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Phoenix, AZ 85007
602-771-1601
http://www.azgs.az.gov
inquiries@azgs.az.gov

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Arizona Department of Mines and Mineral Resources Mining Collection

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PRINTED: 03-01-2013

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES AZMILS DATA

previously Helvetia East

PRIMARY NAME: ROSEMONT

ALTERNATE NAMES:
HELVETIA-ROSEMONT
HELVETIA EAST
EAST HELVETIA

PIMA COUNTY MILS NUMBER: 866

LOCATION: TOWNSHIP 18 S RANGE 15 E SECTION 36 QUARTER NE
LATITUDE: N 31DEG 49MIN 57SEC LONGITUDE: W 110DEG 45MIN 29SEC
TOPO MAP NAME: SAHUARITA - 15 MIN

CURRENT STATUS: EXP PROSPECT

COMMODITY:
COPPER SULFIDE
COPPER OXIDE
SILVER
MOLYBDENUM SULFIDE
GOLD
STONE MARBLE
CALCIUM MARBLE

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HELVETIA MINING & MILLING CO.

PIMA COUNTY

HELVETIA DIST.
T18S, R16E, Sec 19

USGS Bull. 1027 p. 315

RI 5650 p. 109

Gunsight Project (file)

SEE: ABM # 148 p. 36

Anamax (file) ACTIVE FILE

MAPS - Upstairs in the ABM rolled file boxes - Under Helvetia Copper co. - shows underground plans for Isle Royal, Copper World, Old Dick and Leader plus several smaller working on individual claims.

USGS Bul. 582 - several places in bulletin - p. 25, 98, 99, 110, 115, [illegible]

USGS Bul. 430 - pl 154

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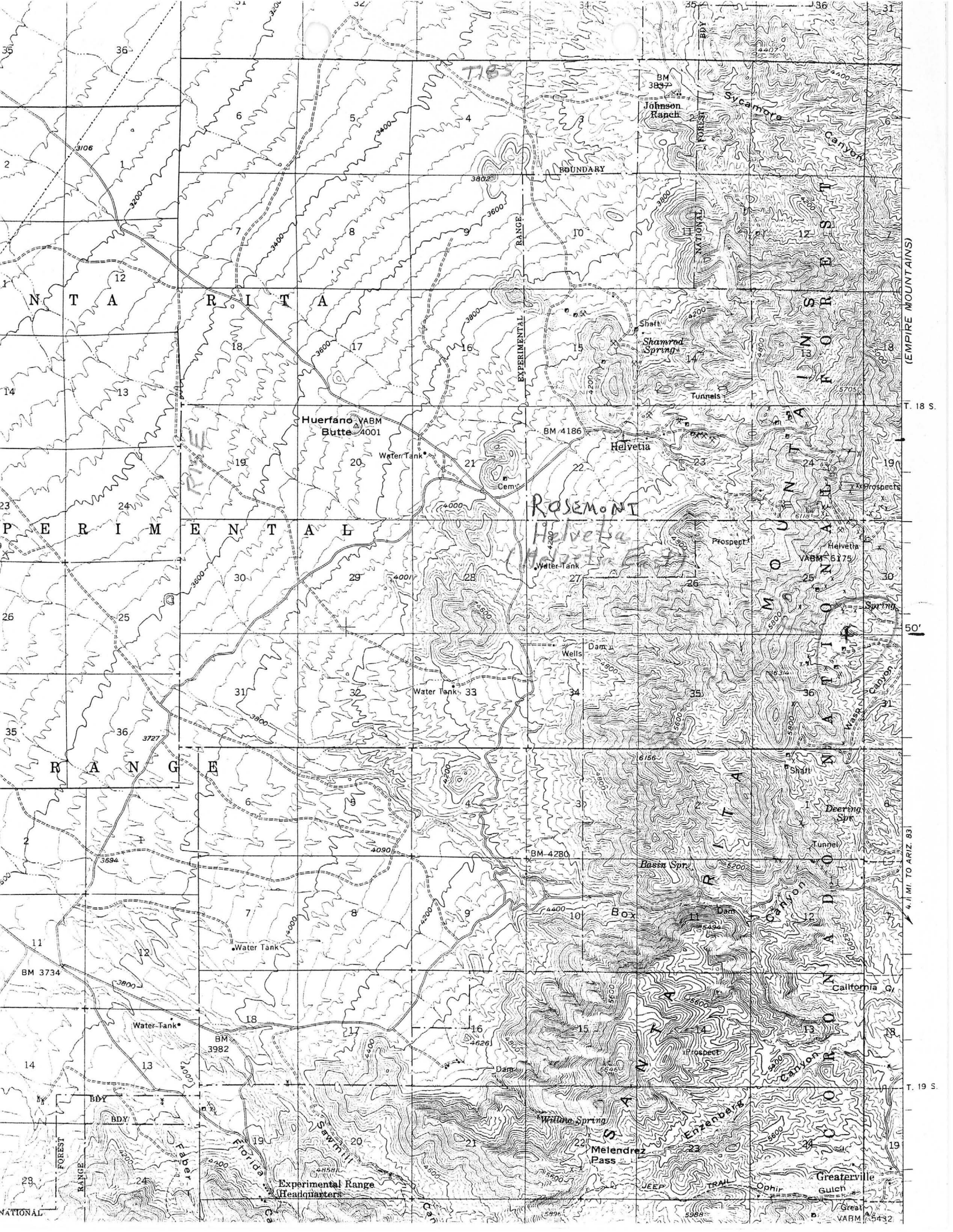
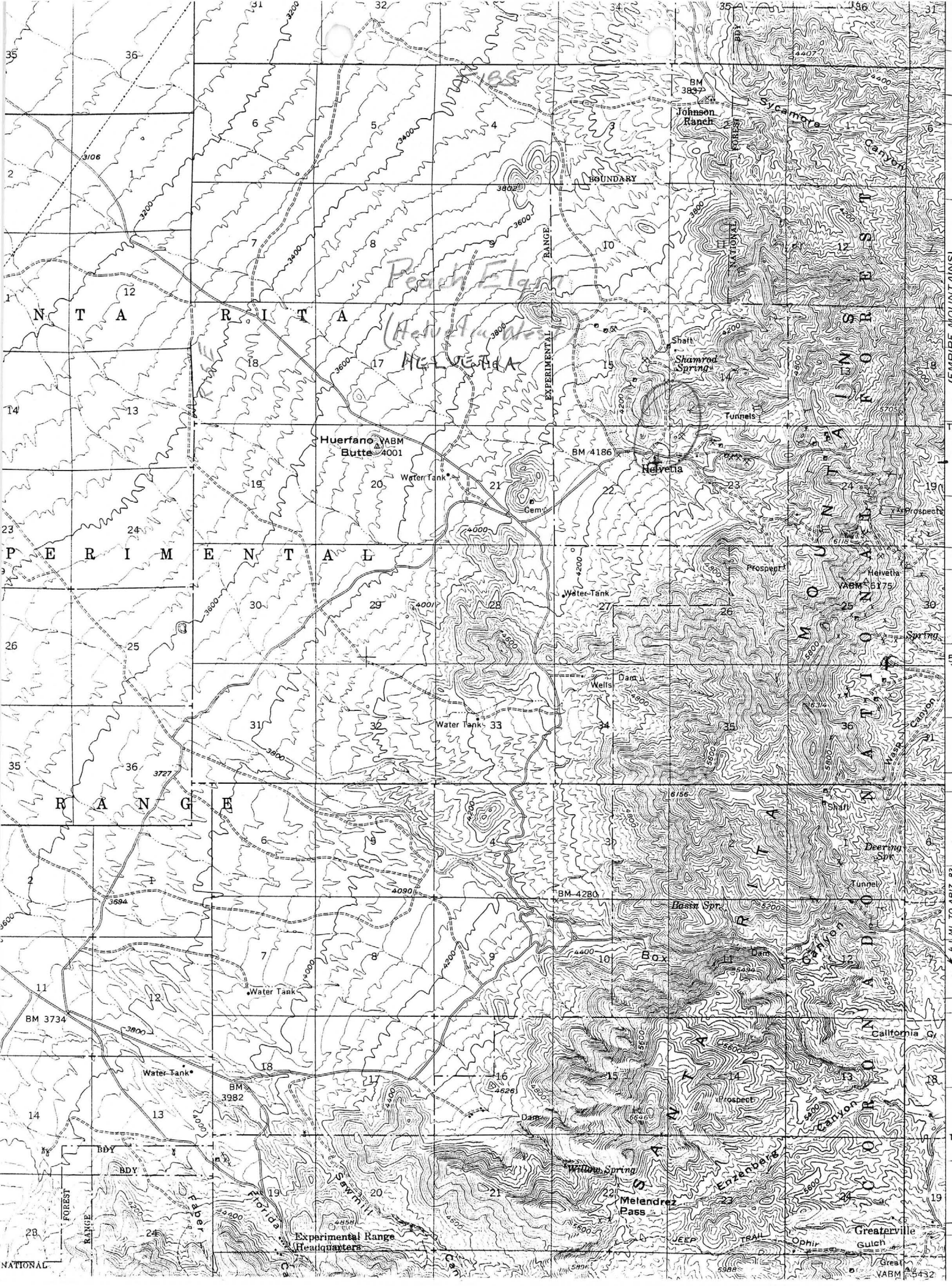


T18S
BM 3837
Johnson Ranch
Sycamore Canyon
BOUNDARY
NATIONAL FOREST BDY
EXPERIMENTAL RANGE
N T A R I T A
P E R I M E N T A L
R A N G E
Shaft
Shamrod Spring
Tunnels
Huerfano Butte
VABM 4001
BM 4186
Helvetia
Water Tank
Cem
ROSEMONT
Helvetia
(Helvetia East)
Prospect
Helvetia
VABM 6175
Spring
Wells
Dam
Water Tank
Wasp Canyon
Shaft
Deering Spr
Tunnel
BM 4280
Basin Spr
Box Canyon
Dam
Water Tank
BM 3734
California Gl
Water Tank
BM 3982
Prospect
Dam
Willow Spring
Enzenberg Canyon
Melendrez Pass
Sawmill
Florida
Faber
Experimental Range Headquarters
Greaterville
Ophir Gulch
JEEP TRAIL
Great
VABM 5432
(EMPIRE MOUNTAINS)
T. 18 S.
T. 19 S.
50'
4.1 MI. TO ARIZ. 83



Peach Elgin
(Helvetia West)
HELVETIA
T18S
R16E
Johnson Ranch
Sycamore Canyon
BOUNDARY
EXPERIMENTAL RANGE
NATIONAL FOREST BDY
Shaft
Shamrod Spring
Tunnels
Huerfano Butte
VABM 4001
BM 4186
Helvetia
Water Tank
Cem
Prospects
Prospect
Helvetia
VABM 6175
Spring
Wells
Dam
Water Tank
Wasp Canyon
Shaft
Deering Spr
Tunnel
BM 4280
Basin Spr
Box Canyon
Dam
Water Tank
BM 3734
California Gl
Water Tank
BM 3982
Prospect
Dam
Willow Spring
Enzenberg Canyon
Melendrez Pass
Sawmill Canyon
Florida Canyon
Faber
Experimental Range Headquarters
JEEP TRAIL
Ophir Gulch
Greaterville
Great
VABM 5432
T. 18 S.
T. 19 S.
50'
4.1 MI. TO ARIZ. 83
(EMPIRE MOUNTAINS)
NATIONAL FOREST
SANTA RITA MOUNTAINS
CORONADO NATIONAL FOREST

HELVETIA PIMA COUNTY

HEM WR 12/4/87: Mr. Harold Metz of Genesis Real Estate & Development Co., Tucson, was contacted by phone regarding his company's listing for sale of the Helvetia (file) copper deposit. Mr. Metz stated that not only was the Helvetia (Rosemont) deposit for sale, but also the Peach-Elgin and the Broadtop Butte deposits. The asking price for the package is $6 million without a royalty agreement. Data on the deposits may be available for the department's files-subject to approval by the owner. Further discussions are planned.

MG WR 3/4/88: The Helvetia copper deposit (file) Pima County, including the Peach Elgin, is owned by Lauderback & Peoneer Trust No. 11778, Tucson, Arizona. Genesis Real Estate Co has an exclusive sales contract for the property; contact Mr. Harold Metz, 325-5932. At present a potential buyer (ASARCO?) has a 45 day option.

MG WR 6/24/88: It has been reported that ASARCO (file) is purchasing the Helvetia copper deposit (file) Pima County. Thus purchase would include the Peach Elgin deposit.

NJN WR 7/22/88: Susan Howell, Bur of M, reported that Palo Seco owns the area to the west that was to be the millsite for the Helvetia Mine (file) Pima Co. This area is currently being sold as ranchettes in parcels of 40 acres. The Cienga and Empire Ranches which were to have been the water surces for the mine now belong to the BLM through land exchanges eith private parties.

~~LEADER MINE~~ PIMA COUNTY

D. G. Chilson Copper

Visited sometime in 1946 by Truman H. Kuhn
Copper, some molybdenum, tungsten is known to exist but no production reported. For this report only the tunnel level could be examined and it was not possible to estimate probable ore. However, several promising areas are suggested for exploration and development.

Banner Mining Company, Box 5605, Tucson, Arizona, has option to purchase this property. 9-6-61

Banner's Helvetia copper molybdenum deposits 20 miles east of Twin Buttes appears to be quite extensive though deeper and of lower grade than Twin Buttes, says Allan Bowman, general manager of Banner Mining Co. Denver Record 6-19-69

NJN WR 12/12/86: Hilton Cass (c) Forest Service Zone Office, provided copes of claim maps of the claims that Anamax tried to patent at Helvetia (file) Pima County and a brief description of the geology on them. These will be added to the files.

NJN WR 12/19/87: Provided general information on the Helvetia deposit (file) Pima County to Mr. Dan Aiken of Cyprus Sierrita. Cyprus Minerals (card) is reviewing data on the property becuase it is considering purchase.

Arizona Copper Reseves and Resources

Compiled by the Arizona Dept. Mines and Mineral Resources

Printed: 1/28/2005
Last Updated: 1/ 3/2005

HELVETIA

Alternate name(s):

Helvetia East (866), Rosemont

Company:

Asarco Inc.
2575 E. Camelback Road, Suite 500
Phoenix, AZ 85016-4240
602-977-6500
www.asarco.com

Location:

Township 18 S Range 15 E Sec. 36
Latitude/Longitude: 31.85 110.75
Twenty miles south of Tucson, west slope Santa Ritas.

Mineralization type and reserve/resource:

Type	Tons (millions)	Grade (%)	
Sulfide	362	0.61	CU
Acid Soluble	66	0.53	Cu

Reserve information and sources:

Sulfide reserve includes 0.25 oz/ton Ag.
Also includes 0.016% Mo & 0.0005 oz/ton Au. (Dresher, T.A., 1979)
Anzalone, S.A. and Brown, R.L., 1992, Geology of the Helvetia Copper Deposit - Arizona, SME Preprint 92-61.

Comments:

Additional mineralization occurs in Broadtop Butte and Copperworld areas. Total mineralization likely exceeds 500 MM tons. Land exchange process underway 1997. Reported sold to Rosemont ranch LLC in 2004. Group holds unpat. claims and patented land.

RH

03/03/94

ARIZONA COPPER RESERVES

COMPILED BY

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES

PROPERTY:

HELVETIA

ALSO KNOWN AS - Helvetia East (866)

OPERATOR\OWNER:

Asarco Inc.
180 Maiden Lane
New York, NY 10038
212-510-2000

LOCATION INFORMATION:

TOWNSHIP 18 S RANGE 15 E SECTION 36
COUNTY - Pima AZMILS - 499
DESCRIPTION - Twenty miles SE of Tucson in Santa Rita Mtns.

ORE TYPE AND RESERVE INFORMATION:

Sulfide - 362 MILLION TONS AT 0.61% Cu
Acid Soluble - 66 MILLION TONS AT 0.53% Cu

RESERVE INFO. - Sulfide reserve includes 0.25 oz/ton Ag.
RESERVE INFO. - Also includes 0.016% Mo and 0.0005 oz/ton Au. (Dresher, T.A., 1979)

SOURCES:

SME Preprint 92-61, Geology of the Helvetia Copper Deposit - Ariz
ona, Anzalone, S.A. and Brown, R.L.

COMMENTS:

Additional mineralization occurs in Broadtop Butte and Copperworl
d areas. Total mineralization likely exceeds 500 MM tons.

03/02/94

ARIZONA COPPER RESERVES

COMPILED BY

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES

PROPERTY:

HELVETIA

ALSO KNOWN AS - Helvetia East (866)

OPERATOR\OWNER:

Asarco Inc.
180 Maiden Lane
New York, NY 10038
212-510-2000

LOCATION INFORMATION:

TOWNSHIP 18 S RANGE 15 E SECTION 36
COUNTY - Pima AZMILS - 499
DESCRIPTION - Twenty miles SE of Tucson in Santa Rita Mtns.

ORE TYPE AND RESERVE INFORMATION:

Sulfide - 337 MILLION TONS AT 0.54% Cu
Acid Soluble - 22 MILLION TONS AT 0.55% Cu

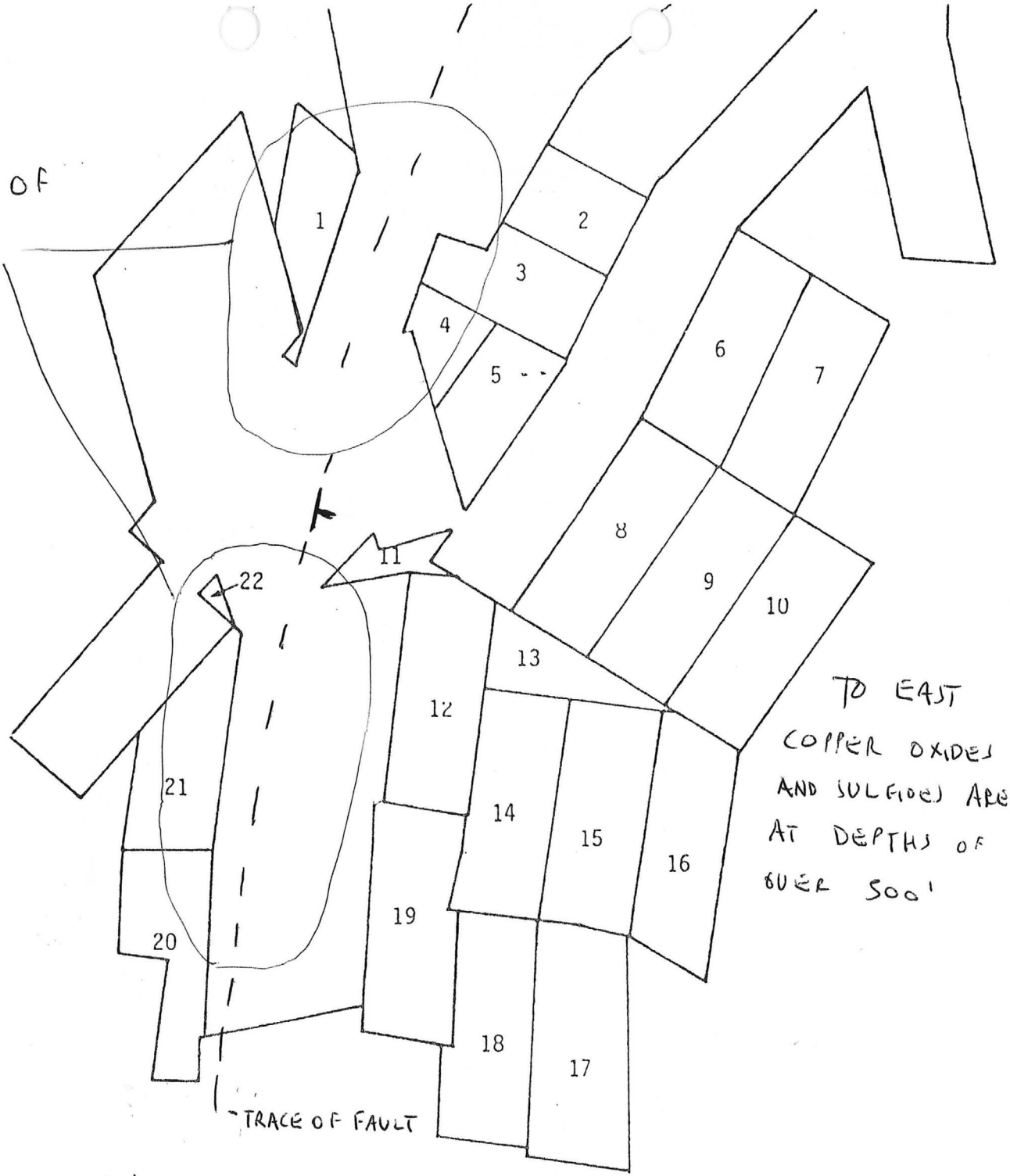
RESERVE INFO. - Sulfide - 0.088 oz/ton Ag, 0.0005 oz/ton Au

SOURCES:

Drescher, T.A. "Deposit Summary Report Helvetia East Deposit" Apr
il 1979 pg 11 ADMMR Helvetia file

COMMENTS:

Purchased by Asarco in 1988 for $1 million cash and 1200 acres of
Non-mineral land. (Peach Elgin included) "Metals Week", Aug 29, 1988 pg
1 gave sulfide - 280 million tons at 0.62% Cu; 0.016% Mo, Acid Soluble
- 23 million tons at 0.78% Cu



CLAIMS ANAMAX ATTEMPTED TO PATENT IN EARLY 1980'S

Patent Appl'n, Mining Claims

1. Falls No.2
2. Tailor
3. Merchant
4. Wedge No.2
5. Wedge
6. Santa Rita #4
7. Santa Rita #5
8. Santa Rita #8-A
9. Santa Rita #9
10. Santa Rita #10
11. Santa Rita Fraction
12. Santa Rita #12
13. Santa Rita #13
14. Santa Rita #14
15. Santa Rita #15
16. Santa Rita #16
17. Santa Rita #28
18. Santa Rita #27
19. Santa Rita #26
20. Last Chance No.2
21. Last Chance No.1
22. Cushing Fraction

Patented Lands

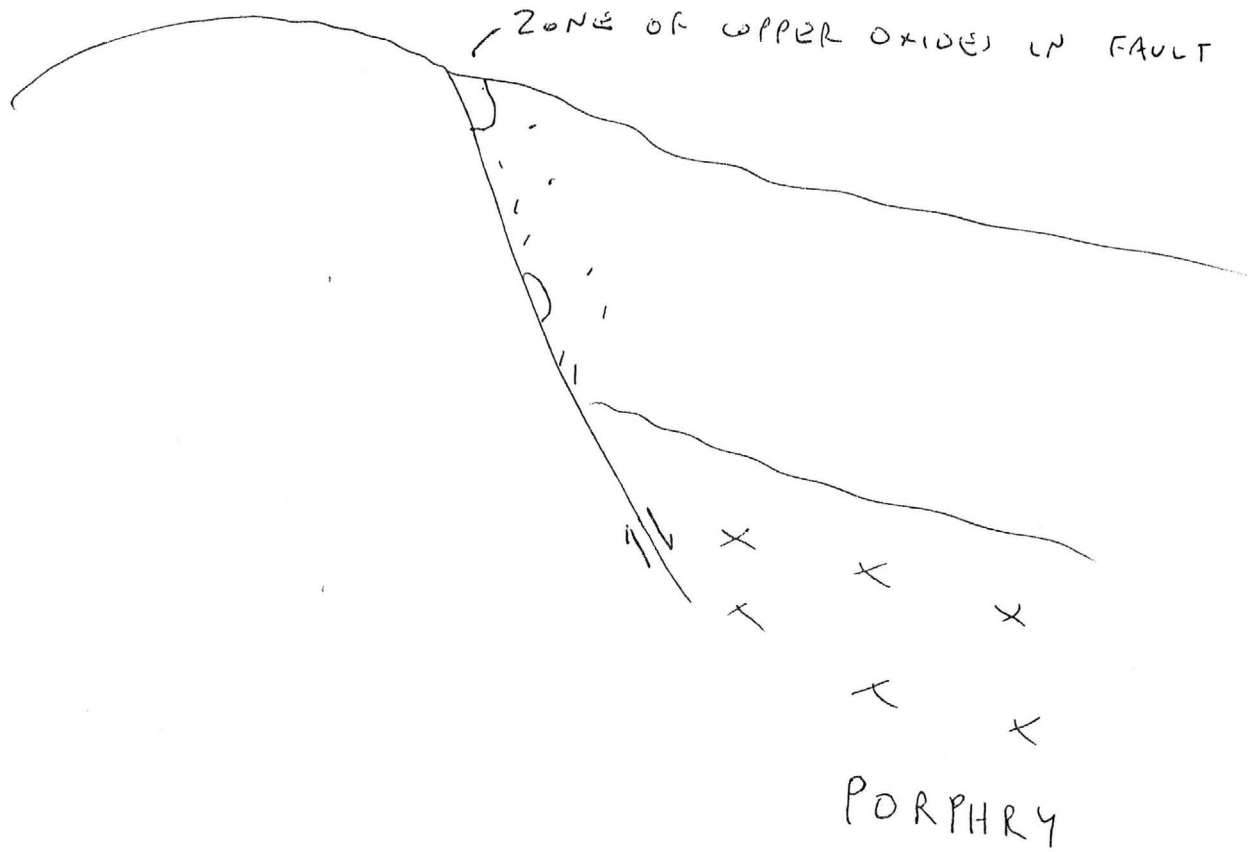
NJN - 86

Attachment 2

GENERALIZED CROSS SECTION THRU HELVITIA

SECTION 25 + 36, T18S R1SE

W E



NOT TO SCALE

NJN 12/86

Helvetia Anamax

1K

UNITED STATES
DEPARTMENT OF
AGRICULTURE
FOREST SERVICE

LAND EXCHANGE NOTICE

Notice is hereby given that the Forest Service is considering an exchange of land with Anamax Mining Company, P.O. Box 127, Sahuarita, Arizona 85629, under the authority of the Act of March 20, 1922 (42 Stat. 465), as amended by the Act of February 28, 1925 (43 Stat. 1090), and the Federal Land Policy and Management Act of 1976 (P.L. 94-579, 90 Stat. 2743).

The lands under the jurisdiction of the Forest Service that are being considered for exchange are described as E½ sec. 11; All sec. 12; Lots 1 through 6, NE¼, E½NW¼, NW¼NW¼ sec. 13; Lots 1 through 7, 9, and 10, S½SW¼, and parts of Lots 8 and 11 sec. 24; Lots 2, 4 through 10, NE¼NW¼, W½W½, and parts of Lots 1 and 3, NE¼NE¼NE¼ sec. 25; NE¼, S½ sec. 26; SE¼ sec. 27; E½ sec. 34; All sec. 35; Lots 1 through 8, W½NW¼, NW¼SW¼, N½SE¼ sec. 36, T. 18 S., R. 15 E.; All secs. 7 and 8; W½ sec. 16; All secs. 17 and 18; Lots 1, 2, 5, E½, E½NW¼, NE¼SW¼, and parts of Lots 3 and 4 sec. 19; All sec. 20; W½ sec. 21; W½ sec. 28; Lots 1, 2, N½, N½SW¼, SE¼ sec. 29; Lots 1 through 9, E½, SE¼SW¼ sec. 30; Lots 1 through 4, N½, N½S½ sec. 31; Lots 1 through 4, NE¼, NW¼NW¼, N½SE¼ sec. 32; Lots 3, 4, NW¼, N½SW¼ sec. 33, T. 18 S., R. 16 E.; Lots 1 through 7, SW¼NE¼ sec. 1, T. 19 S., R. 15 E.; Lots 3, 4, S½NW¼, SW¼ sec. 4; Lots 1 through 4, S½N½, S½ sec. 5; Lots 1 through 7, SE¼, S½NE¼, SE¼NW¼, E½SW¼ sec. 6, T. 19 S., R. 16 E., G&SRM, all together comprising 13,338.77 acres, more or less, in the Coronado National Forest, Pima County, Arizona. The Anamax lands are described as the APACHE: W½NE¼, SE¼NE¼, LESS AND EXCEPTING THEREFROM a 5-acre portion, sec. 27, T. 6 N., R. 27 E.; SE¼SW¼SE¼ sec. 21 and Lot 12, sec. 28, T. 7 N., R. 30 E.; NE¼, E½NE¼NW¼, N½SE¼ sec. 26 and SW¼SE¼NE¼, SE¼SW¼NE¼, W½SW¼NE¼, SE¼SE¼, E½SW¼SE¼, W½NE¼SE¼, E½NW¼SE¼, E½SE¼NW¼ sec. 35, T. 8 N., R. 30 E., G&SRM, comprising a total of 555.78 acres, more or less, in the Apache National Forest, Apache County, Arizona. COCONINO: E½E½W½SE¼, W½SE¼SW¼SE¼, S½SE¼SE¼, S½N½SE¼SE¼, N½NW¼SE¼SE¼, SW¼NE¼SE¼, W½NW¼NE¼SE¼ sec. 29; N E ¼ N W ¼ N E ¼, E½SE¼NW¼NE¼. LESS AND EXCEPTING THEREFROM the southernmost 430 feet of the E½SE¼NW¼NE¼; W½NE¼NE¼, LESS AND EXCEPTING THEREFROM the southernmost 430 feet; W½E½NE¼NE¼, LESS AND EXCEPTING THEREFROM the southernmost 430 feet; E½E½NE¼NE¼, LESS AND EXCEPTING THEREFROM the southernmost 430 feet and the northerly 400 feet of the southerly 830 feet of the easterly 220 feet of said NE¼NE¼ sec. 32 and W½W½NW¼NW¼, LESS AND EXCEPTING THEREFROM the southernmost 430 feet and the northerly 400 feet of the southerly 830 feet of the westerly 330 feet of said NW¼NW¼ sec. 33, T. 23 N., R. 8 E.; E½NE¼NW¼, N½SW¼NW¼, SE¼NW¼ sec. 29, T. 24 N., R. 8 E., G&SRM, comprising a total of 195.00 acres, more or less, in the Coconino National Forest, Coconino County, Arizona. CORONADO: SE¼NE¼, NE¼SE¼ sec. 1; W½NW¼SE¼, E½NE¼SW¼ sec. 2 and N½S½ sec. 11, T. 15 S., R. 18 E.; SE¼SE¼ sec. 22, T. 19 S., R. 14 E.; MS 1791, Old Pennsylvania Placer Mining Claim, Greaterville Mining District, sec. 25, T. 19 S., R. 15 E.; E½ sec. 19; All sec. 20; N½, SW¼, NW¼SE¼, S½SE¼ sec. 29; Lots 2, 3, 4, E½, E½E½NE¼NW¼, SE¼NW¼, E½SW¼ sec. 30; NE¼, NE¼NW¼, NE¼SE¼NW¼ sec. 31; W½NE¼, NW¼, N½SW¼, N½SE¼ sec. 32 and S½S½NE¼, N½SW¼, N½N½SE¼ sec. 33, T. 19 S., R. 16 E., G&SRM, comprising a total of 3,457.50 acres, more or less, in Pima County, Arizona; Lots 1, 2, 5, S½NE¼, SE¼NW¼ sec. 6, T. 15 S., R. 19 E.; a portion of the E½SE¼NW¼NW¼ described by metes and bounds together with an undivided two-twentieths interest in and to the associated well site described by metes and bounds (1.10 acres), sec. 25, T. 17 S., R. 23 E.; N½NW¼, NW¼NE¼ sec. 27; NE¼NE¼, N½NW¼, SW¼NW¼ sec. 28 and SE¼NE¼ sec. 29, T. 19 S., R. 29 E., G&SRM, comprising a total of 560.18 acres, more or less, in Cochise County, Arizona; Five portions of MS 3992, Iron Cap Lode, Tyndall Mining District (17.227 acres), sec. 2, and two portions of MS 4251, Susie Lode, Tyndall Mining District (3.218 acres), secs. 2 and 11, T. 20 S., R. 14 E., G&SRM, comprising a total of 20.445 acres, more or less, in Santa Cruz County, Arizona; All together the Coronado National Forest offered private lands comprising 4,038.125 acres, more or less. SITGREAVES: W½SW¼SE¼, SE¼SW¼SE¼, SW¼SE¼SE¼ sec. 9, T. 9 N., R. 23 E., G&SRM comprising 40.00 acres, more or less, in the Sitgreaves National Forest, Navajo County, Arizona./

TONTO: NE¼SW¼, SW¼SE¼ sec. 14; NW¼NE¼ sec. 23; W½SW¼ sec. 24 and N½NW¼, E½SW¼ LESS AND EXCEPTING THEREFROM the South 330 feet sec. 25, T. 6 N., R. 10 E.; E½NW¼NE¼, E ½ W ½ N W ¼ N E ¼, NW¼NW¼NE¼NE¼ sec. 29, T. 9 N., R. 13 E.; Portions of a subdivision known as Cherry Creek Estates Amended: Tracts "A" and "B" and Lots 1 through 12, 14 through 22, 24 through 26, 29, 30, and 32 through 55, Cherry Creek Estates Amended, according to Map No. 326, records of Gila County, Arizona, sec. 4, T. 9 N., R 14 E., G&SRM, comprising a total of 466.50 acres, more or less, in Gila County, Arizona; portions of MS 3569 described as the patented Red Rover Mining claims Nos. 6, 7, and 15, Magazine Mining District (61.90 acres), within unsurveyed protracted secs. 27 and 28, unsurveyed T. 8 N., R. 5 E.; portions of MS 2359 described as the patented Humming Bird, Key, Blue Coat, Mammoth, Deposit, Black Lode, Arlington, Silver Reef, Rosalie, and Cecil Lode Mining Claims, Copper Creek Mining District (189.732 acres), secs. 21 and 28, T. 9½ N., R. 4 E., comprising a total of 251.632 acres, more or less, in Maricopa and Yavapai Counties, Arizona; All together the Tonto National Forest offered private lands comprising 718.132 acres, more or less. The TOTAL offered private lands comprise 5,547.037 acres, more or less.

Any or all of the above described lands may be exchanged provided the values are equal. In the event the values are not equal, either party may equalize the values by the payment of cash. The amount of cash to be paid may not exceed twenty-five percent of the value of the National Forest lands.

Persons claiming such properties or having valid objections to this proposed exchange must file their claims or objections with the Regional Forester, USDA Forest Service, 517 Gold Avenue, SW, Albuquerque, New Mexico 87102, within 15 days after date of the last publication of this notice.

/s/ Ray J. Woodbury
Acting Director of
Lands and Minerals

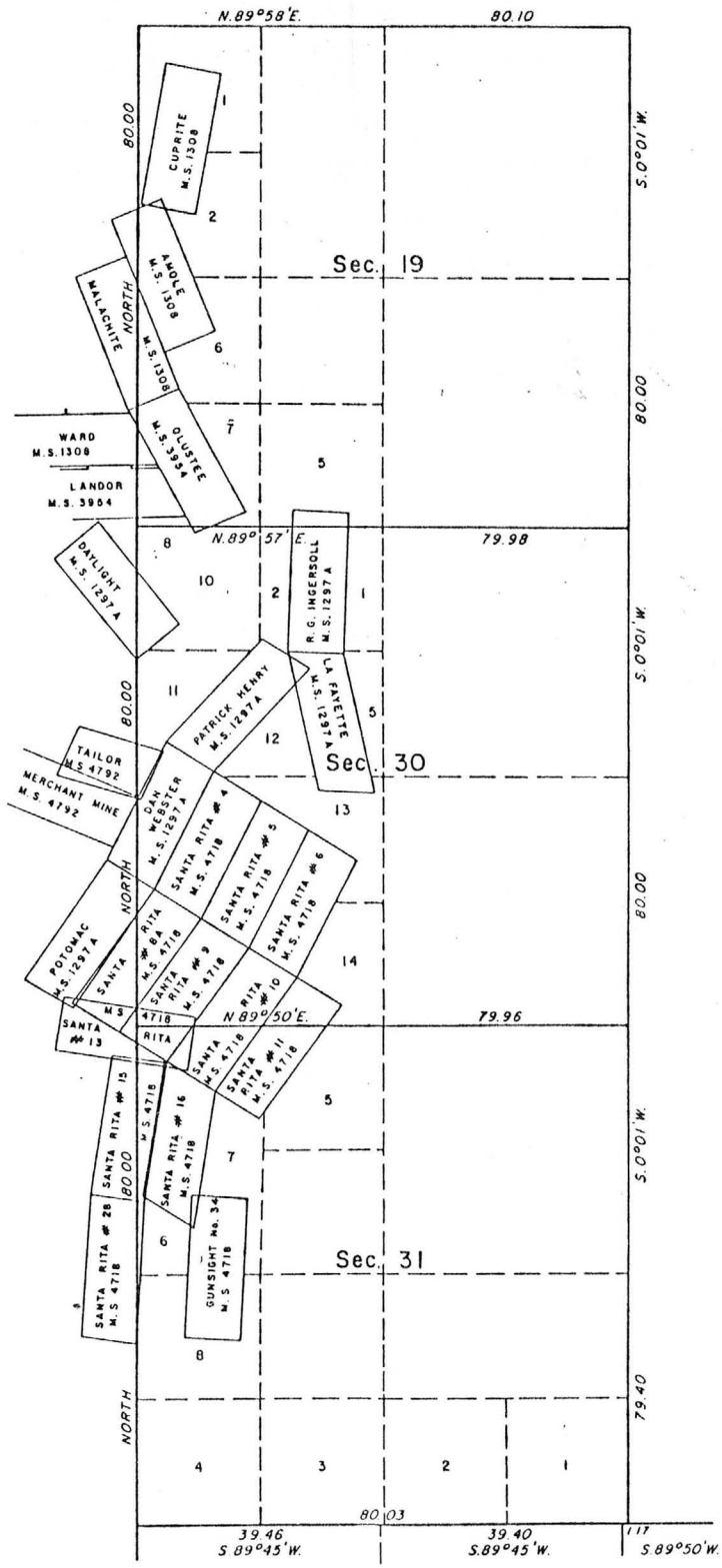
Publish: May 30, June 6, 13, 20, 1983
The Arizona Daily Star

6-19-83

DATE ____

WNSHIP, 18 SOUTH, RANGE 16 EAST, OF THE GILA AND SALT

SUPPLEMENTAL PLAT OF SECTIONS 19, 30 AND 3



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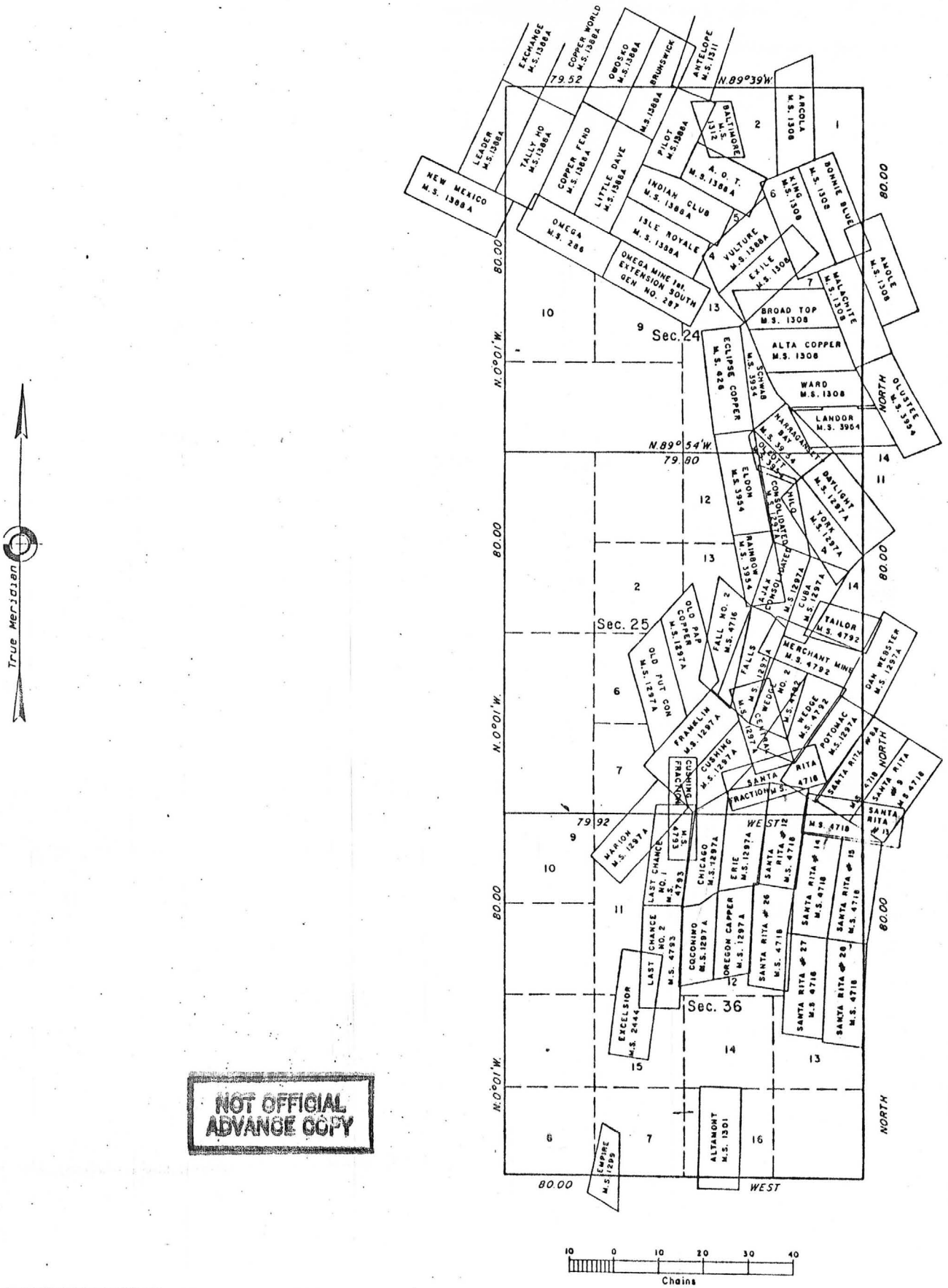
TOWNSHIP 18 SOUTH, RANGE 15 EAST, OF THE GILA AND SA

SUPPLEMENTAL PLAT OF SECTIONS 24, 25 AND



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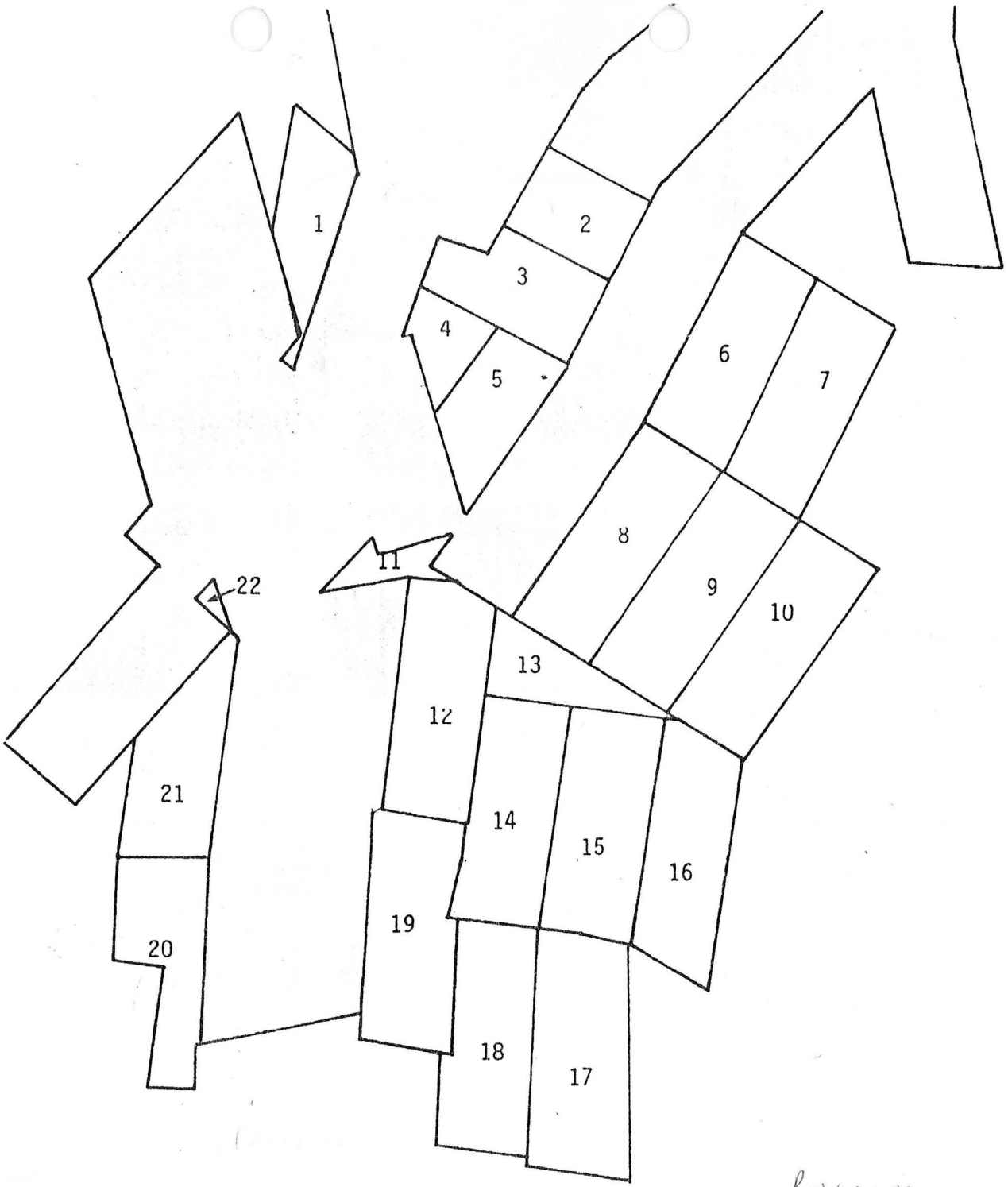

Rosemont

Patent Appl'n, Mining Claims

1. Falls No.2
2. Tailor
3. Merchant
4. Wedge No.2
5. Wedge
6. Santa Rita #4
7. Santa Rita #5
8. Santa Rita #8-A
9. Santa Rita #9
10. Santa Rita #10
11. Santa Rita Fraction
12. Santa Rita #12
13. Santa Rita #13
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15. Santa Rita #15
16. Santa Rita #16
17. Santa Rita #28
18. Santa Rita #27
19. Santa Rita #26
20. Last Chance No.2
21. Last Chance No.1
22. Cushing Fraction

Patented Lands

Attachment 2

ASARCO Incorporated

6/97

ROSEMONT RANCH LAND EXCHANGE

FACT SHEET

EXCHANGE FACTS

- In 1995, ASARCO Incorporated entered into a process of analysis and study with the Coronado National Forest to determine the feasibility of a land exchange.
- The land exchange would put into Forest Service ownership 23 privately owned land parcels totaling 2,222.45 acres in national forests in Arizona. Appraised value of this land is $5,323,190.
- The land under consideration for transfer to the company is in the vicinity of the Rosemont Ranch about 35 miles southeast of Tucson, near State Highway 83, and totals 13,272 acres with an appraised value of $5,125,000.
- Asarco is seeking the land exchange because it would facilitate the potential development of a **mineral resource** near Rosemont Ranch.
- The land exchange will involve an Environmental Impact Statement of the Rosemont acreage including public participation. The process is expected to take from four to six years.
- As soon as the exchange is approved, the offered parcels become part of the National Forest system lands and will be public property.
- In 1992, Asarco completed a land exchange which put into the public trust (Bureau of Land Management) more than 26,000 acres at the Empirita Ranch along Cienega Creek and 40 acres in the Waterman Mountains northwest of Tucson. Pima County received 360 acres at the Empirita and is working with BLM to create a regional park. The old ranch buildings are being converted into a visitors' center featuring an equestrian trail head.

ENVIRONMENTAL FACTS

- The development of a mine on the Rosemont property is a separate process and would require extensive permitting for air and water quality, groundwater protection, and endangered species assurances. These permits would involve working with the U.S. Environmental Protection Agency, the Arizona Department of Environmental Quality, the Arizona Department of Water Resources, and U.S. Fish and Wildlife Department, among others. Mining cannot commence until these permitting processes, which will take at least 5 years, are complete. All of these permitting processes provide opportunities for public comment.
- Today's mines are strictly regulated by environmental laws and are not allowed to discharge toxic waste or toxic materials to air, surface water, groundwater, or land surface.
- Asarco has no significant water rights on the east side of the Santa Rita Mountains. Water resources that would be acquired with the land exchange are minimal and inadequate to sustain a mine.
- There are more than 100 historic mining-related sites in the Rosemont Ranch area, including old dumps, adits, mill sites, and declines, which represent mining activities from before the turn of the century to the present day.

PATENT AND MINERAL RESOURCE FACTS

- In addition to the lands sought through the exchange, Asarco holds patented mining claims on a copper deposit in the Rosemont Ranch area including 132 lode claims totaling 2,015 acres. Patents for 347 of these acres were issued in 1995 concluding a process that spanned more than ten years. Some of the mining claims on the exchange property were filed during the 19th century.

- The mineral resource underlying the 2,015 acres contains about 3 billion pounds of copper.

- About 1.5 billion pounds of the 3 billion would be recovered in the event a mine is developed.

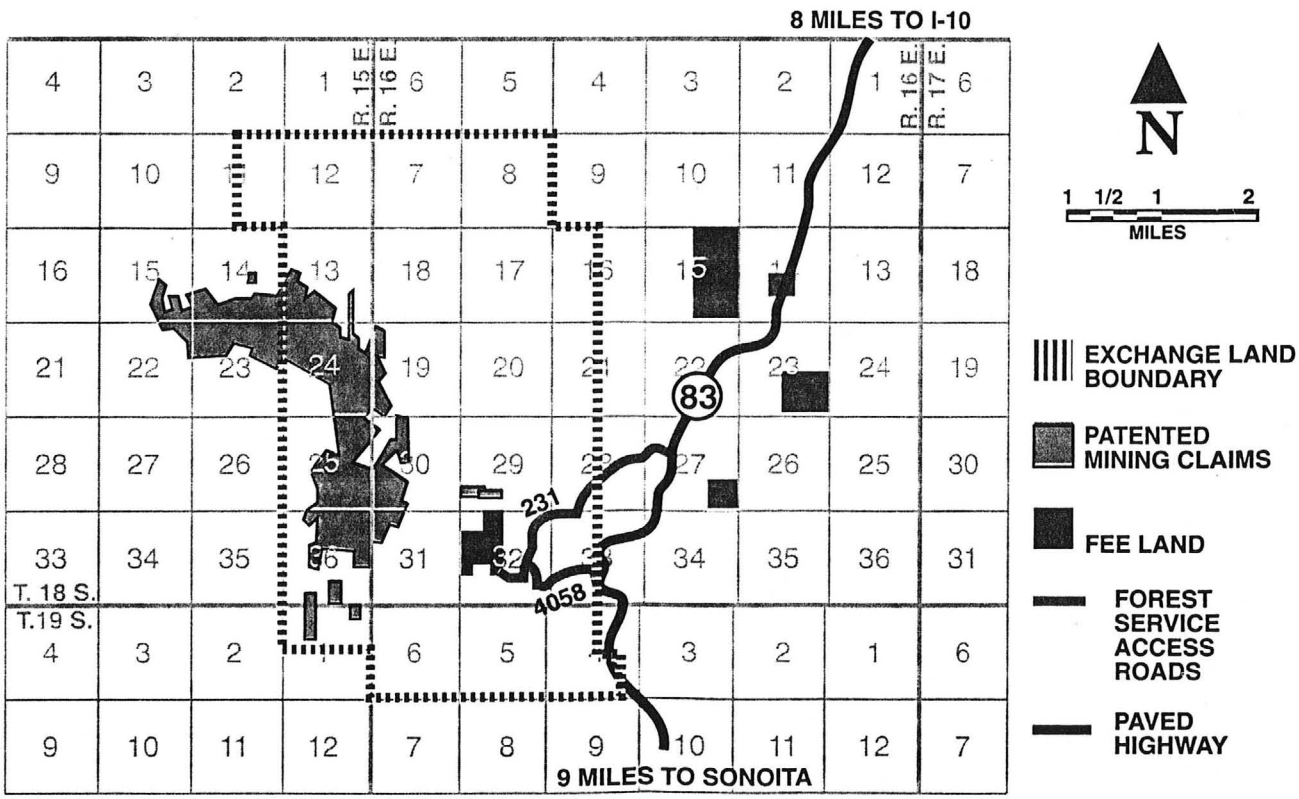
MINE FACTS

- The decision to develop a mine on the property would be considered after the exchange is complete. A final decision will depend on many factors including world demand for copper, project capital cost, and cost of operation.

- More than $15 million has been spent for discovery and exploration of this area thus far.

- The cost of developing a mine would be $300 million to $500 million. An additional $1 billion in operating costs would be expended while mining the 1.5 billion pounds of recoverable copper. Operating costs for recovering copper from similar mines today is 65 to 75 cents per pound.

- If a mine were developed, it would employ about 650 local people and generate taxes and business for local suppliers.



6/97

If you are interested in demonstrating your support of Asarco's Rosemont Ranch Land Exchange, we would encourage you to write to any or all of the following individuals:

Senator Jon Kyl
P.O. Box 10246
Phoenix, AZ 85064-0246

Senator John McCain
450 W. Paseo Redondo #200
Tucson, AZ 85701-8275

Representative Ed Pastor
2432 E. Broadway Blvd.
Tucson, AZ 85719

Representative Jim Kolbe
1661 N. Swan Road #112
Tucson, AZ 85712

Senator Keith Bee
Capitol Complex
1700 N. Washington
Phoenix, AZ 85007-2890

Representative Bill McGibbon
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Phoenix, AZ 85007-2890

Representative Lou-Ann Preble
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Jack Ward Thomas
Chief of the Forest Service
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Regional Forester
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Albuquerque, NM 87102

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517 Gold Avenue
Albuquerque, NM 87102

Wayne Thornton, U.S. Forest Service
Director of Land Use and Minerals
517 Gold Avenue
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Rosemont Project Manager
300 W. Congress Street
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ASARCO Incorporated
180 Maiden Lane
New York, NY 10038-4991

Frank McAllister, Executive V.P.
ASARCO Incorporated
1150 N. 7th Avenue
Tucson, AZ 85705

Letters should include:
Full name and mailing address
Phone number
Each letter should be individually addressed to the person listed above

AMIGOS MEMO

Arizona Mining and Industry Get Our Support • SEPTEMBER '96

Helvitia Mine file

Guest column...

Dale Dixon is the manager of Development Project Services, Copper Operations, for ASARCO, Inc. The following is a reprint of his column that appeared in the Tucson Citizen. In it he corrects the misinformation contained in a guest editorial by George Trigaux that was printed in the Citizen. We are printing it so that AMIGOS members will be armed with the facts relating to the proposed Rosemont mine:

Misinformation being dug up about Sonoita mine

By Dale Dixon

The concerns of Sonoita Crossroads residents about a potential Rosemont mine are understandable. Many of these concerns will be addressed in the Environmental Impact Study process and in subsequent public hearings required by law before a spadeful of dirt is dug.

The issue of visual impact is a sensitive one, and ASARCO is sensitive to it. The site is nine miles from Sonoita Crossroads and not visible from there. A Rosemont mine and its waste rock piles would be visible for less than three miles midway in the half-hour drive from Interstate 10 to Sonoita. As now planned, tailings would not be visible from Highway 83.

In no case would there be 13,000 acres of waste rock and tailings. Waste rock and tailings at the mission Mine, clearly visible from I-19, cover 6,400 acres after 40 years of operation. Most of the land for the Rosemont mine would appear as it does today.

Mining practices that produced problems in the 19th and early 20th centuries are indeed a thing of the past. Today, mining is heavily regulated by both federal and state laws. Air emissions, including dust, are regulated by the federal Clean Air Act. Surface water is regulated by the federal Clean Water Act and ground water by the Arizona Aquifer Protection Program. Mines may not release contaminated runoff onto adjacent land, into streams, or into the aquifer. These matters are central to the Environmental Impact Study process, every step of which is open to public review.

ASARCO expects to use the water source now being used by the Mission Mine, if a Rosemont mine is developed. This source could be either ASARCO's extensive water rights in the Santa Cruz Basin or water from the Central Arizona Project. In either case, there would be no impact on water users in the Cienega Basin, where the operation would be located, and the watershed flow from there toward Tucson would be undisturbed.

Social impacts on the closest communities of Sonoita or Vail are difficult to predict 20 years out. There are more than 2,000 mine workers employed at Tucson-area mines living in Tucson. The typical pattern now for mine workers is to live in Tucson and carpool to work. This pattern would probably continue. If mine workers choose to live closer to work, the community of Vail is about the same distance from the proposed Rosemont mine as Sonoita and, today, offers more to families in the way of access to shopping, entertainment, youth activities, secondary employment, and schools.

In any case, mine workers are the highest paid workers in the state, averaging about $40,000 a year. Their spending power is an asset to their communities.

Where should copper be mined? First and foremost, it can only be mined where it occurs and Arizona is one of

Continued on page 4

INSIDE

Find out about:

- AMIGOS Online!
- Face-to-face with Jeff Clevenger
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Guest column by Dale Dixon continued...

those places. If Arizona were a country, it would have been second in production in 1995 as a nation, after Chile, with an all-time high production record of 1.3 million tons.

The importance of copper to Arizona's economy may be subject to some debate, but the role of the state in U.S. and worldwide copper production is not. Arizona produces about 65 percent of U.S. copper and 11 percent of world copper.

Why do we need copper? People generally don't buy copper directly. But copper is critical in many of the things that provide each of us with the comforts we all enjoy, such as cars, homes, air conditioning, heating, lighting, electronic equipment and airplanes. It is an essential industrial and building material in the places that we all work and in the tools that help protect the environment we all are concerned about.

The United States produces about 20 percent of world copper but it is a net importer of refined copper needed for those industrial, building and consumer products. To suggest that the U.S. look to other nations for its copper needs would leave us increasingly dependent on them for a critical material. Such a situation could have far-reaching economic and national security effects. Furthermore, if the suggestion is for the U.S. to export environmental issues to other nations, such exportation has been debated and characterized, in its kindest terms, as deceptive environmental policy.

A decision to proceed or not proceed with a mine is a decision separate from a land exchange ASARCO has proposed to the Forest Service. Such decision, when made, would commit ASARCO to an environmental permit process independent of the Environmental Impact Study required by the Forest Service. The environmental permit process is expected to take five to seven years.

The Environmental Impact Study process is designed to involve affected and interested people in an ongoing dialogue to produce the best possible final project. We are pleased with the input we have received so far, and look forward to working with interested people as the Environmental Impact Study process goes forward.

AMIGOS members urged to take advantage of Arizona Employers' Council

A $600 value to all member companies

Since 1992, all AMIGOS members throughout the state of Arizona have had the opportunity to receive human resource advice and assistance from the Arizona Employers' Council as an additional benefit of membership in AMIGOS. The staff of the Arizona Employers' Council are experts in helping employers wade through the complexities of personnel and employee relations. AMIGOS members, their management and supervisory staff, are entitled to a broad spectrum of services and benefits under the Council's "Fee-For-Service" membership package. This is a $600 value for every AMIGOS member company.

This service arrangement allows your company to receive one hour of professional assistance per month on any personnel or employee relation situation. Any time used thereafter is billed on a pro-rated basis at the Council's current billable rate. Most AMIGOS members who use the service get their needs taken care of within the one hour per month that AMIGOS membership covers. Many members take full advantage of this service by calling the Employers' Council on such issues as hiring procedures, disciplinary actions and/or personnel policy issues. Often members already have in-house expertise and merely want the Council to look over possible options or alternatives to certain personnel management situations. Other members have had the Council conduct a series of in-house management educational programs based on their specific needs.

Gene Roinick, Administrative Human Resource Manager at United Fire Equipment said after using the service, "The Arizona Employers' Council was great! I got a quick response and correct information. They did the research, faxed us the results and helped us to quickly resolve a complex issue. It was very cost effective -- a lot less than paying a labor attorney."

Because of this unique relationship between AMIGOS and the Employers' Council, members also have the opportunity to participate in all of the briefings, luncheons and training programs sponsored by the Arizona Employers' Council.

We encourage you to take full advantage of the many services and benefits the Employers' Council offers. Representatives from the Council will be available at the next Face-to-Face Luncheon to answer any questions you may have. In the meantime, if there is someone else in your company who deals with human resource matters who should be aware of the services included in AMIGOS membership, please pass this important phone number on to them:

The Arizona Employers' Council can be reached at (602) 258-2681 or toll free at 1-800-437-9262.

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

ARIZONA PUBLIC LANDS UPDATE

This is another in a continuing series of information newsletters designed to keep the public and user groups informed on BLM policies and programs.
DEBORAH STEVENS, Editor

Bureau of Land Management
PUBLIC LANDS ☆USA☆
USE ☆ SHARE ☆ APPRECIATE

May-June 1988

P.1-HELVETIA MINE (F)

BLM completes Empire-Cienega land exchange; public gains rich resources

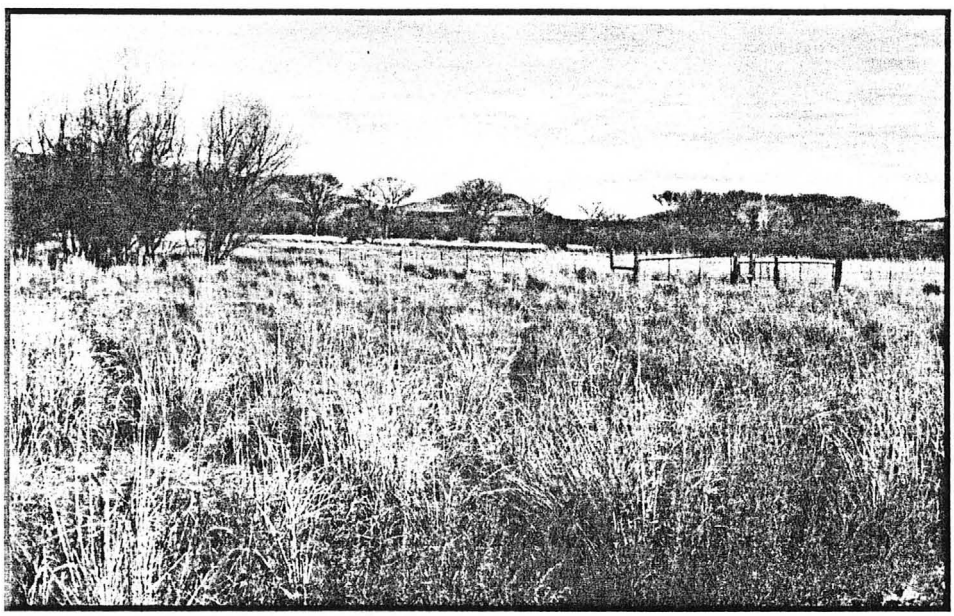
More than 54,000 acres of prime Arizona grasslands, riparian areas, scenic forests and canyonlands came into public ownership on June 8, 1988 with BLM's completion of the Empire and Cienega land exchange.

Through this exchange, the federal government gained title to 41,604 acres of the Empire and Cienega and portions of the Rose Tree ranches in southeastern Pima and Santa Cruz counties, as well as the 13,000-acre Gubler-Frei Ranch that abuts the Grand Canyon National Park in the Arizona Strip.

According to BLM Arizona State Director D. Dean Bibles, "BLM is mandated to manage the land for multiple uses. And this is a prime example of multiple use. The public has gained invaluable riparian areas, a diversity of wildlife habitat and recreational and educational opportunities that will grow into the next century."

BLM accepted title for the four parcels from Seven West Properties of Scottsdale, which in turn acquired title to 49,482 acres of public land. The public land includes 80 acres at Wilmot and Valencia roads in southeast Tucson and three parcels near Phoenix. The Phoenix tracts include 6,854 acres east of Arizona Highway 89 and south of Highway 74, 6,721 acres west of Phoenix and southwest of Morristown, and 35,827 acres west of Phoenix and north of Interstate 10 in the Tonopah area.

"The public has gained invaluable riparian areas, a diversity of wildlife habitat and recreational and educational opportunities that will grow into the next century."



The Empire and Cienega Ranches, 52 miles southeast of Tucson, comprise some of the finest true grasslands in the state.

The Empire, Cienega, Rose Tree and Gubler-Frei properties were appraised at $35,745,000 by an independent appraiser using federal standards, and his work was approved by BLM reviewing appraisers. The tracts acquired by Seven West Properties were appraised for $35,754,332. BLM received $9,332 in equalizing money.

Bibles said the Empire and Cienega ranches, 52 miles southeast of Tucson, comprise a mixture of outstanding resources that include some of the finest true grasslands in the state. He also extolled the 7 1/2-mile Cienega Creek and the rich riparian zone it nourishes. Fisheries biologists say the creek is vital to the survival of the endangered Gila topminnow and is also a haven for the Gila chub, a candidate for the endangered list. A third Arizona native fish, the longfin dace, also is found in the creek.

The ranches provide habitat for a variety of game and non-game animals and birds including a herd of pronghorn antelope that was re-introduced by the Arizona Game and Fish Department. The pronghorns once were native to the area but disappeared several years ago for various reasons.

Other mammals include both mule and whitetail deer, javelina, mountain lion and an occasional black bear that wanders onto the ranches from the higher slopes nearby.

Among the bird population are three species of quail, various raptors and such scarce species as the yellow-billed cuckoo. The Tucson Chapter of the Audubon Society is assisting BLM on an inventory and compilation of a bird list for the area.

The ranches produce huge cottonwood trees that line Cienega Creek, as well as

(Continued on Page 2)

(Empire-Cienega continued)

willow and velvet ash. Elsewhere, oak, juniper and mesquite thrive.

In the Arizona Strip, the Gubler-Frei Ranch features stands of ponderosa pine, deep canyons and spectacular scenery.

Bibles, pointing out that the property abuts both the Grand Canyon National Park and Lake Mead National Recreation Area at an elevation of some 6,000 feet, said "This promises to be an excellent back-country recreation area as well as a key wildlife area." The ranch house will be used as an administrative site for field work and to house a fire crew.

Bibles said grazing on the ranch will not be assigned to any one rancher. Instead, it will be used as a supplemental or emergency allotment as the need arises. This procedure will also eliminate the problem of cattle wandering onto the two National Park Service properties.

The Empire and Cienega ranches are open to immediate public use, but with some restrictions to safeguard environmentally-sensitive areas and to protect livestock that graze there.

The public is encouraged to use two main access routes to the ranches, one off Highway 83 and the other off Highway 82. Both entrances will be marked by signs that read "Empire-Cienega Resource Conservation Area".

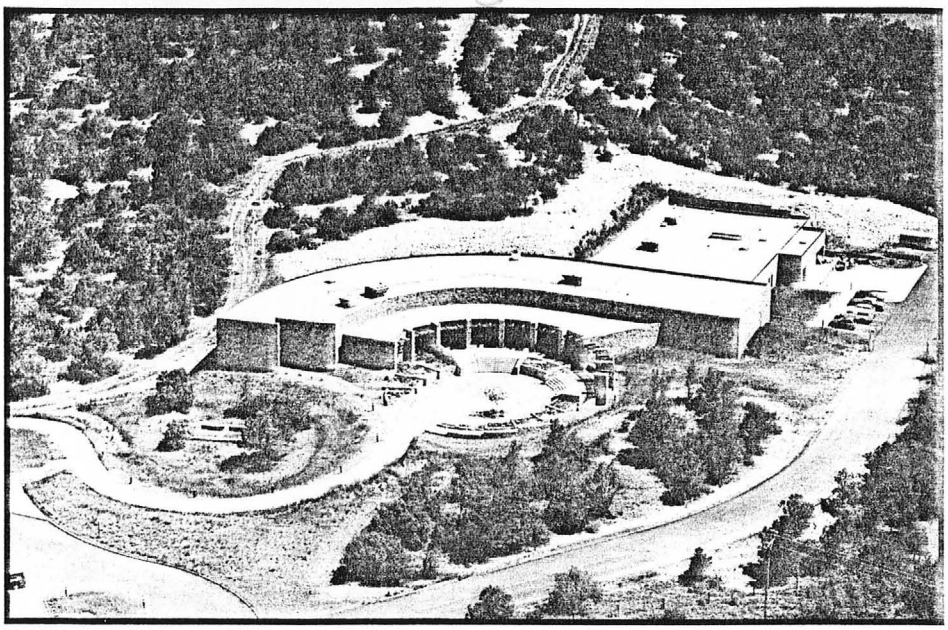
Vehicle use will be limited to designated roads to protect the watershed from erosion, and woodcutting will be prohibited.

A BLM fire crew will be stationed at the ranches, and a BLM ranger will patrol the area.

Further uses and regulations for managing the property will be subject to BLM's planning system. Bibles said a committee of citizens from the area, including Tucson, has been named to advise BLM in this process.

"We feel extremely fortunate in being able to make this exchange," Bibles said. "The Empire and Cienega ranches were being looked at for subdividing and development, but there also was much public sentiment for not developing them."

He called the area some of Arizona's best lands for multiple use management and said that it is gratifying that we were able to exchange land near expanding metropolitan areas that have low public resource values for land high in scenic, recreational and other mutiple use values.



The Anasazi Heritage Center staff currently manages almost 2 million artifacts, samples and documents. The majority of the archaeological collections resulted from the Dolores Archaeological Program (DAP), the largest single archaeological contract awarded in the U.S. to date.

BLM announces Anasazi Heritage Center grand opening

If you are facsinated with prehistoric artifacts and eager to visit one of the richest archaeological regions in the U.S., you'll be happy to know that the BLM Anasazi Heritage Center (AHC) located near Dolores, Colorado will soon open its doors to the public. Official dedication ceremonies have been set for August 27, 1988.

After 10 years of planning, building, collecting and cataloging prehistoric artifacts, the AHC will open daily from 9 a.m to 5 p.m. (10 to 5 on Sundays) beginning June 25. The pueblo-style museum was constructed by the Bureau of Reclamation as mitigation for construction of the McPhee Dam and Reservoir Project. The 40,500 square-foot facility will serve as a visitor, interpretive and research center, as well as a repository for millions of archaeological artifacts.

According to BLM Director Robert Burford, "The Anasazi Heritage Center is a one-of-a-kind facility with a great deal to offer the public." Visitors will enjoy a "total" museum experience. Permanent exhibits focus on the prehistoric Anasazi Indians, modern archaeology and changing resource uses. But there is much more. A full-scale replica of an Anasazi pithouse dwelling illustrates how these prehistoric people lived in the Four Corners area between A.D. 1 and A.D. 1300. In the Discovery Area visitors can grind corn, attempt to weave on a replicated loom, use microscopes and handle actual Anasazi artifacts. Visitors can also take the self-guided interpretive walk to the Escalante and Dominguez ruins adjacent to the center.

Director Burford noted that the opening of the center is a very special celebration for the citizens of the Four Corners states of Colorado, Arizona, New Mexico and Utah.

The new center reflects BLM's multiple use management philosophy. This management philosophy balances public and resource needs and provides for preservation and protection, as well as for use and development. Visitors will have the opportunity to explore this philosophy through exhibits and interactive computers.

The center is set into the hillside near the remains of the 12th century Dominguez and Escalante Anasazi ruins. These sites were named after the two Spanish Franciscan friars who led a 1776 expedition into the area and were the first to record discovering prehistoric Indian ruins in Colorado. The ruins were excavated and stabilized 200 years later. The Escalante ruins turned out to be a trading outpost for the Chaco Anasazi Indian tribe.

SOCIETY FOR MINING, METALLURGY, AND EXPLORATION, INC.

P.O. BOX 625002 • LITTLETON, COLORADO • 80162-5002

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GEOLOGY OF THE HELVETIA COPPER DEPOSIT — ARIZONA

S. A. Anzalone

ASARCO Incorporated
Tucson, Arizona

R. L. Brown

ASARCO Incorporated
New York, New York

For presentation at the SME Annual Meeting
Phoenix, Arizona — February 24-27, 1992

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DEPOSIT SUMMARY REPORT
COPPER

Helvetia East Deposit ROSEMONT
Anamax Mining Company
Pima County, Arizona

by

T. A. Drescher, Geologist
Intermountain Field Operations Center
April 1979

NOTICE

The views and conclusions in this document are the author's and should not be interpreted as necessarily representing the official policies or recommendations of the Interior Department's Bureau of Mines or the U.S. Government. The purpose of this report is to provide information for further review within the Bureau of Mines.

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ABSTRACT - MAS DEPOSIT SUMMARY REPORT

STATE/CNTRY: Arizona/U.S.A. DISTRICT: Rosemont

COUNTY/PSD: Pima COORD:UTM Zone 12;3521700 m north;522,900 m east

QUAD-SCALE: Sahuarita, AZ - 1:62,500 NAME: Helvetia East

COMMODITIES: Copper (Cu), silver (Ag), gold (Au) SEQ. NO.: 0040190010

OWNER/OPERATOR: Anamax Mining Company

TYPE: Proposed open pit mine STATUS: Explored prospect

OPERATION SUMMARY: Proposed open pit mine: 33,069 st (30,000 mt) per day of sulfide ore, 77,162 st (70,000 mt) of waste and oxide ore. Sulfide flotation mill: 33,069 st (30,000 mt)of ore per day producing 555 st (503 mt) per day of 28-percent Cu concentrate containing 4.58 troy ounces per st (157 g/mt) Ag and 0.026 troy ounces per st (0.88 g/mt) Au. Oxide mill to tank-leach 4,106 st (3,725 mt) of ore per day and to produce, after solvent extraction and electro-winning, 18.1 st (16.4 mt) of cathode copper. Concentrate shipped to Magma Copper Company's San Manuel, AZ, smelter and refinery; copper cathodes sold f.o.b. mill.

RESOURCES: 337,000,000 st (305,700,000 mt) sulfide ore containing 0.54 percent Cu, 0.088 troy ounces per st (3.03 g/mt) Ag, and 0.0005 troy ounces per st (0.017 g/mt) Au. 22,000,000 st (19,950,000 mt) oxide ore containing 0.55 percent Cu.

DEPOSIT DESCRIPTION: Porphyry copper deposit in mineralized quartz latite porphyry stock of Tertiary age and in adjacent Paleozoic carbonate sedimentary rocks.

LAND HOLDING: 63,000 acres (25,500 ha) STATUS: Fee ownership, patented and unpatented claims

DOMAIN: Private, national forest AREA POTEN. DISTURB: 5,330 acres (2,160 ha)

ENVIRONMENTAL FACTORS:	Short term:	Long term:
LAND:	Moderate	Minor
WATER:	Moderate	Minor
AIR:	Moderate	Minor
FLORA:	Moderate	Minor
FAUNA:	Moderate	Minor
SOUND:	Minor	Nil
AESTHETICS:	Moderate	Minor
OVERALL:	Moderate	Minor

OPERATIONAL/ECONOMIC DATA: Mine and mills would begin production in 1982 after 3 preproduction years, 3 shifts/day, 357 days/year. Sulfide mill to operate 29 years; oxide mill-15 years. Employees: mine-439 employees; sulfide mill-208; oxide mill-87. Estimated capital: mine-$157,269,700; sulfide mill-$63,359,000; oxide mill-21,012,800. Operating costs: mine, sulfide mill, and oxide mill: $2.638, $1.969, and $5.013/st ($2.908, $2.171, and $5.526/mt) of ore, respectively. Transportation of sulfide concentrate to smelter: $8.173/st ($9.009/mt). Smelter cost: $85.29/st (94.02/mt) of concentrate. Refining cost: $168.97/st (186.26/mt) of blister copper. Breakeven (0.0% ROR) copper price $0.98/lb ($2.15/kg); 15% ROR copper price $1.32/lb (2.91/kg)

OFFICE LOCATION	DC	CS	IA	E	I	W	A
FILES: DATA SHEETS					x		
BACKUP FILES					x		
EVALUATOR: T. A. Drescher					x		

INTRODUCTION

Helvetia East (figure 1), a porphyry copper deposit located in the Santa Rita mountains near Tucson, Arizona, was discovered by Banner Mining Company in 1961. Other names by which the deposit has been called include Helvetia, East Helvetia, Helvetia-Rosemont, and Rosemont.

The following Minerals Availability System (MAS) deposit evaluation is based upon general information about the regional and district geology and upon an evaluator-proposed mine and mill system. Some preliminary MAS evaluation work in 1978 on the Helvetia East deposit by P. Olmstead was not used as a basis for the present evaluation because more recent and more specific information required a complete re-evaluation. The author acknowledges the assistance of R. A. Salisbury in referring him to some useful sources of information (1, 14) and of R. Baer in providing cost data on an existing electrowinning plant used at another mine. Until recently, almost no specific information about the deposit had been released by Anamax Mining Company, the present owner, but a recently completed environmental study contracted by Anamax (1) gave some basic information needed for an evaluation, including the deposit location, maximum pit limits, mill site, waste dump location, and water requirements for the mill. All costs are estimated in June 1978 dollars.

OPERATION DATA

The following sections summarize information about the deposit location and ownership, past district production, general features, and environmental impact of the proposed operation.

Location and Ownership

The Helvetia East deposit is situated 30 miles [50 kilometers (km)] [1/] southeast of Tucson, Arizona, in the Rosemont mining district of eastern Pima county (figure 2). The Rosemont district is located on the east flank of the northern Santa Rita mountains, across the crest of the range from the Helvetia district. The deposit can be reached from Tucson by driving 21 miles (33 km) southeast on Interstate Highway 10 to the Vail exit, then going south on unimproved State Route 83 for 14 miles (23 km), and, finally, taking an unimproved dirt road southwest for 4 miles (6 km).

The deposit is owned by Anamax Mining Company, an equal partnership between the Anaconda Company (a subsidiary of Atlantic Richfield Corporation) and Amax Arizona Corporation (a subsidiary of Amax Corporation). The corporate address of Anamax is: P.O. Box 127, Sahuarita, AZ 85629, telephone 602/884-7845.

Land Situation

Anamax controls all of the land required for development of the deposit. The area of the proposed open pit is held as Amax-owned patented claims. Adjacent land which would be used for waste dumps, mills, and service shops is presently held by unpatented Anamax mining claims and mill sites in the Coronado National Forest. The area to be used for tailings disposal is held by lease from the State of Arizona. The company is attempting to obtain complete title to a 5,544-acre [2,244-hectare (ha)] block of national forest land (which includes many of Anamax's unpatented claims) through a land exchange with the Forest Service for property owned by Anamax and adjacent to

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1/ Numbers are presented in English units followed by the approximate metric equivalent in parentheses. Values are rounded; therefore, neither is precisely convertible to the other.

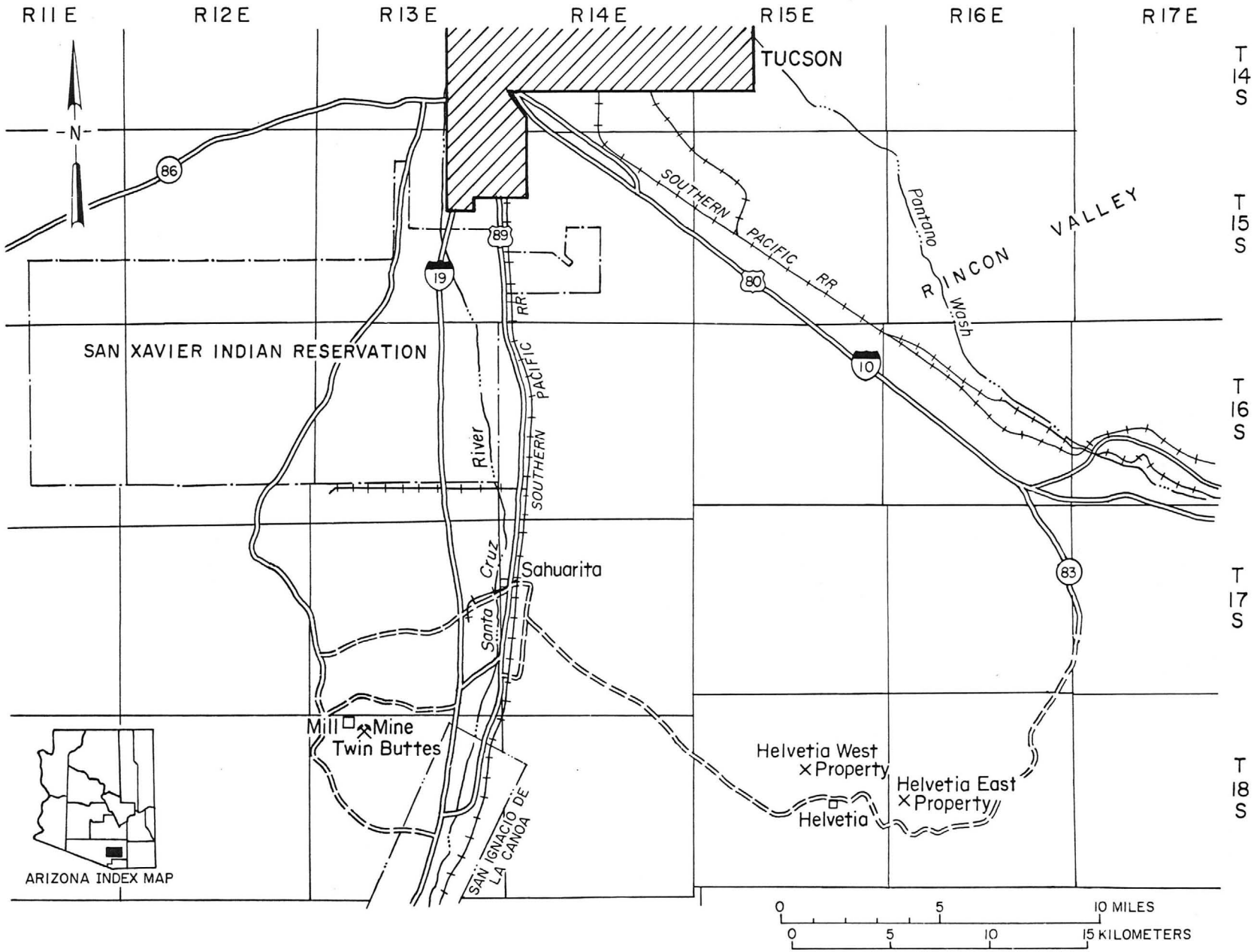


FIGURE 2. - Index map showing location of the Helvetia East deposit.

national forest land in other areas in Arizona (2). In 1974, Anamax purchased the 47,000-acre (19,000-ha) Empire Ranch, a few miles southeast of the deposit, for eventual use as a water source for the proposed mills (1, 13, 21). The total land holdings, after completion of the land exchange, will be approximately 63,000 acres (25,500 ha).

Production Summary

There has not yet been any production from the Helvetia East deposit. Production since the 1880s, from several small mines and prospects overlying the deposit, has totaled about 6,960 short tons [6,310 metric tons (mt)] of ore with an average grade of 7 to 8 percent copper, 1-1/4 troy ounces per short ton [40 grams/mt (g/mt)] silver, and minor gold (15, pp. 123-129). Since initial discovery of mineralization in the 1870s, total production from the Helvetia and Rosemont mining districts has been about 426,000 short tons (386,000 mt) of ore containing an average of 4 percent copper, 0.2 percent zinc, 0.06 percent lead, 0.8 troy ounces per short ton (30 g/mt) silver, and 0.004 troy ounces per short ton (0.1 g/mt) gold (15, p. 31). Since 1959, there has been very little production from the district.

Mine Development, Mining, and Milling Methods

The proposed mining and milling systems are based on a limited amount of general information from an environmental study contracted by Anamax (1). Details of the proposed operation are unavailable and are thus based on a hypothetical system designed in this evaluation. Elecric shovels and truck haulage would be used both during the operation of the proposed open pit mine and during preproduction development to strip overburden and waste from the deposit. The three-year preproduction period would include two

years of stripping. The sulfide ore would be concentrated by standard flotation methods, and the oxide ore would be treated by tank leaching, solvent extraction, and electrowinning.

Operational Integration

The proposed mine and mills would be owned by Anamax. Ore would be trucked 1 mile (2 km) from the mine to the mills. Copper concentrate from the sulfide flotation mill would be trucked 20 miles (32 km) to the rail shipping point at Vail, Arizona, and then shipped 174 miles (280 km) via the Southern Pacific Railroad to Magma Copper Company's Hayden, Arizona, smelter and refinery. Electrowon copper cathodes from the oxide mill would be sold to fabricators f.o.b. the mill.

Environmental Impact of Operation

The results of the environmental study contracted by Anamax (1) indicate that the overall impact of the proposed operation on the environment would be moderate in the short term and minor in the long term. Vegetation would be removed from a 5,330-acre (2,160-ha) area disturbed by the mining operations, resulting in the migration from the area of the wild and domestic animal populations. With the exception of one threatened plant species and three reptile species, whose area of habitat would be reduced, relatively few classified species would be affected (1, p. 62). Removal of vegetation would also result in increased erosion.

Groundwater level in the vicinity of the proposed mine would be lowered by the hydrologic sink created by the open pit, but, within a few years after termination of mining operations, the water table would be restored to its original level by normal annual recharge. As proposed in this evaluation, the water requirements for the mills would be satisfied by sustained pumping

from widely spaced wells on the Empire Ranch, located a few miles south of the operation. The water table should not be appreciably lowered because of the large area over which pumping would occur. Water runoff from the area would be decreased by water impoundment in the pit and on the waste dumps.

Ground cover removal could be expected to create dust problems downwind from the mining area. The scenic beauty of the area would be marred to some extent by the highly visible waste dumps, tailings pond, and open pit. Several sites of archeological and historical interest which might be destroyed by the mining operations will be excluded from the Anamax-Forest Service land exchange and will be held by the Forest Service to ensure their protection (21). Because of the proximity of the deposit to a metropolitan area, local attitudes toward the proposed operation can be expected to be less favorable than for similar deposits in more remote areas; however, since the Tucson area is a major center for copper production, this type of adverse reaction would be somewhat mitigated. The deposit is located about three miles (five km) northwest of a proposed land development for a new residential district (18, p. 4).

CHARACTER OF DEPOSIT

Sedimentary and igneous rocks, complexly folded and faulted and with a considerable range of age and lithologies, occur in the Santa Rita Mountains. The area's oldest exposed lithologic unit, the Precambrian Pinal Schist, occurs in small, isolated roof pendants and fault slivers in the Continental Granodiorite, a regionally extensive Precambrian batholith (11, plate 4; 10, p. 5). A 6,000-foot (1,800-m) thickness of Paleozoic marine sediments unconformably overlies these Precambrian units (10, p. 5). Near the middle of the Permian Period, the region was up-

lifted and subsequent deposition was predominantly continental. Deposition of Triassic and Jurassic redbeds and tuffaceous sediments was preceded and followed by periods of strong regional uplift and normal faulting, after which the Early to Late Cretaceous Bisbee Group of conglomerates, arkoses, and siltstones was deposited (12, p. 315).

The Laramide Orogeny was characterized in the Santa Rita Mountains by 1) a strong early phase of thrust faulting, folding, and plutonism during the Late Cretaceous, 2) a mid-orogenic tectonic lull, and 3) weaker orogenic phases of faulting and intrusion during the Paleocene (11, pp. 29-34). Deposition of thick accumulations of sediments in local basins and volcanic activity were associated with the early phase of the orogeny (12, p. 315). The final phase of the Laramide included the emplacement of the Greaterville intrusives, also called the "ore porphyries" because of their genetic relationship to mineralization in the districts, including the Helvetia East deposit (9, pp. 15, 43-45). Drewes 9, p. 15) believes that the Greaterville intrusives were "probably emplaced at shallow depths from fairly fluid magmas, as indicated by their fine grain size and habit of intruding faults." Mineralization in the districts is associated with argillic-pyritic hydrothermal alteration and intense contact metamorphism (9, p 9), and carbonate rocks in the lower Paleozoic Abrigo and Martin Formations are common host rocks (11, p. 32).

Normal faulting and associated andesitic and rhyolitic volcanism which followed the Laramide are responsible for the present topography of uplifted ranges and adjacent alluvium-filled valleys. Examples of range-front faults in the vicinity of the Helvetia East deposit are the Deering Springs and Backbone faults.

General Description

No specific information has been published on the geology of the Helvetia East deposit. However, general information on the geology of the district is available in a number of recent publications (1, 8, 9, 10, 11, 12, 15). A recent environmental study contracted by Anamax (1) revealed the specific location of the proposed open pit and made it possible to glean much about the geology of the deposit. Two fairly detailed geologic maps of the deposit area have been recently published (1, fig. D-2; and 11, plate 4), and figure 3 is a synthesis of information from both sources. Where differences of opinion on the geology exist, the Anamax map (1, fig. D-2) was given more credence, since the company has the benefit of data from their extensive drilling in the area.

In the environmental study, the company also revealed that some of the drill holes over the deposit penetrated Paleozoic rocks (1, vol. 1, p. 32), indicating that several thousand feet of overlying Mesozoic sediments are faulted out, presumably by Drewes' thrust fault IV (11, p. 20 and plate 4). This low-angle, eastward-dipping thrust typically separates Paleozoic from Cretaceous rocks both to the north and south of the deposit. However, in the immediate area of the deposit, the fault is not exposed because of down-faulting along the Deering Springs and Backbone range-front faults shown in figure 3. In this evaluation, the thrust fault is assumed 1) to be barely hidden below the surface at the intersection of the Deering Springs and Backbone faults, 2) to underlie the Bisbee Group (Glance conglomerate), and 3) to dip ten degrees eastward as it does in surface exposures exposures one mile (two km) to the south (figure 3)(11, p. 20). This assumed location of the thrust fault

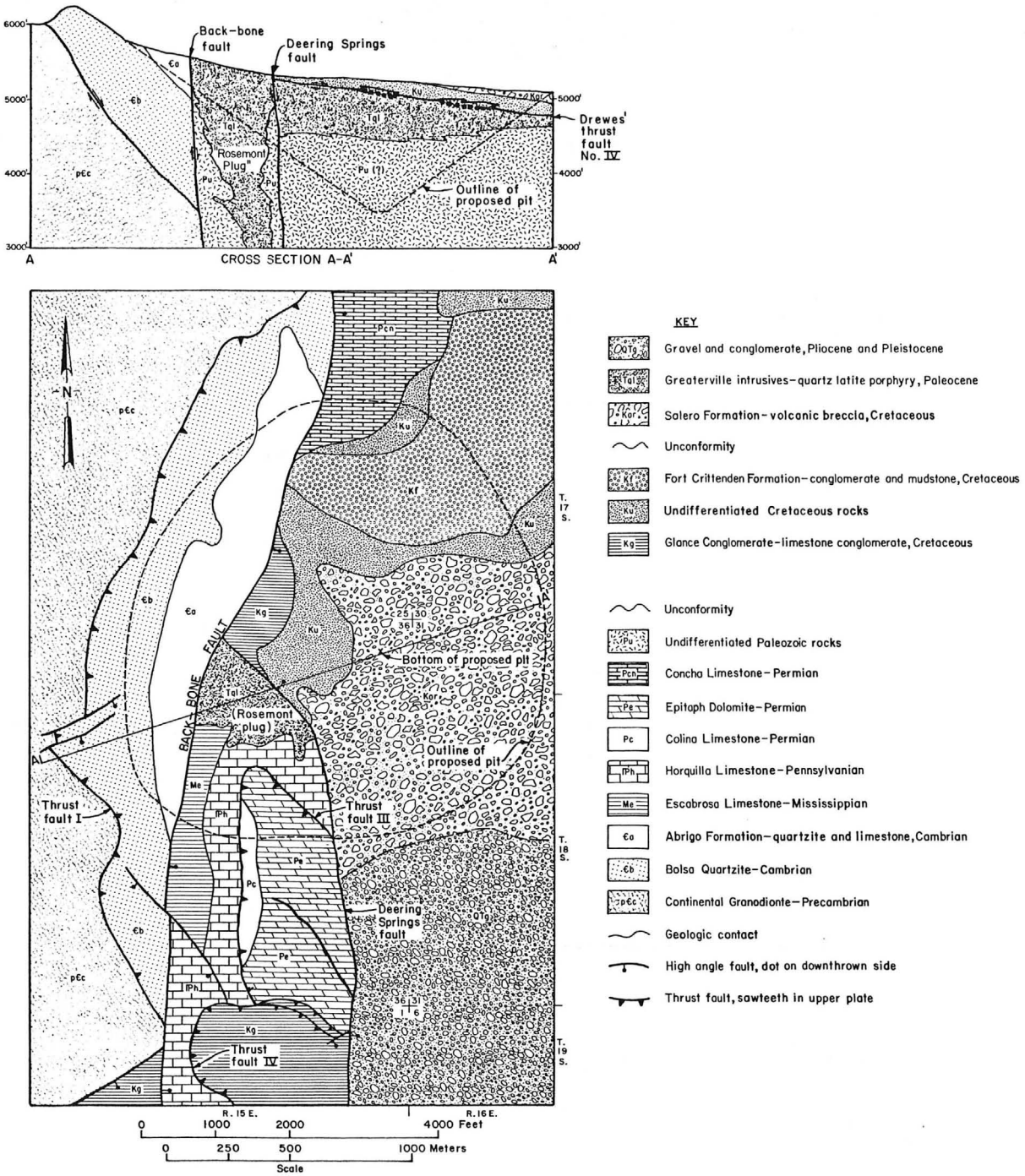


FIGURE 3. - Geology of the Helvetia East deposit (after 1, fig. D2; 11, plate 4).

would require that only a few hundred feet of vertical displacement occurred on the Deering Springs fault, as Drewes implies (11, pp. 1, 19, and 26).

Exposed within the area of the proposed open pit is the Rosemont plug, a mineralized quartz latite porphyry plug belonging to the group of "ore porphyry" intrusives previously described. The portion of the intrusive which is downdropped by the Deering Springs fault (figure 3) is assumed to have invaded the thrust, as is characteristic of the "ore porphyries" (9, p. 15), and thus to be of much wider subsurface extent in the downdropped block than in the upthrown block. Supporting this conclusion is the fact that the Cretaceous rocks exposed at the surface in the downdropped block are 1) strongly argillized and iron-stained, 2) contain anomalous amounts of zinc, lead, bismuth, silver, arsenic, and antimony, and 3) are invaded by small dikes of quartz latite porphyry (9, pp. 44-45).

The ore body has been termed a "porphyry" copper deposit (15, pp. 30-31; 25, p. 47), and it is assumed in this evaluation, for lack of information to the contrary, that the major portion of the deposit occurs within the Rosemont plug. Drewes, however, believes that the geochemical anomalies to the northeast of the plug could indicate mineralization in the Paleozoic carbonate rocks beneath the exposed Mesozoic rocks (9, pp. 44-45), and it is assumed in this evaluation that a lesser part of the ore body consists of contact metasomatic, replacement, and disseminated sulfide deposits of copper and other metals along faults and favorable beds in the Paleozoic rocks beneath the thrust fault (figure 3).

Dimensional Data

A depth of about 200 to 300 feet (60 to 90 m) to the thrust fault (and to the top of the ore body in this interpretation) is not contradicted

by company statements that the ore body is "several hundred feet down" (18, p. 3). Tonnage and volume calculations, assuming an average specific gravity of 2.6 for ore and waste, and average pit slopes of at least 37 degrees from the horizontal, indicate that more than enough room (at least 60 percent more than necessary) exists for the ore body to fit below the thrust fault within the open pit limits (figure 3). If the upper limit to the ore body is the thrust fault and the lateral and lower limits are the maximum pit boundaries, then the ore body must be roughly disk-shaped, dipping ten degrees to the east, having an average thickness of about 600 feet (200 m) and a diameter of 3,000 feet (900 m), and probably thinning considerably to the east (figure 3). In detail, the shape of the ore body may be very irregular, with dikes of porphyry intruding the surrounding rocks along faults and fractures (9, p. 14) and with pyrometasomatic, replacement, and disseminated copper sulfide deposits extending away from the porphyry contact along faults and favorable carbonate beds (15, pp. 123-128; 11, p. 32).

Major Ore and Gangue Minerals

In barren, relatively unaltered surface exposures, the Rosemont plug and other plugs of the "ore porphyry" group in the Santa Rita Mountains consist of closely fractured quartz latite porphyry with saccharoidal groundmass and abundant bipyramidal quartz phenocrysts, sparse small biotite phenocrysts, and traces of disseminated sulfides (16, p. B4). The copper content in unaltered porphyry is two to five times higher than in older intrusives in the district and five to fifteen times higher in biotite concentrates (16, pp. 3 and 5), suggesting that copper is a primary constituent in the porphyry and that copper-rich biotite may be the metal source for the copper deposits in the area.

For lack of specific information released by the company, the ore mineralogy can only be guesstimated from descriptions of oxidized ore mined in surface exposures above the ore body or from typical descriptions of ore from other porphyry copper deposits (22). The "sulfide" portion of the ore body might consist of disseminated to massive sulfide mineralization in argillized porphyry host rock and in adjacent silicated carbonate rocks. Sulfide minerals probably include pyrite, chalcopyrite, and bornite, with possibly some chalcocite supergene enrichment. The "oxide" portion might consist of oxidized products of the sulfide minerals, such as chrysocolla, azurite, malachite, and cuprite.

EXPLORATION LEADING TO DISCVOERY

Operating intermittently from the late 1800's through the 1950's, several small mines within the periphery of the proposed Helvetia East pit have produced high-grade copper ore from pyrometosomatic deposits at or near the contact of the Rosemont plug with Paleozoic carbonate rocks (15, pp. 123-128). For an extended period from 1948 through 1961, Banner Mining Company gradually acquired several properties in the Helvetia area (18, p. 3, 5, pp. 47-48). Diamond drilling by Banner from 1961 to 1963 resulted in the discovery of mineralization on two of the properties, called in this evaluation the Helvetia East and Helvetia West (3, p. 53). In March 1963, Banner leased the properties to the Anaconda Company. Anaconda continued the exploration drilling program and more definitively determined the shape, tonnage, and grade of the Helvetia East deposit (3, p. 53). In 1973, concomitant with formation of Anamax Mining Company (an Arizona partnership between Amax and Anaconda mining companies), Banner Mining Company was merged into the new partnership. Since 1973,

Anamax has shown continued interest in the deposit through additional geologic and economic evaluation of the deposit (3, p. 15), acquisition of lands adjacent to the deposit, and environmental studies (1).

RESERVE ESTIMATION

The sulfide and oxide portions of the Helvetia East reserves are entered respectively in quantity-resources matrices one and two of the Minerals Availability System (MAS) data base (see appendix A) from recently published data (27, p. 67). As the detailed geological relationships of the ore body are unknown, no attempt was made to subdivide the reserves by probability of occurrence, and the quantity of reserves entered at the 90-percent probability level in quantity-resource matrices one and two is repeated at lower probability levels. Because of a large tonnage difference from previous, more reliable estimates (3, p. 54; 27, p. 67), a published reserve estimate (26, p. 110) of slightly more recent date (reserve record 5 in appendix A) was not used as a basis for the quantity resource matrices. The sulfide reserves are 337,000,000 short tons (305,700,000 mt) of ore containing 0.54 percent copper, 0.088 troy ounces per short ton (3.03 g/mt) silver, and 0.0005 troy ounces per short ton (0.017 g/mt) gold. The oxide reserves are 22,000,000 short tons (19,950,000 mt) of ore containing 0.55 percent copper. Because gold and silver grades have not been published, they were estimated from average gold to copper and gold to silver ratios in past production from mines above the deposit and from the Helvetia and Rosemont districts (15, pp. 31, 123-129).

Under the development plan proposed in this evaluation, the sulfide ore will be mined over a period of 29 years at a production rate of 33,069 short tons (30,000 mt) per day, 357 days per year, and the oxide ore will

be mined over a 15-year period at a 4,106-short-ton (3,725-mt) per day, 357-day-per-year rate.

EXTRACTION TECHNOLOGY

As very little information has been released by Anamax on methods of mining and milling, it was necessary to propose an extraction system. The meager information on which assumptions are based was published in an Anamax environmental study (1) giving 1) mine pit and waste dump location and maximum areal extent, 2) mill location and water consumption, 3) concentrate haulage route and rail shipping point, 4) water table depth and typical water well yields, 5) date of earliest possible production, and 6) rough employment estimates during both production and preproduction development.

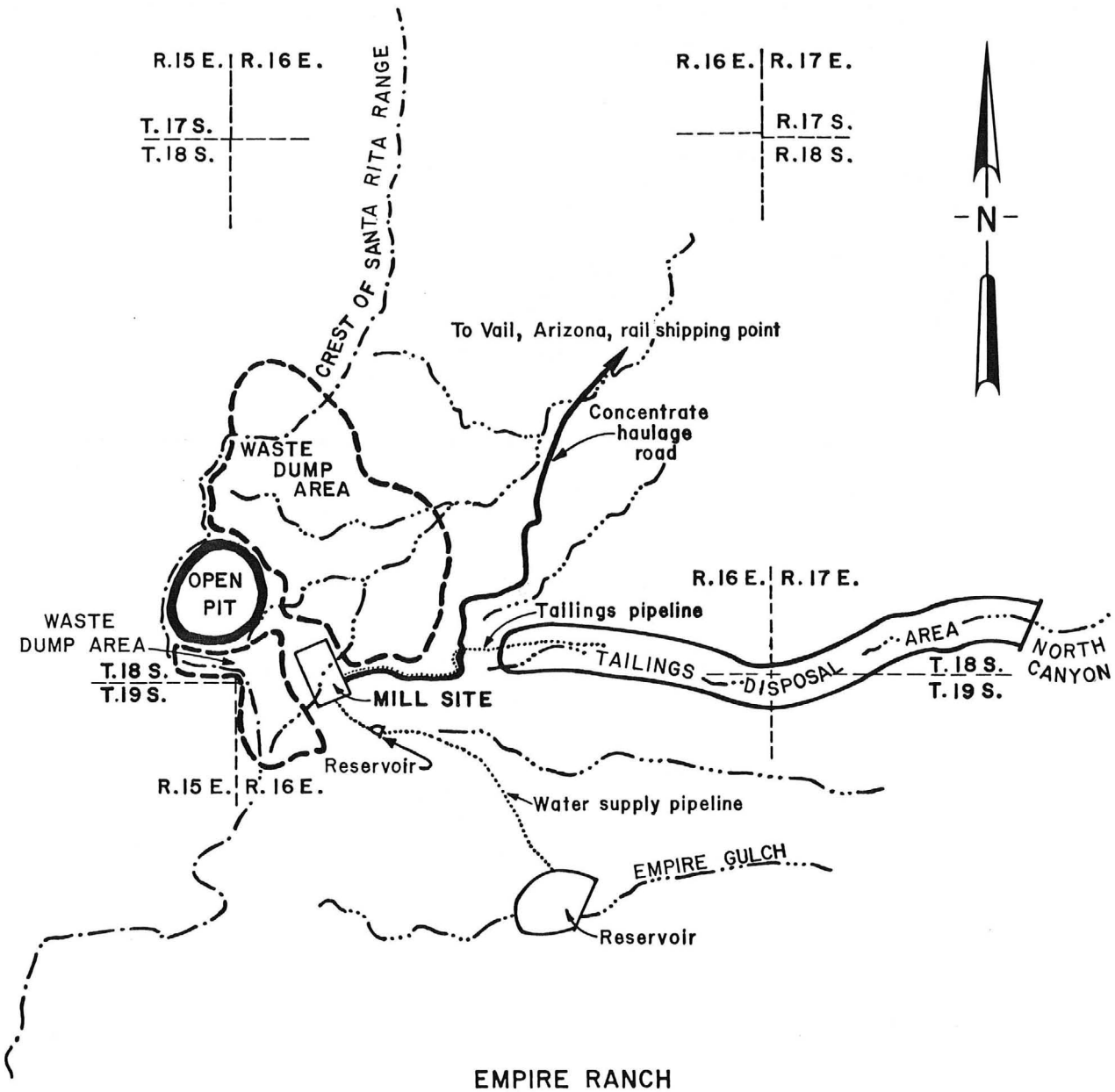
Mining and milling systems were designed using the above information in combination with models described in a Bureau of Mines cost-estimating handbook (24). An oxide tank-leaching and electrowinning mill was designed using the knowledge that Anamax actually employs this system to treat its oxide ore at the nearby Twin Buttes mine.

Proposed in this evaluation is a water supply system from numerous, widely spaced water wells which could be installed on the extensive, 47,000 acre (19,000-ha), Anamax-owned Empire Ranch. This method, although expensive compared with other methods, was chosen for this evaluation because of the reliability of obtaining a constant, uninterrupted (by drought) water supply and because of the minimal lowering of the water table (and consequent environmental damage). The Empire Ranch was purchased by Anamax as a water source for the Helvetia East project in 1974 for $12,808,000 (21; 23, p. 16; 13).

Figure 4 shows the general layout of the mining operation, including the water supply and tailings disposal system.

Mining System

The proposed open pit mine would operate three shifts per day, 357 days per year, and employ 439 personnel. By projecting 37-degree pit slopes from the maximum pit perimeter, shown superimposed on a topographic map in the environmental study (1), the maximum depth and elevation contours of the pit were calculated. By the same method, a total ore plus waste tonnage of 1.205 billion short tons (1.093 billion mt) was estimated, assuming an average ore and waste specific gravity of 2.6. Knowing this total tonnage and the total ore tonnage, one can calculate an overall stripping ratio of 2.575 to one (waste to sulfide ore). Assuming a constant sulfide ore production rate of 33,069 short tons (30,000 mt) per day, and assuming a two-year period of preproduction stripping of waste and overburden at the operating rate of materials handling, an operating stripping ratio of 2.33 to one (waste to sulfide ore) can be calculated. The waste mining rate would thus be 77,162 short tons (70,000 mt) per day during the 29-year production life of the mine, and a total of 110,231 short tons (100,000 mt) per day of material would be removed throughout the 31-year preproduction (stripping) plus production life of the mine. During the two-year preproduction stripping period, 78,700,000 short tons (71,400,000 mt), or 35,900,000 cubic yards [27,500,000 cubic meters (cu m)], of overburden and waste would be stripped from the deposit. Included in the waste tonnage during the first 15 years of production is the oxide ore production of 4,106 short tons (3,725 mt) per day. The maximum pit depth at the end of the mine



EMPIRE RANCH
(Anamax-owned as a water source area)

FIGURE 4. - General layout of the proposed mining, milling, and water supply system.

life would be 1,600 feet (490 m), measured from the lowest point on the pit rim, and 2,600 feet (790 m), measured from the highest point on the rim.

Equipment proposed for the operation is listed in table 1. Actual production time per eight-hour shift for all equipment is assumed to be seven hours (87.5 percent utilization). Rotary drills would drill 55-foot (17-m) deep, 12-1/4-inch [31-centimeter (cm)] diameter holes with 30-foot (9-m) spacing and 27-foot (8-m) burden. A 70-percent equipment availability for drills is assumed. Benches of 50-foot (15-m) height would be blasted after loading the holes with ammonium nitrate-fuel oil (AN/FO) blasting agent. The broken ore or waste would be loaded into 85-short ton (77-mt) reardump trucks by ten-cubic yard (7.6-cu m) electric shovels and front-end loaders. An average swell factor for all mined material of 61 percent is assumed. The trucks would haul ore or waste an average distance of one mile (1.6 km) up an eight-percent grade to the rim of the pit, then either 0.7 miles (1.1 km) on a slight downgrade to the mills or 1.5 miles (2.4 km), on the average, over a level grade to the waste dumps. The trucks would have a cycle time of 14 to 18 minutes, depending on loading method and destination (6, pp. 16-6 to 16-9; 19, pp. 571-577). An 85-percent equipment availability for the trucks is assumed (19, p. 579). Service and road maintenance equipment includes bulldozers, graders, pick-up trucks, and miscellaneous mechanical and electrical vehicles. Exploration drilling within the pit during mining would be done by an NX core drill.

TABLE 1. - Mine equipment

Equipment description	Number of pieces
Trucks, Caterpillar 777, 85-ton	17
Shovels, 10-cubic yard	4
Front-end loader, Caterpillar 992B, 10-cubic yard	1
Rotary drills, 12-1/4 - inch diameter holes	3
Core drill, NX	1
Bulldozers	5
Graders	2
Pickup trucks	7
Mechanical and electrical vehicles	7

An employment breakdown based on labor factors from a Bureau of Mines cost estimating handbook (24) is given in table 2, and table 3 lists productivities for the mine.

TABLE 2. - Mine employment

Labor category [1]	No. of employees [2]
Direct	
Excavation, load and haul	
Ore	52
Overburden and waste	119
Drill and blast	
Ore	7
Overburden and waste	16
Maintenance [3]	97
Total direct	291
Indirect	
General operations	40
Administrative [4]	
Supervisory	39
Technical	50
Clerical	19
Total indirect	148
Total employment	439

1/ Labor categories (except maintenance) from Bureau of Mines cost-estimating handbook (24).

2/ Number of employees calculated from labor portions of operating costs which were estimated from Bureau of Mines cost estimating handbook (24).

3/ One-third of the direct labor has been assigned as maintenance labor, as was done for a similar-sized mine (4, p. 73).

4/ Administrative labor breakdown based on a breakdown in the Bureau of Mines handbook (24, p. 44).

TABLE 3. - Mine productivity[1/]

Labor category	Productivity, mt per employee per man-shift
Direct	116
Indirect	228
Overall	77

1/ Productivities are given in total ore tonnage (i.e., sulfide and oxide ore) produced per employee.

Beneficiation System

Depending on the degree of oxidation of contained copper minerals, ore would be processed either in the 4,106-short-ton (3,725-mt)-per-day-capacity oxide, tank leaching and electrowinning mill or in the 33,069-short-ton (30,000-mt)-per-day-capacity sulfide flotation mill. Both mills would operate three shifts per day, 357 days per year. The sulfide mill, employing 208 personnel, would operate throughout the life of the mine, and the oxide mill, employing 87 personnel, would operate only during the first 15 years of mine life, after which the oxide ore reserves will have been extracted. Tables 4 and 5 give breakdowns of employment and productivity for the sulfide and oxide mills, respectively.

Water to supply the mills, estimated at 19,000 acre-feet per year, or 12,000 gallons per minute (gpm) 66,000 cu m/day) (1, v. II, p. iv.), would be supplied by a system of 120 water wells, drilled at 4,100-foot (1,250-m) spacings on the Empire Ranch. Each well would consist of a 5-inch (13-cm) hole, rotary drilled in alluvium to an average depth of 150 feet (46 m), lined with perforated steel or aluminum casing, and equipped with a 100-gallon-per-minute (six-liter/second) submersible pump, plastic pipe, and a small surface storage tank. Water from the well storage tanks would flow by gravity through a system of plastic and cement pipe (with increasing diameter at junctions) to a storage reservoir in Empire Gulch (section

TABLE 4. - Employment in mills

Labor category [1]	Number of employees [2] Sulfide mill	Oxide mill
Direct		
Crushing	16	7
Grinding	11	7
Regrinding	7	-
Leaching and solvent extraction	-	8
Electrowinning	-	24
Flotation	14	-
Concentrate thickening	1	-
Concentrate filtering	2	-
Tailings dewatering	2	1
Transport and place tailings	7	3
Maintenance [3]	39	14
Total direct	99	64
Indirect		
General operations	45	11
Administrative [4]		
Supervisory	18	4
Technical	28	5
Clerical	18	3
Total indirect	109	23
Total employment	208	87

1/ Labor categories (except maintenance) from Bureau of Mines cost-estimating handbook (24).

2/ Number of employees calculated from labor portions of operating costs which were estimated from Bureau of Mines cost-estimating handbook (24).

3/ A portion of the direct labor has been assigned as maintenance labor, as was done for similar mills (4, pp. 118, 120, and 136).

4/ Administrative labor breakdowns based on a breakdown in the Bureau of Mines handbook (24, p. 246).

TABLE 5. - Productivity in mills

Labor category	Productivity, mt per employee per man-shift Sulfide mill [1]	Oxide mill [2]
Direct	303	58
Indirect	275	162
Overall	144	43

1/ Productivity in mt of sulfide ore processed per employee.

2/ Productivity in mt of oxide ore processed per employee.

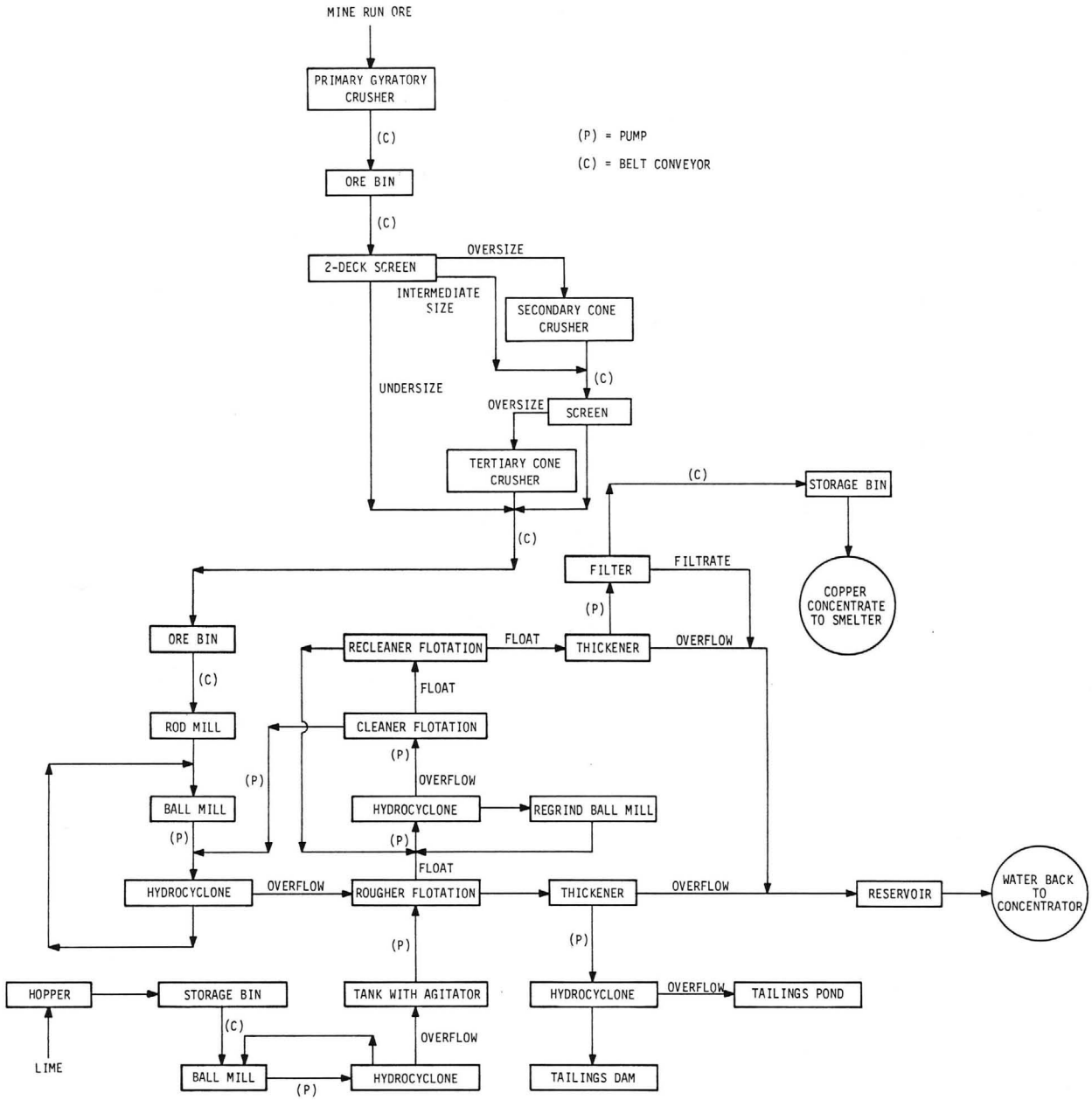


FIGURE 5. - Flow sheet of the proposed sulfide flotation mill (after 4).

15, T. 19 S, R. 16 E. The reservoir, contained by an earthfill dam and designed to hold a two month's supply of mill water, would be held at low water levels to minimize evaporation loss and to permit the catchment of runoff from infrequent summer storms. From the reservoir 12,000 gpm (66,000 cu m/day) of water would be pumped through a steel flume to a smaller reservoir (one day capacity) located above the mills. The sulfide mill would use about 10,500 gpm (57,200 cu m/day) and the oxide mill about 1,500 gpm (8,200 cu m/day). Water from the tailings pond would not be reclaimed because of the long [8-mile (13-km)] distance to the tailings pond in North Gulch.

The mills are described separately in the following sections.

Sulfide Mill

The following description of the beneficiation process is based on published descriptions of typical copper flotation mills (4, pp. 98-114; 24, pp. 195-298). Figure 5 is a flow sheet of the mill. Ore would be reduced in size to 80-percent minus 3/8-inch (0.95-cm) in a primary gyratory crusher and in secondary and tertiary cone crushers, ground to minus 100-mesh in rod and ball mills, and floated in rougher, cleaner, and recleaner cells. Approximately 10 percent of the original mill feed would be reground following rougher flotation. Concentrate would be thickened, filtered, dried, and stored before shipment to the smelter. Tailings would be partially dewatered in thickeners at the mill and then pumped to the disposal pond as described in the preceding section. Table 6 gives an equipment list for the mill. Concentrate would be trucked 20 miles (32 km) north to the Vail, Arizona, railroad shipping point, then shipped 174 miles (280 km) to the Hayden smelter and refinery.

TABLE 6. - Equipment for sulfide flotation mill

Equipment description	No. of pieces
Gyratory (primary) crusher, Nordberg 54-80 H.D.	1
Gyratory (primary) crusher, Allis Chalmers 30-70	1
Cone (secondary) crusher, 7-ft Symons standard	3
Cone (tertiary) crusher, 7-ft Symons shorthead	4
Rod mill, Allis Chalmers 14 x 18-ft.	6
Ball mill, Allis Chalmers 14.5 x 28-ft.	6
Flotation cell, Galigher 120 Agitair	216
Ball mill (regrind), 7.5 x 23 ft.	6
Vibrating screens	2
Conveyor belts	10
Storage bin, fine ore	2
Cyclones	25
Pumps	30

Oxide Mill

The following description of the oxide mill follows closely (with minor modifications) the published descriptions of Anamax's Twin Buttes leaching, solvent extraction, and electrowinning mill (20, pp. 44-45, 14). After crushing to 80-percent minus 3/8-inch (0.95 cm), as in the sulfide mill, the ore would be wet ground to minus 65 mesh in rod and ball mills while maintaining a pulp density of 72-percent solids. At the ball mill discharge, water would be added to provide a 60-percent solids slurry feed to the leaching tanks.

Approximately nine-tenths of the ground ore slurry would go directly to the leaching tanks, the remainder to the pH adjustment tanks to raise pH (figure 6). The actual split would depend on the lime content of the ore and on the pH of the pregnant solution from the leaching tanks. Sulfuric acid, to be obtained cheaply from any of several nearby smelters, would be added to the ground ore slurry at the first in a series of five mechanically-agitated leach tanks. Acid consumption, assuming a similar lime content to the Twin Buttes oxide ore, may be as high as one weight unit of acid for every eight weight units of ore.

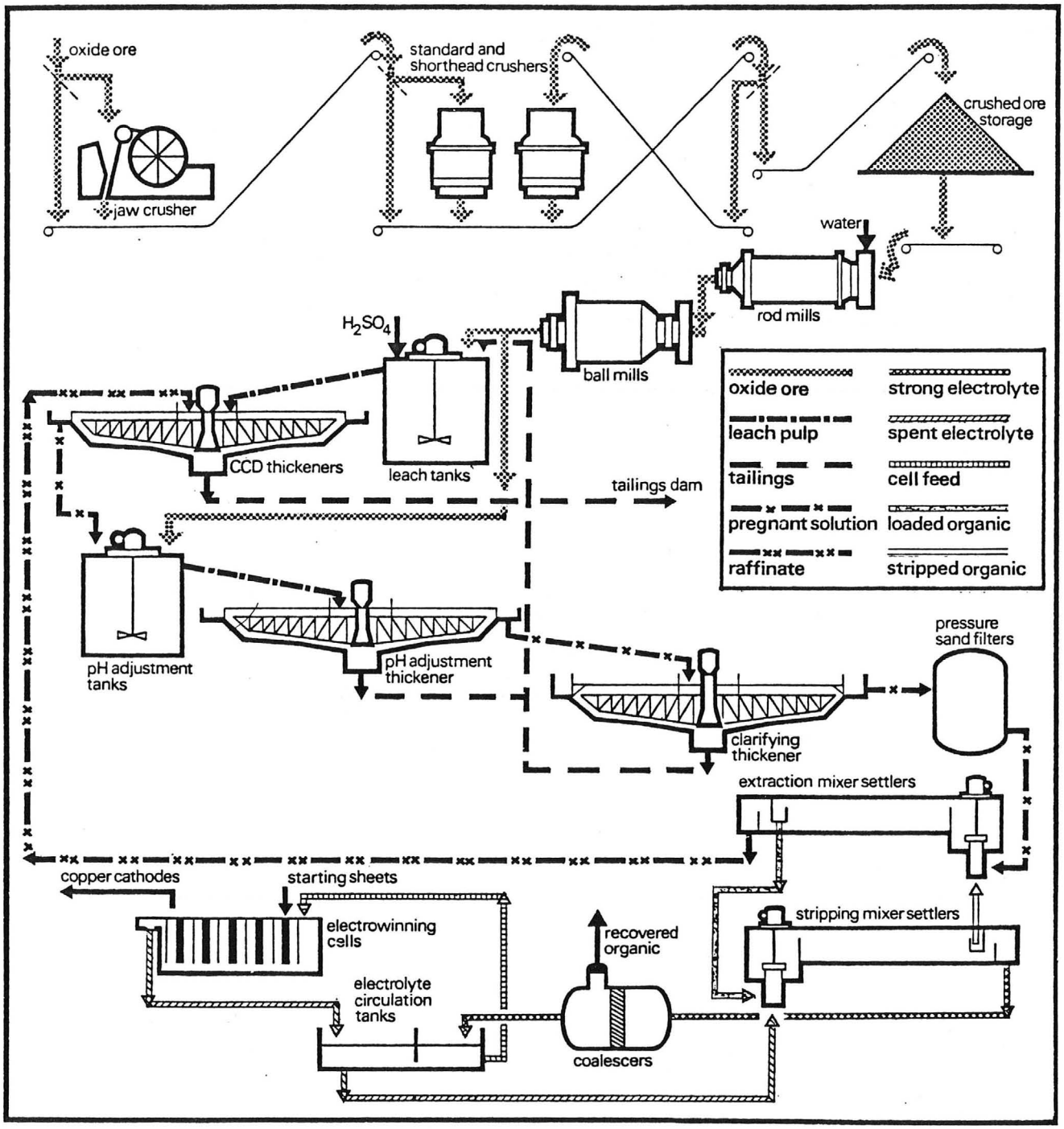


FIGURE 6. - Flow sheet of the proposed oxide leaching, solvent extraction, and electrowinning plant (after 14).

After a leaching period of five hours, the reacted material (at 50-percent solids) is pumped from the final leaching tank to the first in a series of four counter-current decantation wash thickeners (CCD thickeners), where the leach pulp is washed with barren aqueous liquor (raffinate) from the solvent extraction plant. The washed pulp and raffinate move in opposite sequence through the series of CCD thickeners so that the final underflow from CCD thickener No. 4 consists of tailings and the final overflow from CCD thickener No. 1 consists of the copper-rich pregnant solution. The tailings, at 50-percent solids, are partially dewatered by additional thickening before being pumped to the tailings disposal area.

The pregnant solution from the CCD thickeners, at a pH of 1.5 and containing about 0.01 percent solids [100 parts per million (ppm)], is pumped to three mechanically agitated pH-adjustment reactors (similar to the leach tanks) and mixed for 45 minutes with the unleached, one-tenth portion of the ground ore slurry in order to raise the pH to 2.5. The 10-percent solids slurry, after pH adjustment, is thickened to reduce the solids content of the solution to 0.05 percent (500 ppm) and clarified in a clarifying thickener to 0.008 percent (80 ppm). The underflow from both thickeners is returned to the leach tanks. The clarified solution is then filtered to 0.001 percent (10 ppm) solids in vertical downflow dual media pressure sand filters. The backwash recirculates to the pH adjustment tanks, and the filtrate goes to the solvent extraction plant.

In the solvent extraction plant, the pregnant solution, containing 0.030 troy ounces per gallon [2.5 grams/liter (g/1)] copper, is mixed in counter-current fashion in extraction mixer-settlers with a 14-percent solution of LIX 64 N organic extractant in kerosene, which extracts 68 percent of the copper from the pregnant solution. The "barren" aqueous liquor, or raffinate, containing the unextracted 32 percent of the copper is recirculated to the CCD thickeners where it again "picks up" another 100 percent load of copper by washing the leach pulp. The "loaded" organic extractant is stripped of its copper content by counter-current mixing in stripping mixer-settlers with spent electrolyte from the electrowinning plant. The stripped organic extractant is then recycled to the extraction mixer-settlers to load more copper. The regenerated electrolyte is transferred to the electrowinning plant.

The regenerated electrolyte releases any remaining entrained organic material in a coalescer feed reservoir before circulating through direct current electrolytic cells, where copper is deposited on cathodes. The cathodes are washed and stored for shipment to copper fabricators (f.o.b. mill).

Table 7 lists the equipment used in the mill (4, pp. 133, 135).

TABLE 7. - Equipment for oxide mill (from 14)

Equipment description	No. of pieces
Jaw crusher, 32- x 42-inch, Allis Chalmers	1
Cone crusher, standard, 5-ft, Allis Chalmers	1
Cone crusher, shorthead, 45-inch, Allis Chalmers	2
Rod mill, 7-by 12-ft, Denver	2
Ball mill, 9- by 14-ft, Denver	2
Leaching tanks, 24-ft diameter by 22-ft high	5
Reactors, pH adjustment, 6-ft diameter by 6-ft high	3
Thickeners, 250-ft diameter, counter-current decantation wash	4
Thickener, 250-ft diameter, clarifying	1
Filter, sand type, 12-ft diameter, 7-ft 9-inch high	3
Mixer settler, extraction	4
Mixer settler, stripping	2
Coalescer	1
Electrolyte circulation tank	4
Electrowinning cells	80
Cranes, for lifting cathodes	2

ECONOMIC EVALUATION

A Bureau of Mines cost-estimating handbook (24) was used to estimate most of the capital and operating costs for the mine, producing 33,069 short tons (30,000 mt) per day of sulfide ore (tables 8 and 9); the sulfide mill (tables 10 and 11); and the oxide mill, handling 4,106 short tons (3,725 mt) of feed per day (tables 12 and 13). Production schedules for all operations are 357 days per year, three shifts per day. Capital and operating costs for the elctrowinning section of the oxide mill are scaled on the basis of pregnant leach liquor flow rate from another mine using the same process. Land acquisition costs are based on published and unpublished figures for the purchase (merger) of Banner Mining Company (3), for the value of lands traded by Anamax for the Helvetia East property (17), and for purchase of the Empire Ranch (21). Infrastructure capital cost (the cost of installing a water supply system) was estimated by designing a hypothetical system and obtaining

current prices for component equipment and materials. Working capital for the mine and mills was estimated as the amount necessary to pay operating costs for 60 days of mine operation.

Financial analyses, using the MINSIM4 GENERAL program, determined that copper prices of 97.6 and 131.9 cents per pound ($2,152 and $2,908 per mt), respectively (appendix B), were required for break-even (0.0-percent) and 15.0-percent rates of return on investment. The cost of shipping sulfide concentrate to the San Manuel, Arizona, smelter and refinery is estimated to be $8.17 per short ton ($9.01/mt) of concentrate (24). Smelter and refinery operating costs of $85.29 per short ton ($94.02/mt) of copper sulfide concentrate and $168.97 per short ton ($186.26/mt) of blister copper, respectively, were used in the financial analysis. June 1978 byproduct metal prices used in the financial analysis are $183.93 per ounce ($5,913,486/mt) for gold and $5.32 per ounce ($170,908.84/mt) for silver.

TABLE 8. - Mine capital costs
(Design capacity: 30,000 mt of ore per day)

Description	Cost, June 1978 dollars
Land acquisition	$ 73,530,000
Exploration	5,790,500
Access roads	634,500
Preproduction development	30,590,200
Mine plant and buildings	4,659,800
Mine equipment	27,268,100
Engineering construction and management fees	4,574,100
Infrastructure	4,888,100
Environmental impact statement	100,000
Working capital	5,234,400
Total mine capital cost	$157,269,700

TABLE 9. - Mine operating costs
(Design capacity: 30,000 mt of ore per day)

Description	Cost, June 1978 dollars/mt
Direct cost:	
Production development	$1.633
Mining and hauling of ore	0.685
Restoration during production	0.071
General operations	0.151
Total direct cost	$2.540
Indirect cost:	
Administrative salaries and wages	0.227
Administrative purchases and equipment	0.056
Total indirect cost	$0.283
Fixed cost (including overhead, insurance, and local taxes)	0.085
Total mine operating cost	$2.908

TABLE 10. - Sulfide mill capital costs
(Design capacity: 30,000 mt of feed per day)

Description	Cost, June 1978 dollars
Crushing	$ 5,218,300
Grinding	15,267,400
Concentrating	4,002,100
Waste and tailings disposal	9,041,600
Site preparation	20,900
Utilities and facilities	20,630,700
Restoration during construction	377,600
Engineering and construction management fees	4,892,600
Working capital	3,907,800
Total sulfide mill capital cost	$63,359,000

TABLE 11. - Sulfide mill operating costs
(Design capacity: 30,000 mt of feed per day)

Description	Cost, June 1978 dollars/mt
Direct cost:	
Crushing	$0.233
Grinding	0.626
Concentrating	0.337
Waste and tailings disposal	0.116
Restoration during production	0.012
General operations	0.629
Total direct cost	$1.953
Indirect cost:	
Administrative salaries and wages	$0.135
Administrative purchases and equipment	0.020
Total indirect cost	$0.155
Fixed cost:	$0.063
Total sulfide mill operating cost	$2.171

TABLE 12. - Oxide mill capital costs
(Design capacity: 3,725 mt of feed per day)

Description	Cost, June 1978 dollars
Crushing	$ 1,396,200
Grinding	1,887,900
Concentrating and electrowinning	6,991,600
Waste and tailings disposal	2,644,700
Site preparation	2,700
Utilities and facilities	5,042,200
Restoration during construction	36,500
Engineering and construction management fees	1,775,900
Working capital	1,235,100
Total oxide mill capital cost	$21,012,800

TABLE 13. - Oxide mill operating costs
(Design capacity: 3,725 mt of feed per day)

Description	Cost, June 1978 dollars/mt
Direct cost:	
Crushing	$0.358
Grinding	0.643
Concentrating and electrowinning	3.252
Waste and tailings disposal	0.213
Restoration during production	0.012
General operations	0.632
Total direct cost	$5.110
Indirect cost:	
Administrative salaries and wages	$0.226
Administrative purchases and equipment	0.029
Total indirect cost	$0.255
Fixed cost:	$0.161
Total oxide mill operating cost	$5.526

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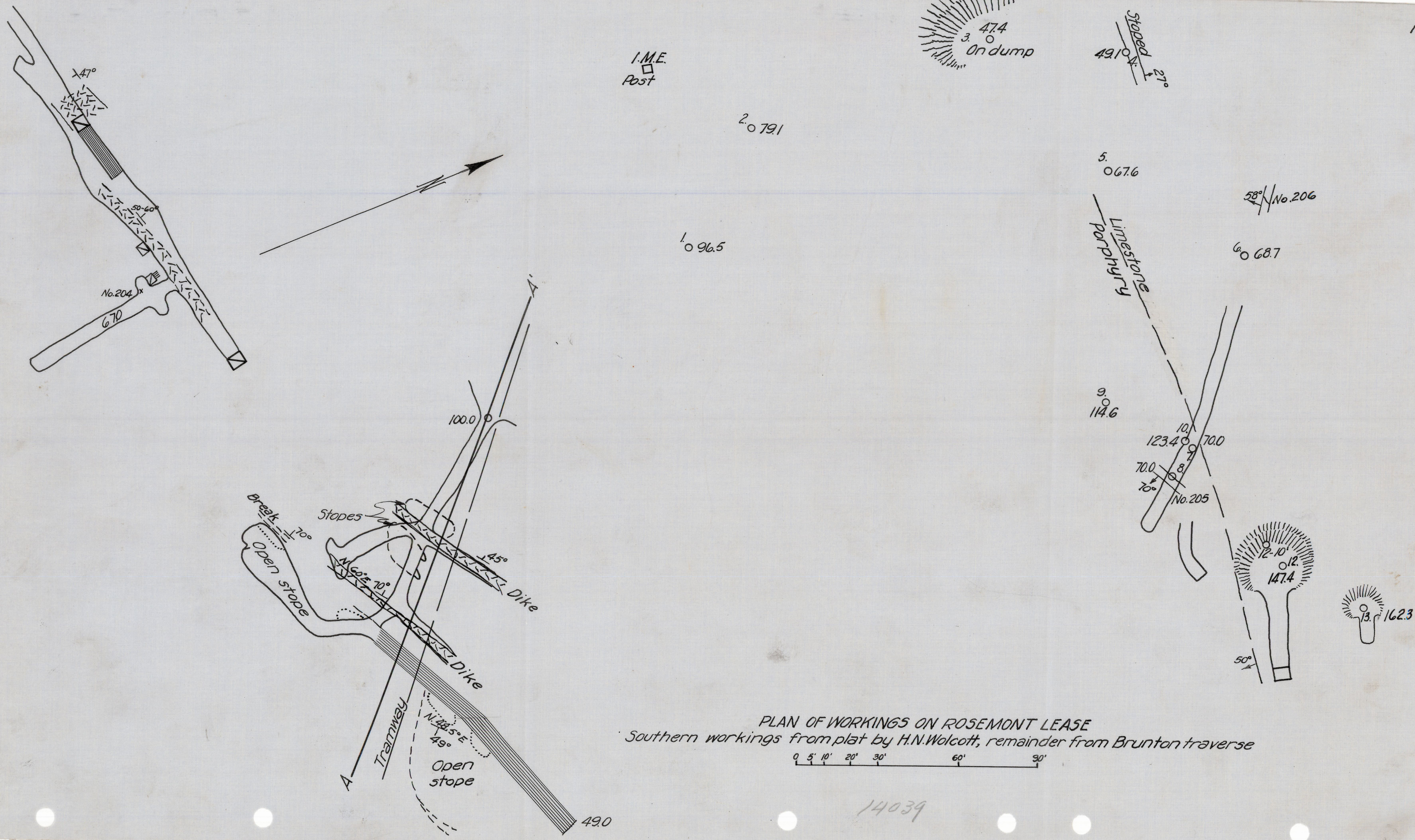
FIG. 3



PLAN OF WORKINGS ON ROSEMONT LEASE

Southern workings from plat by H.N.Wolcott, remainder from Brunton traverse

0 5' 10' 20' 30' 60' 90'

14039