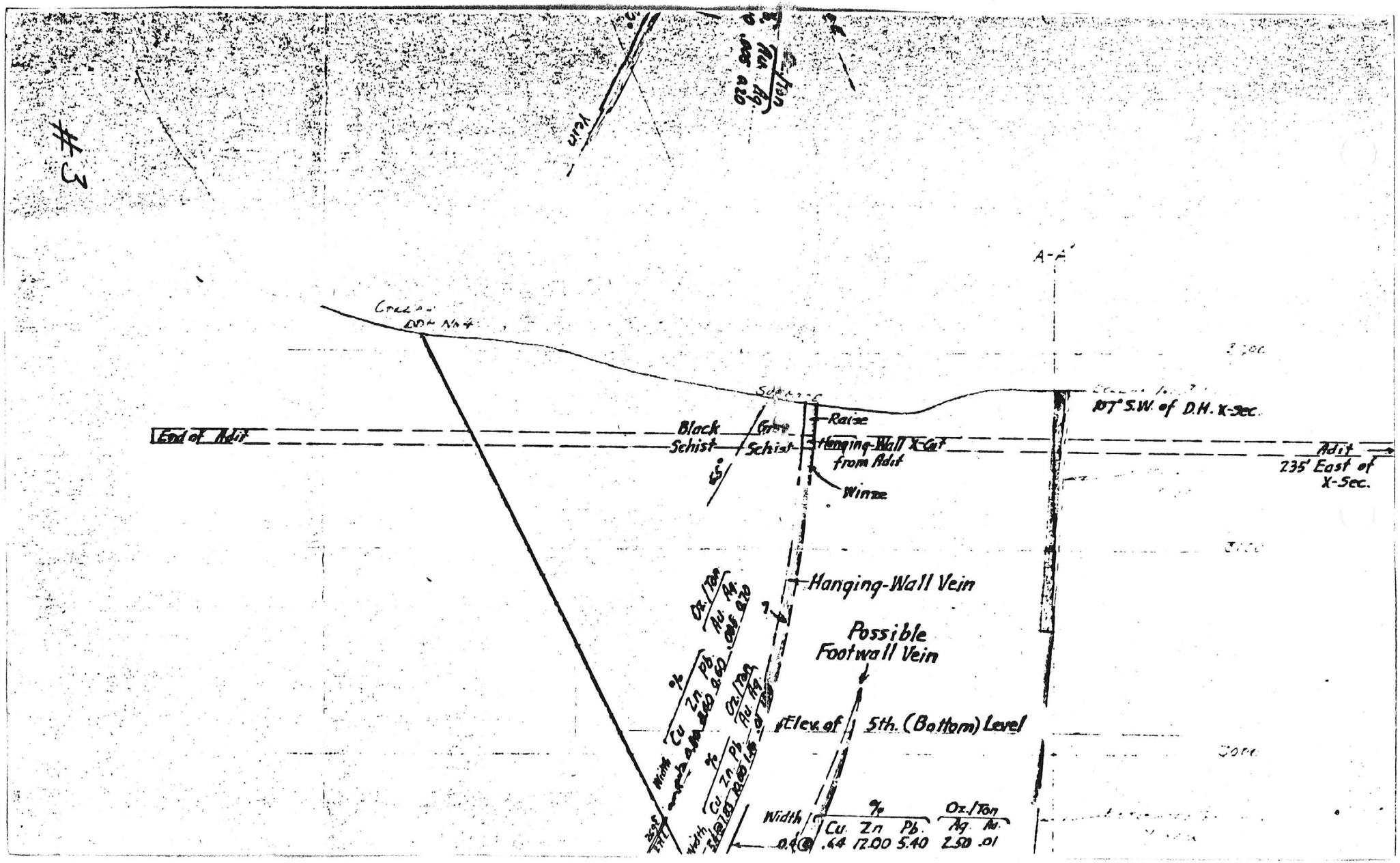

5th Level
To Shaft
This survey does not check with that on Composite Map
Elev. Approx. 3010'
DDH. No. 3
MAP KEY
1
2
3
4

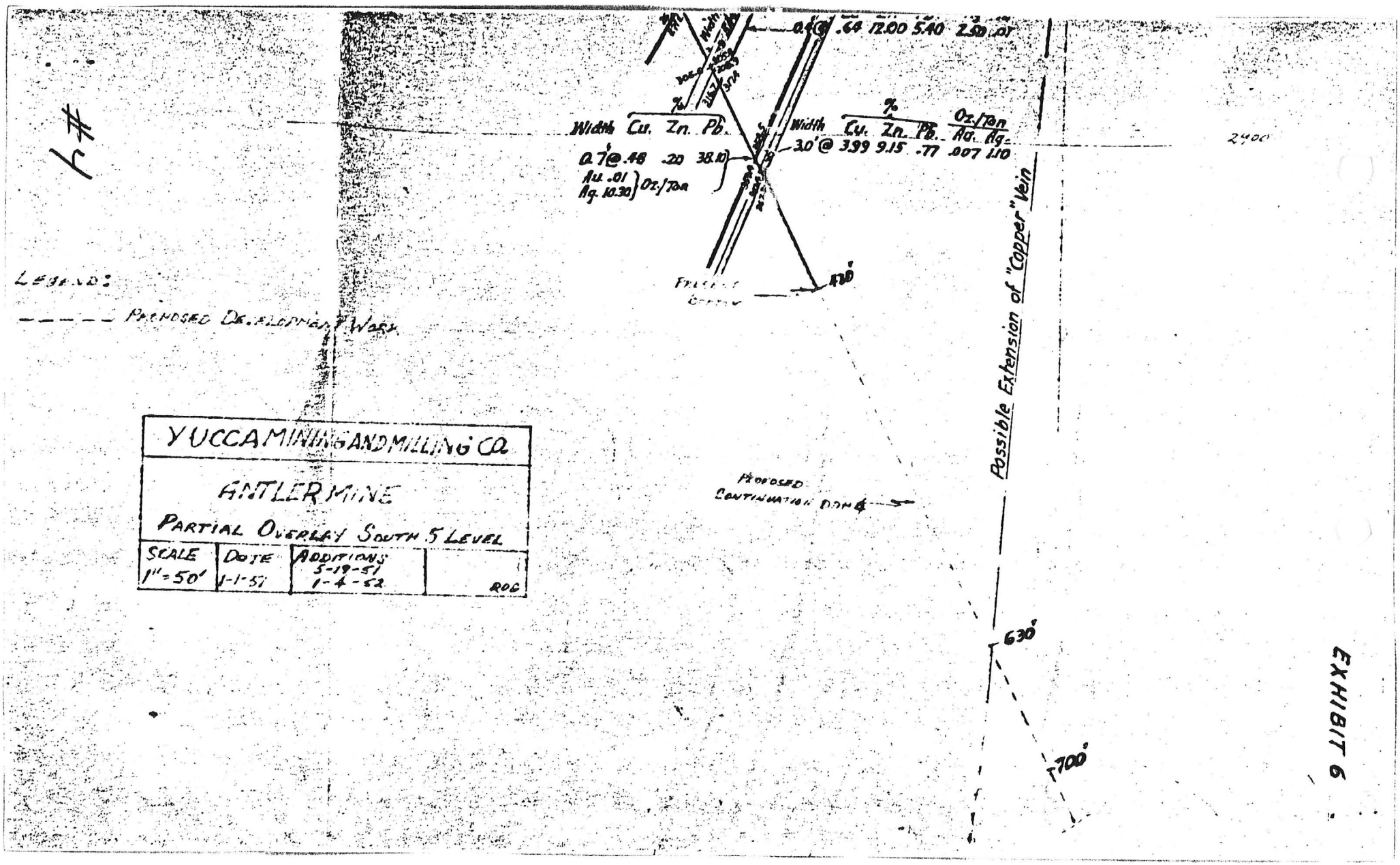
#1



Work proposed by Antler Co.
Adit
Narrow Copper-Sulphate Vein
Elev. Approx 3150'
Raise
Vein
80°
Foot Wall Vein
Hanging-Wall Vein
Sulphide Vein 6" to 5'
Gray Schist
Black Schist
Iron Stained
Width Cu. Zn. Pb.
3.0'-3.99 9.15 0.77
0.7'-0.48 0.20 38.10
0.4-0.64 12.00 5.40
1.83 10.00 1.16
0.80 8.40 0.60 .005 0.70
Oz/Ton Au. Ag.
.007 1.10
.01 10.30
.01 2.50
.01 1.00
4.25'@ 1.37 11.00 0.10
D.D.H. No. 4
ACTUAL LOCATION BY TRANSIT SURVEY
D.D.H. No. 5

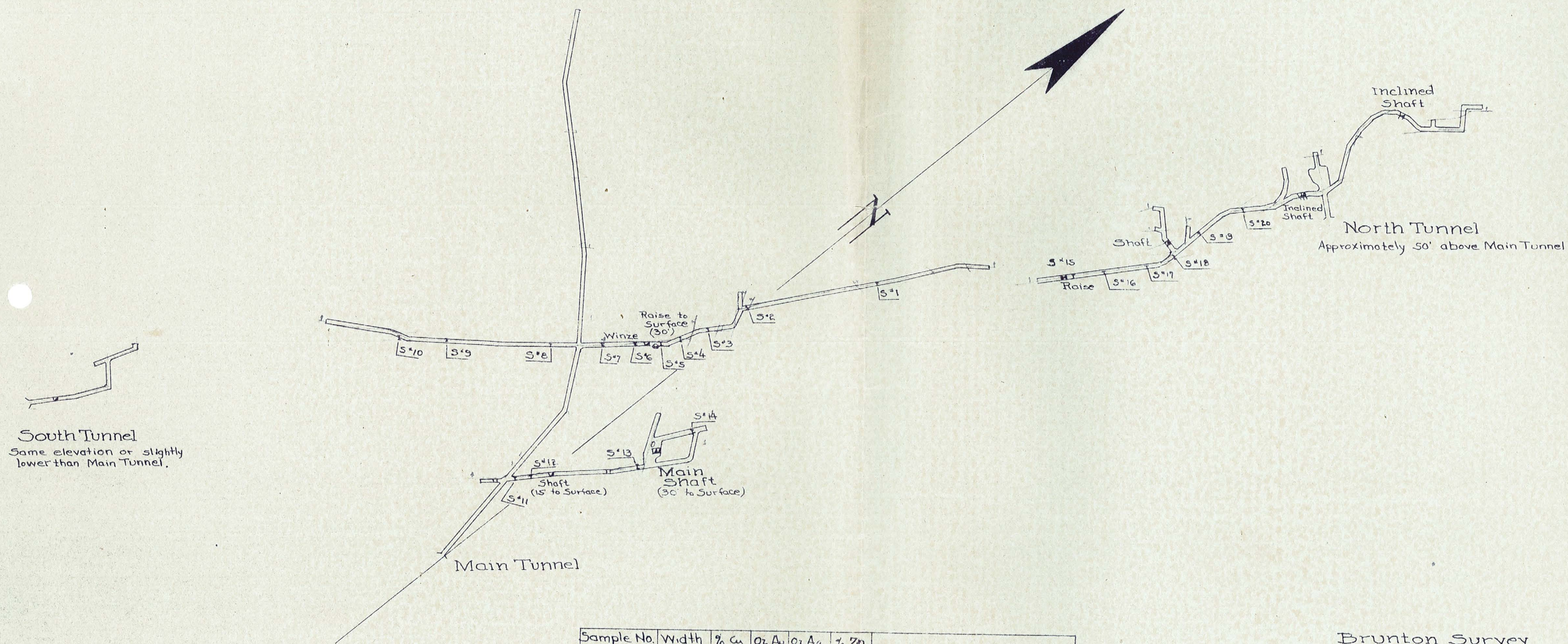
#2


#3
Vein
Oz./Ton
Au. Ag.
.005 0.20
A-A'
107° S.W. of D.H. X-Sec.
End of Adit
Black Schist
Grey Schist
Raise
Hanging-Wall X-Cut from Adit
Winze
Adit
235' East of X-Sec.
Hanging-Wall Vein
Possible Footwall Vein
Elev. of 5th. (Bottom) Level
Width
%
Cu. Zn Pb.
Oz./Ton
Ag. Au.
.64 12.00 5.40 2.50 .01


Width Cu. Zn. Pb.
0.7' @ .48 .20 38.10
Au .01
Ag. 10.30 Oz./Ton
Width % Cu. Zn. Pb. Oz./Ton Au. Ag.
3.0' @ 3.99 9.15 .77 .007 1.10
0.4' @ .64 12.00 5.40 2.50 .07
2400
420'
Possible Extension of "Copper" Vein
Proposed Continuation D.D.H. #4
630'
700'
LEGEND:
Proposed Development Work
YUCCA MINING AND MILLING CO.
ANTLER MINE
PARTIAL OVERLAY SOUTH 5 LEVEL
SCALE 1" = 50'
DATE 1-1-51
ADDITIONS 5-19-51 1-4-52
ROG
#4
EXHIBIT 6

Sample No.	Width	% Cu	Oz Au	Oz Ag	% Zn	
1	4"	-	Nil	.16	-	Part of stringer vein
2	6"	-	Tr	2.24	-	Quartz Lense
3	5"	8.52	.01	1.76	-	Oxidized Cu stain
4	6"	2.93	Tr	.92	7.4	Black metallics, Qtz gangue
5	22"	3.32	.02	2.28	-	Qtz and alt. sch with sulphide. W.- Nil
6	21"	6.80	.01	2.20	9.1	Alt. sch with sulphates
7	20"	10.82	.02	1.80	14.9	Best part 50' sulphide lense

Sample No.	Width	% Cu	Oz Au	Oz Ag	% Zn	
8	24"	6.52	.01	1.52	9.8	Best part 30' sulphide lense
9	12"					Qtz vein WO3 Tr
10	12"					No returns
11	16"	1.40	Tr	.76	-	Center S'Vein, Cu stain limonite
12	10"	24.40	.01	1.08	-	Hanging Wall streak, partly sulphate
13	24"	3.00	Nil	.60	-	Loose limonite, Cu stain in hanging wal
14	25"	10.60	Nil	.28	-	Hard limonite with Cu stain.



Sample No.	Width	% Cu	Oz Au	Oz Ag	% Zn	
15	6"	11.60	Nil	.28	-	Highgrade streak, 4' Vein
16	17"	3.15	Nil	.60	2.7	Sulphide
17	24"	2.01	Tr	1.28	11.4	Sulphide
18	7"	27.6	Tr	1.76	20.6	Sulphide vein
19	25"	9.75	Tr	1.48	6.7	Sulphide
20	15"	10.59	.01	1.98	11.2	Sulphide, quartz & Schist

Brunton Survey

ANTLER MINE

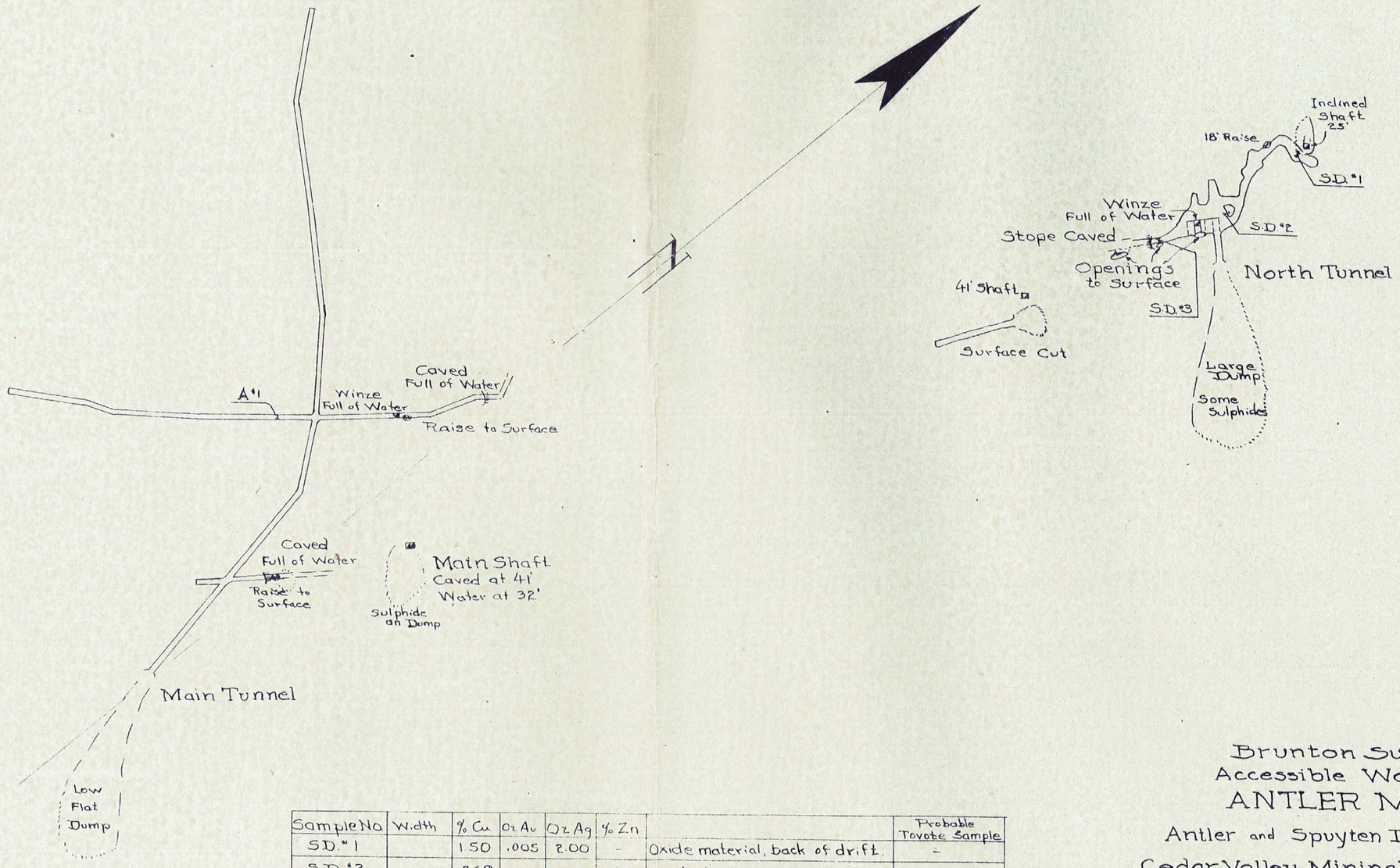
Antler and Spuyten Duyvil Claims

Cedar Valley Mining Dist. Mohave Co.

1" = 100'

August 23, 1916 W. Tovote

(Traced from original sketch 9-3-42) PFY



Sample No.	Width	% Cu	Oz Au	Oz Ag	% Zn		Probable Tovote Sample
S.D. #1		1.50	.005	2.00	-	Oxide material, back of drift.	-
S.D. #2		7.69	-	-	98	Leached material, Abundant sulphates	-
S.D. #3	4'	3.73	.01	1.04	12.9	Siliceous sulphide Vein	S #20
A #1	1½'	8.12	.02	.88	-	Carbonate ore - Vein	S #8

Brunton Survey
Accessible Workings
ANTLER MINE
Antler and Spuyten Duyvil Claims
Cedar Valley Mining Dist. Mohave Co.
1" = 100'

August 17, 1942

C.E. Mills, R.F. Yates