



## **CONTACT INFORMATION**

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United States Department of the Interior



NATIONAL PARK SERVICE

Grand Canyon National Park

P.O. Box 129

Grand Canyon, Arizona 86023-0129

AUG 18 1994

IN REPLY REFER TO:

H32 (GRCA-8219)

Mr. H. Mason Coggin  
Director, Department of Mines and Mineral Resources  
State of Arizona  
1502 West Washington  
Phoenix, Arizona 85007

Dear Mr. Coggin:

Thank you for your interest in Grand Canyon and the Orphan Mine. A copy of your comments has been forwarded to the historian in our Western Regional Office. At the present time a revised version of the Orphan Mine National Register of Historic Places nomination form is being reviewed by the Arizona Office of Historic Preservation. An earlier version was reviewed as a draft by the Keeper of the National Register of Historic Places in Washington D.C. Based on comments from the Keepers office, additional data was collected and incorporated into the form.

After a formal determination has been made as to the status of the historical significance of the Orphan Mine, we will examine our alternatives to best manage the mine and associated structures. We will take your comments into consideration during this process.

Sincerely,

*for Robert L. Arnberger*  
Robert L. Arnberger  
Superintendent

cc:

Jim Garrison, Arizona Office of Historic Preservation, Arizona  
State Parks, 1300 West Washington, Phoenix, Arizona 85007  
w/incoming

ORPHAN MINE (A)

HACK MINE (F)

ther down; it boils and shoots up. The process continues until there isn't enough water left in the system to power the eruption. Things are quiet for minutes, hours, or days, until enough surface water seeps down to reload the geyser.

For some reason that geologists don't understand, not every intitial spurt of water from a geyser will trigger an eruption. That is why Old Faithful is irregular. "It has never and never will erupt every hour on the hour", says park geologist Rick Hutchinson. But the time of the next eruption can usually be predicted from the duration of the last, he says, and it is predictability and size that make it the best known of the geysers. "That", says Hutchinson, "and lots of publicity over the years".

(From Science Digest, via Rear Trunk, .bit Pick & Pack)



No. 19  
by  
Raymond Grant

Here are eight more minerals to add to the list of Arizona minerals. It seems amazing that so many minerals new to Arizona are constantly being found. More data about these minerals will be in the annual supplement to the Checklist. WITTITE, a lead bismuth sulfide and selenide has been found at Middlemarch in Cochise County by Sid Williams. CESBRONITE, a copper tellurite has also been found by Sid from Tombstone, Cochise County. HECTORITE, a lithium clay mineral has been mined at the Lyles Hectorite Deposit in

Yavapai County. The hectorite was used for drilling mud and for complexing with organic compounds. RANCIEITE, a complex manganese oxide was found on the dumps in the Courtland, Cochise County area by Dr. H.Hori of Japan. MACKINAWITE, an iron-nickel sulfide has been found with massive sulfides in the Bagdad, Yavapai County area. Three new minerals for Arizona have been found at the Orphan Mine in Coconino County. The Orphan Mine was worked for uranium in the 1950's and 60's and is in the Grand Canyon. There is a head frame for the mine on the South Rim just west of Grand Canyon Village. The minerals found there include: RAMMELSBURGITE, a nickel arsenide; GERSDORFFITE, a nickel arsenide and sulfide; and SIEGENITE, a nickel-cobalt sulfide. Siegenite has also been found at the Hack No.2 Mine in Mohave County.

ORIGINAL

DEPARTMENT OF MINERAL RESOURCES  
STATE OF ARIZONA  
FIELD ENGINEERS REPORT

Mine Orphan

Date November 19, 1975

District Grand View (Grand Canyon)

Engineer Ken Phillips

Subject: Recent information

Information from: J. Marcell, Coconino County Assessor's Office

Owner: Cotter Corporation  
D.A. Dughman, v.p.-finance  
Jesse Link, Jr., treasurer  
Box 352  
Golden, Colorado  
(303) 232-8218

The property consists of unsecured personal property in the form of mining equipment at the mine site and deeded land at Tuziann, 10 miles south of the Canyon on Highway 60, with equipment and buildings valued in excess of \$120,000. At the mine site the company reported equipment worth \$21,000 and buildings worth \$7,000 for the 1974 tax year. The 1974 report included the addition of \$2,000 worth of equipment.



STATE OF ARIZONA  
DEPARTMENT OF MINERAL RESOURCES  
MINERAL BUILDING, FAIRGROUNDS  
PHOENIX, ARIZONA 85007



March 20, 1968

ORPHAN MINE

Walter<sup>will</sup> Ashwheel, AEC, Grants, New Mexico, Box 2038, Milan, New Mexico 87020  
in the office 3-20-68.

According to Mr. Ashwheel<sup>will</sup>, the Orphan mine has 40 men working and the Cotter company wishes to double production.

Maurice Castagne still is manager and Eric Bruner geologist. Have recently employed a young geologist and plan to increase exploration. The Riverview property in the Cameron area is said to be one of interest.

Interest in the breccia pipes of the Cameron area is attracted by the presence of minerals other than uranium. Cotter can recover copper, etc. in its process.

Uranium exploration also is active in the Globe area and elsewhere in the State.

F. P. Knight, Director.

*Active Mine List  
4-1968 40 men*



ORPHAN MINE (file)

United States Department of the Interior

NATIONAL PARK SERVICE  
DENVER SERVICE CENTER  
12795 W. ALAMEDA PARKWAY  
P.O. BOX 25287  
DENVER, COLORADO 80225-0287



IN REPLY REFER TO:

July 19, 1993

Mr. Ken Phillips  
Arizona Department of Mines and Mineral Resources  
1502 West Washington  
Phoenix, Arizona 85007

Dear Mr. Phillips:

Attached for your review is a draft National Register of Historic Places nomination form for the Orphan Lode Mine in Grand Canyon National Park, Arizona. The draft form has been submitted to the Western Regional Office of the National Park Service for transmittal to the Arizona State Historic Preservation Office.

Any comments that you might have on this draft nomination form should be sent to:

Thomas D. Mulhern  
National Park Service  
Western Regional Office  
Park Historic Preservation  
600 Harrison Street, Suite 600  
San Francisco, California 94107-1372

Thank you for your attention to this matter.

Sincerely,

Harlan D. Unrau  
Historian

Attachment

United States Department of the Interior  
National Park Service

# National Register of Historic Places Registration Form

This form is for use in nominating or requesting determinations of eligibility for individual properties or districts. See instructions in *Guidelines for Completing National Register Forms* (National Register Bulletin 16). Complete each item by marking "x" in the appropriate box or by entering the requested information. If an item does not apply to the property being documented, enter "N/A" for "not applicable." For functions, styles, materials, and areas of significance, enter only the categories and subcategories listed in the instructions. For additional space use continuation sheets (Form 10-900a). Type all entries.

### 1. Name of Property

historic name Orphan Lode Mine  
other names/site number Orphan Mine

### 2. Location

street & number Grand Canyon National Park  not for publication N/A  
city, town PO Box 129, Grand Canyon  vicinity  
state Arizona code AZ county Coconino code 025 zip code 86023

### 3. Classification

Ownership of Property	Category of Property	Number of Resources within Property	
		Contributing	Noncontributing
<input type="checkbox"/> private	<input type="checkbox"/> building(s)	<u>2</u>	<u>0</u> buildings
<input type="checkbox"/> public-local	<input checked="" type="checkbox"/> district	<u>22</u>	<u>0</u> sites
<input type="checkbox"/> public-State	<input type="checkbox"/> site	<u>17</u>	<u>0</u> structures
<input checked="" type="checkbox"/> public-Federal	<input type="checkbox"/> structure	<u>8</u>	<u>0</u> objects
	<input type="checkbox"/> object	<u>49</u>	<u>0</u> Total

Name of related multiple property listing:  
N/A

Number of contributing resources previously listed in the National Register N/A

### 4. State/Federal Agency Certification

As the designated authority under the National Historic Preservation Act of 1966, as amended, I hereby certify that this  nomination  request for determination of eligibility meets the documentation standards for registering properties in the National Register of Historic Places and meets the procedural and professional requirements set forth in 36 CFR Part 60. In my opinion, the property  meets  does not meet the National Register criteria.  See continuation sheet.

\_\_\_\_\_  
Signature of certifying official Date

\_\_\_\_\_  
State or Federal agency and bureau

In my opinion, the property  meets  does not meet the National Register criteria.  See continuation sheet.

\_\_\_\_\_  
Signature of commenting or other official Date

\_\_\_\_\_  
State or Federal agency and bureau

### 5. National Park Service Certification

I, hereby, certify that this property is:

- entered in the National Register.  
 See continuation sheet.
- determined eligible for the National Register.  See continuation sheet.
- determined not eligible for the National Register.
- removed from the National Register.
- other, (explain:) \_\_\_\_\_

Signature of the Keeper

Date of Action

**6. Function or Use**

Historic Functions (enter categories from instructions)

Extraction -- Extractive Facility

Current Functions (enter categories from instructions)

Vacant/Not in Use

**7. Description**

Architectural Classification

(enter categories from instructions)

No Style

Materials (enter categories from instructions)

foundation \_\_\_\_\_

walls \_\_\_\_\_

roof \_\_\_\_\_

other Steel, Concrete, Wood, Asphalt,

Corrugated Metal

Describe present and historic physical appearance.

**8. Statement of Significance**

Certifying official has considered the significance of this property in relation to other properties:

nationally     statewide     locally

Applicable National Register Criteria     A     B     C     D

Criteria Considerations (Exceptions)     A     B     C     D     E     F     G

Areas of Significance (enter categories from instructions)

Politics/Government

Period of Significance

1953-1969

Significant Dates

1953-1969

Cultural Affiliation

N/A

Significant Person

N/A

Architect/Builder

N/A

State significance of property, and justify criteria, criteria considerations, and areas and periods of significance noted above.

See continuation sheet

**9. Major Bibliographical References**

See continuation sheet

Previous documentation on file (NPS):

- preliminary determination of individual listing (36 CFR 67) has been requested
- previously listed in the National Register
- previously determined eligible by the National Register
- designated a National Historic Landmark
- recorded by Historic American Buildings Survey # \_\_\_\_\_
- recorded by Historic American Engineering Record # \_\_\_\_\_

Primary location of additional data:

- State historic preservation office
- Other State agency
- Federal agency
- Local government
- University
- Other

Specify repository:

Grand Canyon National Park \_\_\_\_\_

**10. Geographical Data**

Acreage of property Original Survey, 1905 -- 20.26 Acres  
Resurvey, 1961 -- 20.64 Acres

UTM References

A	1 2	3 9 6 3 4 0	3 9 9 2 6 0 0	B	1 2	3 9 6 4 9 0	3 9 9 2 5 6 0
	Zone	Easting	Northing		Zone	Easting	Northing
C	1 2	3 9 6 3 0 0	3 9 9 2 1 4 0	D	1 2	3 9 6 1 6 0	3 9 9 2 1 8 0

See continuation sheet

Verbal Boundary Description

The Orphan Lode Mining Claim Patent No. 43506, located on the South Rim of Grand Canyon National Park, has the following legal boundary description as recorded in Book 32, Page 278, Records of Coconino County, Arizona:

See continuation sheet

Boundary Justification

Boundary as described includes the entire Orphan Lode Mining Claim Patent 43506, dated March 25, 1906.

See continuation sheet

**11. Form Prepared By**

name/title Harlan D. Unrau, Historian  
organization National Park Service, DSC-TWE-Plng date May 28, 1993  
street & number PO Box 25287 telephone (303) 969-2254  
city or town Denver state Colorado zip code 80225

United States Department of the Interior  
National Park ServiceNational Register of Historic Places  
Continuation SheetSection number 7 Page 1SUMMARY

Located on the south rim of the Grand Canyon in Grand Canyon National Park, Arizona, the Orphan Lode mining claim is a 20.64-acre (original 1905 survey measured 20.26 acres but resurvey in 1961 measured 20.64 acres) site approximately 2-1/2 miles west of Grand Canyon Village and several hundred yards north of West Rim Drive between the Maricopa Point and Powell Memorial viewing areas. The mining claim consists of approximately 5-6 acres on the rim, the remainder extending down the precipitous and desolate canyon walls to the north end of the claim some 1,100 feet below the rim. Located and filed in 1893 and patented in 1906, the mine yielded minimal amounts of copper and traces of gold and silver during the next 45 years. Because of its unprofitable production, a 2-3 acre section in the southwest corner of the claim on the rim was developed and operated as a tourist resort facility between the late 1930s and the mid-1960s. All of the structures associated with this building complex were razed by the National Park Service in 1967-68. The discovery of anomalous radioactivity on the property in 1951 led to speculation that the Orphan Mine contained uranium deposits. As a result of exploration and development of the claim between 1953-69, the Orphan Mine achieved its greatest period of significance, becoming one of the leading producers of high-grade uranium ore on the Colorado Plateau and of some of the richest uranium ore in the United States.

With the possible exception of remnants of an early trail from the rim to the lower mine workings and portions of several adits in the lower workings there are no known extant resources on the claim that date from the pre-1950s mining operations. The extant features on the rim, which date from the uranium mining period, include an 80-foot-high steel headframe over the mine shaft and associated surface structures/foundations/debris in a fenced enclosure covering slightly less than 3 acres in the southeast corner of the claim. Most of the buildings in this enclosure were razed by the National Park Service in 1987. A series of extant remnant foundation and superstructure elements and a surviving hoist house, all associated with an aerial tramway that operated between the rim and the lower mine workings during the mid-to-late 1950s, dot the steep canyon walls on the claim. The lower mine workings include several structures and two adits approximately 150 feet uphill and to the southeast of the extant lower tramway terminal remains, an adit leading to the mine shaft, and the so-called "glory-hole" near the north edge of the claim. Portions of the three adits may date to the late 19th or early 20th centuries.

The Orphan Lode Mine property has been abandoned since 1969. While many of the structures, buildings, and objects associated with the mine have either been razed or removed and many of its extant remains are in a state of significant deterioration, the mining property, as a whole, retains a fair degree of integrity since the principal elements of its operation during the 1950s and 1960s remain intact and visible. Each of the 45 extant resources on the claim was present during the uranium mining period from 1953 to 1969 when the Orphan Mine achieved its documented significance and thus contribute to the overall historical significance of the property.

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National Park Service

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DISCUSSION

The Orphan Lode Mine, situated on the picturesque south rim of the Grand Canyon, is not visible from West Rim Drive. However, the 80-foot-high steel headframe and portions of the associated surface development on the rim and remnants of the aerial tramway and lower mine workings can be seen from the heavily visited Maricopa Point and Powell Memorial viewing areas. The paved foot path leading west from Maricopa Point terminates at the east fence of the mine yard and park visitors are required to walk around the south end of the fenced yard, an enclosure covering slightly less than 3 acres, as they proceed to the Powell Memorial overlook. The area immediately surrounding the mine yard is covered with pinon and juniper trees and some sparse mixed vegetation. The fenced mine yard has been topped with volcanic red cinder-type material, and mixed weed vegetation has overgrown portions of the yard.

Immediately to the west of the fenced mine yard is an area of several acres that is part of the original Orphan Lode mining claim. Tourist accommodations were developed and operated in this area from the late 1930s to the mid-1960s. By 1959 the improvements at the resort, then known as the Grand Canyon Inn, had become largely obsolete according to an appraisal conducted by a firm in Phoenix. The improvements included 7 small cottages, each containing 2 units or rooms, a building containing 13 hotel rooms as well as laundry and utility facilities, a lodge building housing a lobby, curio store, bar, cocktail lounge, dining room, kitchen, office, and third floor employees dormitory, a tepee structure, tool house, several small sheds, and a terrace swimming pool. The cottages and 13-unit building were frame stucco with corrugated metal roofs, while the lodge consisted of frame, stucco, and masonry sections and had a corrugated metal roof.

After acquiring this section of the claim at the end of 1966, the National Park Service razed the entire building complex during the next two years. Although the area in which the resort was located is covered with pinon and juniper trees and sparse mixed vegetation, one can find flattened cleared areas where some of the structures presumably stood. No foundation, structural outlines, or other building remnants are visible, but scattered concrete, mortared stonework, brickwork, and cinder-block fragments may be seen. The area of the resort is honeycombed with "social" trails, and evidence of driveways related to the tourist accommodations is visible. A powerline that is still in use crosses the area. A circular graveled site on the north side of the access road from West Rim Drive and approximately 50 yards west of the southwest corner of the fenced mine yard marks the location where a 60,000-gallon water storage tank and associated pumphouse stood from the late 1950s to the late 1980s.

The Orphan mine yard on the rim of the canyon is enclosed with a 6-foot-high standard chainlink fence on its west, south, and east sides. The fence is in poor repair and can be easily penetrated in places. A main gate is located at the southwest corner of the mine yard, and the yard is open to the canyon rim on its north side. The predominant structure in the mine yard is the steel 80-foot-high shaft headframe constructed in 1959 near the canyon rim in the northeast quadrant of the fenced area. Other extant features in the yard, all

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National Park Service

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of which were constructed during the 1950s and 1960s, include a corrugated metal compressor building housing old compressor machinery, a cinder-block wall, hoisting machinery, concrete scales, a powerline, and a part of one cinder block structure.

The mine yard features numerous concrete foundation slabs, wall footings, and porches associated with previously standing corrugated metal structures, which included a lab building, warehouse, mess hall and recreation building, office, core house, timber and framing shed, shop, supporting structures, and ore loading facilities. Various concrete and asphalt pads, and quantities of mining-related machinery parts, ventilation duct piping, electrical transformer and hoisting cable equipment, and debris are scattered throughout the yard. There is evidence of 2 buried underground fuel storage tanks located approximately in the center of the yard.

Immediately below the rim and just northeast of the steel headframe is a corrugated metal water tank painted yellow. The tank is 7 feet in diameter and 15 feet high, rests on a concrete base, and is covered with wood planks.

Just over the canyon rim to the northwest and immediately outside of the fenced mine yard is a two-compartment concrete septic tank that was apparently vented for evaporative purposes. Some 75-100 feet directly below the headframe is a second concrete two-compartment septic tank nestled against an excavated portion of the cliff side. The structure is partially covered with wood planks and corrugated metal and was apparently vented for evaporation. West of the headframe and below the rim one finds what appears to be a small adit that has been cemented shut with a sewer pipe extending out of its bottom.

A short distance below the rim and to the east of the septic tank is a rock-sheltered overhang which features some faint red petroglyphs on its ceiling. Remnants of a loose rock-walled structure are located under the overhang. The rock walls are 2-3 feet in height with an opening for an entryway, and the structure is approximately 5 feet wide and 15 feet long. A fire ring is located in the southeast corner of the structure, and there are smoke stains on the ceiling of the overhang above the fire ring. The rock structure does not possess characteristics associated with prehistoric architecture, and because it is located directly below the location of the aforementioned tourist lodge and is close to the mine yard one can speculate that it may have been related to the resort or that it may have been constructed and utilized by miners.

An old wooden ladder adjacent to the septic tank leads off the rim. One may climb down the ladder and follow along the base of the rock rim wall eastward to the rock overhang. The rock-sheltered overhang may also be reached by following an old trail leading off the rim east of the fenced mine yard. A fallen tree and other debris block this trail, which conceivably could be part of the trail developed by Daniel L. Hogan to reach the lower workings of his copper mine during the late 19th or early 20th centuries.

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National Park Service

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Between the resources on or near the canyon rim and the lower workings of the Orphan Mine one may find a series of foundation and superstructure remnants for the aerial tramway. The tramway served as the medium of transport for ore from the lower workings to the rim during the late 1950s prior to the construction of the mine shaft in 1959. The most visible element of the tramway system is the intermediate hoist house and a rusting metal superstructure with supporting wood beams at the top of the Coconino Sandstone approximately 700-800 feet below the rim. The extant wood frame hoist house still contains a pulley, winch, and related machinery that were used to operate the aerial tramway. The structure (approximately 6 feet x 6 feet) features a 6-pane glass window (each pane of which is broken) and an opening for a missing door on its front (north) facade. The hoist house rests on cement footings and has a corrugated metal roof. Just below the structure are the remnants of a cut log feature. Uphill from the hoist house is at least one set of concrete footings which apparently provided support for an intermediate tramway tower, the remains of which are no longer extant. Further down the canyon slope from the hoist house at the edge of a major dropoff approximately halfway down the Coconino Sandstone another twisted and rusting metal tram tower is anchored in concrete. This tower served as an inflection point for the tramway cables down the steeper part of the canyon cliffs.

Remnants of an old trail or trails lead from the canyon rim to the hoist house. The trail/trails have numerous switchbacks and feature what appear to be old rock retaining walls to buttress sections on slopes and wooden remnants to cross gulleys. There is evidence of erosion and numerous washouts, and portions of the trail/trails appear to have been built during different periods. It is possible that portions of these trail remnants date back to the late 19th or early 20th centuries, and that they may have been expanded by miners during the 1950s to service and maintain the aerial tram towers and hoist house. The trail corridors are littered with cable, electrical, and telephone lines and other mine-related debris.

The lower workings of the Orphan Mine, located some 1,100 feet below the canyon rim, can be reached only by foot via a 2-hour trek along the base of the Coconino Sandstone from the Bright Angel Trail. The lower workings consist of various resources/features at the base of the Coconino Sandstone which are located some 150 feet above and to the southeast of the so-called "glory hole." The resources/features at the base of the Coconino Sandstone are scattered in a semi-circular pattern over a distance of some 150 feet near and along an excavated ledge buttressed in places by a loose rock retaining wall. The easternmost feature is a wood box remnant just below the ledge. At the east end of the ledge is a pile of cut wood scraps. To the west of the pile is a wood plank platform (8 feet x 12 feet) with plank sides that served as the base for a tent frame. A wood frame door with screen is loosely attached to the doorway frame on the west facade of the platform.

Immediately adjacent to the west of the tent frame platform is a frame bunkhouse (10-1/2 feet x 19 feet) that is partially located in an arched cut into the rock formation. The front part (north facade) of the bunkhouse is covered with green rolled roofing tarpaper, the west side of its exterior mid-section is corrugated metal, and the back sections of both west and east sides

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National Park Service

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are wood plank. The front of the bunkhouse is 8-1/2 feet in height, but its corrugated metal roof slopes downward toward the back to fit into the cut arched opening in the rock formation. There are window frames on the east and west sides of the structure, and the east side window frame has glass in it. The bunkhouse has a wood plank floor, interior walls covered with fiberboard, and a framed opening for a front center door. There are two metal frame beds with springs in the bunkhouse, one of which has a mattress. Various magazines, boxes, and printed materials are scattered throughout the interior.

Immediately west of the bunkhouse is a wood frame structure (10 feet x 12 feet; 7-1/4 feet in height) that apparently served as a small mess hall. The structure, similar in form and construction to the bunkhouse, faces north and is partially located in an arched cut into the rock formation. The building's exterior walls and flat roof are covered with green rolled roofing tarpaper. The floor is wood plank, and the interior walls are covered with fiberboard. An opening for a front door is located on the east side of the front facade, and a screened opening for a window is on the west side. The interior of the structure features a wood table, wood stool, and wood shelves, and there are several scattered empty food and beverage can containers.

To the west of the mess hall structure a small 1-1/2-inch diameter pipe protrudes about 1 foot out of the sandstone formation. Discolored brackish water is seeping down the formation below the pipe. Adjacent to the pipe is a spike in the rock formation to which a cable remnant is appended.

West of the pipe are two arched adits that have been driven into the contact between the Coconino Sandstone and Hermit Shale formations. The easternmost of the two adits is approximately 4 feet wide and 5 feet high. The adit extends back into the formation some 15 feet. A pool of discolored, brackish water, which apparently served as a water supply for the mining operations, is dammed by a 2-foot-high concrete wall at the front of the adit. The adit opening was apparently used as a cistern to contain naturally occurring groundwater and continues to discharge a small quantity of water. The open space above the cement wall has a wood frame with screen remnants. A pipe protrudes out of the water. A metal spike with attached cable has been driven into the rock formation, and the cable extends around a large tree below the ledge. It is possible that this adit may have first been bored during the late 19th or early 20th centuries, and that it was expanded and dammed during the 1950s or 1960s.

A second edit, approximately 4-1/2 feet high and 4-1/2 feet wide, is located to the west of the water pool adit. One can see some 50 feet into the adit before it veers to the southwest, apparently into the lower mine workings. A metal wheelbarrow has been placed across the adit's opening to discourage entry. Various colors in the rock around the adit, such as yellow, green, and blue, show evidence of mineral oxidation. It is possible that portions of this adit and tunnel date to the late 19th or early 20th centuries.

A rusty metal pipe and several old wood stakes are located some 50 feet below the ledge. The exact function of these features is not known, but they may be boundary markers or they may have been used to survey the claim.

**United States Department of the Interior  
National Park Service**

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Continuation Sheet**

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At the bottom of the lower workings of the mine some 150 feet below and northwest of the resources around the ledge is the so-called "glory-hole," which has opened up due to subsidence of surface material into mined-out areas of the breccia pipe structure below. The "glory-hole," which has been getting larger at the surface because loose unconsolidated material that surrounds the hole on the downslope is being washed into the opening and material is sloughing off the slope of the opening into the hole, is some 30 feet in diameter and 200-300 feet deep. Cables and wood planks extending across the open "glory-hole" demonstrate an apparent attempt to isolate the open hole from men and equipment in the area. An adit on the west edge of the "glory-hole," portions of which may date to the late 19th or early 20th centuries, leads to the mine shaft.

The remains of the timber supports for the lower aerial tram terminal are located adjacent to the east side of the "glory-hole." Nearby is an enclosure over a small raise into the mine workings.

In addition to the aforementioned resources near the ledge and the "glory-hole," the vicinity of the lower mine workings contains miscellaneous scattered remnants of mining materials and equipment and debris associated with mine operations. Most of these remnants can be best characterized as mine-related junk.

During the 1980s a series of studies demonstrated that the Orphan Lode mining claim posed serious health hazards because of the elevated radiation levels at various locations on the site. The highest radiation levels were recorded at several spots on and near the mine yard on the rim and near the adits and "glory hole" at the lower mine workings. During the mid-1980s the Orphan Mine was the subject of two reclamation studies designed to assess and develop innovative technological solutions for the cleanup of hazardous materials -- one by Landmark Reclamation, Inc., a subsidiary of Energy Fuels Corporation [1986], and the other by the Bureau of Land Management, Phoenix District Office, Division of Mineral Resources in 1986. In December 1992 Harding Lawson Associates of San Francisco prepared a draft preliminary study of hazardous materials at the site and developed a work plan to assess the magnitude and extent of radioactivity resulting from the tailings at the site and assess park visitor and employee exposure.

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National Park Service

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LIST OF CONTRIBUTING RESOURCES

A. MINE YARD ON CANYON RIM

1. Headframe
2. Compressor House
3. Concrete Platform Footings
4. Concrete Pad
5. Concrete Pad
6. Concrete Pad
7. Concrete Slab Foundation
8. Concrete Scales
9. Concrete Pad
10. Concrete Slab Foundation
11. Underground Fuel Storage
12. Hoisting Machinery on Concrete Slab
13. Cinder Block Wall
14. Concrete Slab Foundation
15. Concrete Ramp
16. Fire Hydrant
17. Cement Incinerator
18. Concrete Pad
19. Asphalt Pad
20. Concrete Footings for Walls
21. Underground Fuel Storage
22. Concrete Porch
23. Concrete Footings for Walls
24. Cinder Block Structure
25. Concrete Footings for Walls
26. Concrete Porch
27. Concrete Ore Pad
28. Fire Hydrant
29. Electric Power Pole

B. BETWEEN MINE YARD AND LOWER MINE WORKINGS

30. Water Tank
31. Septic Tank
32. Cemented Adit
33. Rock Shelter Feature
34. Lower Septic Tank
35. Aerial Tram Footings
36. Hoist House
37. Aerial Tram Tower
38. Aerial Tram Tower

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C. LOWER MINE WORKINGS

- 39. Wood Box Remnants
- 40. Wood Plank Tent Frame Platform
- 41. Bunkhouse
  
- 42. Mess Hall
- 43. Protruding Pipe
- 44. Spike with Cable Remnant
- 45. Adit Partially Cemented for Water Supply
- 46. Adit Leading to Mine Workings
- 47. "Glory-Hole"
- 48. Adit Leading to Mine Shaft
- 49. Lower Aerial Tram Terminal

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STATEMENT OF SIGNIFICANCE

The Orphan Lode Mine is recommended for nomination to the National Register of Historic Places under Criterion A, because it is considered as a property significant for its association "with events that have made a significant contribution to the broad patterns of our history." The applicable area of significance for which the mine has been evaluated under this criterion is Politics/Government. The period of significance and significant dates for the mine are 1953-69, the years when it was one of the leading producers of high-grade uranium ore on the Colorado Plateau and of some of the richest uranium ore in the United States. Thus, the mine played an exceptionally important role in the development of the nation's nuclear capabilities during the Cold War under the aegis of the Atomic Energy Commission (AEC). Hence the mine is considered eligible for listing in the National Register under Criterion Consideration G, because its period of significance occurred less than 50 years ago.

The Orphan Lode Mine was also evaluated for significance under National Register Criteria B and C. Under Criterion B the site is not "associated with the lives of persons significant in our [nation's] past." Neither Daniel L. Hogan, who discovered and developed the mining claim during the late 19th and early 20th centuries, nor the persons involved in the post-World War II operation of the uranium mine have made contributions that have sufficient significance for the property to qualify for eligibility under Criterion B.

Under Criterion C the site is not considered to be significant, because its architectural and engineering features do not "embody the distinctive characteristics of a type, period, or method of construction or that represent that work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction."

HISTORIC CONTEXT

In its historic context the Orphan Lode Mining Claim was located and filed in 1893 and patented in 1906. During the next 45 years it yielded minimal amounts of copper and traces of gold and silver. Because of its unprofitable mining production, a 2-3 acre portion in the southwest corner of the claim on the south rim of the Grand Canyon was developed as a tourist resort facility between the late 1930s and the mid-1960s. The discovery of anomalous radioactivity on the property in 1951 led to speculation that the Orphan Mine contained uranium deposits. As a result of exploration and development of the mine between 1953-69, the Orphan claim became one of the leading producers of high-grade uranium ore on the Colorado Plateau and of some of the richest uranium ore in the United States. Thus, the mine played an exceptionally significant role in the development of the nation's nuclear capabilities during the Cold War under the direction of the AEC.

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DISCUSSION

1. EARLY HISTORY OF ORPHAN LODE MINING CLAIM: 1890s-1950s

The Orphan Lode Mine was first prospected as part of the copper mining boom that began to sweep across the Arizona Territory during the 1880s. After the gold fever in California waned during the 1850s miners went east to prospect in Arizona. Prospectors first found placer gold along the Colorado River, then the Gila River, then along Lynx Creek and Rich Hill in central Arizona. They discovered lode gold close to the surface and found silver in Tombstone and Crown King in the southeastern and central parts of the territory, respectively. Boom town followed boom town as the itinerant miners followed strikes and rumors.

Prospecting fever and mining successes contributed to a rapid increase in the population of the territory, as it doubled between 1860 and 1864 and doubled again by 1870. In the 1880 census some 4,700 miners represented one-fifth of the male workers in the Arizona Territory. By 1909 the number of miners had grown to more than 18,000.

Silver production dominated the territory's economy during the years 1865-93, but despite the number and importance of gold and silver strikes in the 19th century Arizona, the two precious metals took a secondary position to copper after 1888. The copper mining boom was initiated in 1880 with the opening of the Copper Queen Mine near Bisbee, and as the 19th century approached its close the price of copper climbed, enabling its production to surpass the value of gold and silver mined in Arizona Territory.<sup>1</sup>

Prospecting began in the Grand Canyon during the late 1860s, but few prospectors were attracted to the desolate and isolated region until the mid-1870s when word of copper and gold along the Colorado River reached other parts of the country. As the copper mining boom swept Arizona in the 1880s prospectors continued to be lured to the territory in great numbers. One such young man was Daniel L. Hogan, an Irishman who had been born on the banks of the Erie Canal in Syracuse, New York, on August 9, 1866.

Arriving in Flagstaff on May 1, 1890, Hogan traveled to the Grand Canyon with Bucky O'Neill, Carl Tinnins, Eddie Leggett, Henry Ward, and several others, reaching the canyon by wagon on November 1. The prospecting tour followed the Colorado River through the canyon. Finding what they thought were promising copper showings between the present-day Powell Memorial and Maricopa Point viewing areas on the south rim, Hogan and Ward, an Oregonian, staked the claim. The single claim covered an outcrop of copper minerals that occurred some 1,100

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<sup>1</sup> Dames and Moore Intermountain Cultural Resources Services, Research Paper No. 6, Gold and Silver Mining in Arizona, 1848-1945: A Context For Historic Preservation Planning, prepared for State Historic Preservation Office, Arizona State Parks, December 1992, pp. 1-2, 53, and Robert L. Spude, "Mineral Frontier in Transition: Copper Mining in Arizona, 1880-1885," New Mexico Historical Review, L1 (January 1976), pp. 19-34.

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feet below the rim of the canyon. Thinking that the deposit occurred as a vein, the claim was located with the outcrops near the north end line; most of the claimed land extended to the southwest, including some 5-6 acres on the rim. Because of the great distance to the nearest claim office in Prescott, Hogan did not file a mining claim until February 8, 1893.<sup>2</sup>

During the next decade Hogan, with the help of Ward, conducted periodic improvement and assessment work on the claim while engaging in a variety of activities in the Grand Canyon. Hogan cut a crude wagon road from Rowe Well to his claim, guided parties into remote sections of the canyon cutting trails as he went, packed for Lombard, Goode and Company while the branch rail line from Williams to Apex was under construction, helped to build Horse Thief Tank, participated in construction of a trail from the tank to Hermit Basin, and aided in construction of a rock and adobe smelter at Rowe Well. During his explorations Hogan filed a claim for a mill site at Indian Gardens but never proved up, later turning his claim over to Ralph Cameron. When the Spanish American War began in 1898, Bucky O'Neill, a colorful character in the history of Grand Canyon lore, raised troops in Arizona for the First U.S. Volunteer Cavalry Regiment ("The Rough Riders") under Colonel Leonard Wood and Lt. Colonel Theodore Roosevelt, and Hogan enlisted as a member of the famed regiment that achieved glory in Cuba.<sup>3</sup>

Following the Spanish American War Hogan returned to Flagstaff where he was appointed deputy sheriff. In 1899 he suffered a knee wound during an encounter with some Navajos he was attempting to arrest.<sup>4</sup>

During the years following the war Hogan resumed improvement and assessment work on the mining claim. Ward sold his interest in the mine to Charles J. Babbitt, a northern Arizona merchant, who reportedly grubstaked Hogan. In those early years Hogan had no residence at the claim, but simply camped on the rim while conducting his improvements. By the early 1900s a crude trail (scattered remnants of which may still be visible), consisting of ropes, ladders, and chiseled rock steps down the precipitous cliffs of the rim to the copper showings some 1,100 feet below the rim, had been constructed. Three short adits were driven into the mineralized outcrops, and some sacks of copper ore were reportedly packed out of the canyon. Because he was an orphan Hogan called his mine the Orphan Lode, but apparently he sometimes referred to it as

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<sup>2</sup> George H. Billingsley, "Prospector's Proving Ground: Mining in the Grand Canyon," Journal of Arizona History, XVII (Spring 1976), pp. 69, 80, and U.S. Department of the Interior, Geological Survey, Open-File Report 86-510, "the Orphan Lode Mine, Grand Canyon, Arizona: A Case History of a Mineralized, Collapse-Breccia Pipe, by William L. Chenoweth, 1986, p. 9.

<sup>3</sup> "Daniel L. Hogan -- Interview, February 3, 1939, and Memorandum for the Files, January 17, 1944, Files, Library, Grand Canyon National Park.

<sup>4</sup> J. Donald Hughes, In the House of Stone and Light: A Human History of the Grand Canyon (National Park, Grand Canyon Natural History Association, 1978), p. 55.

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the Lost Orphan Mine.<sup>5</sup>

After having made improvements valued at \$1150 the claim was surveyed by John F. Hesse, U.S. Deputy Mineral Surveyor, on January 18-20, 1905 (Mineral Survey No. 2004) and found to contain 20.26 acres. The mineral survey indicated that the improvements on the claim included one shaft (4 x 8 x 10 feet deep) valued at \$100, one tunnel (4 x 6 x 80 feet long) valued at \$800, and one tunnel (4 x 6 x 25 feet long) valued at \$250. (A copy of the mineral survey may be seen on the following page.)<sup>6</sup> The Orphan Lode Mining Claim was patented (Patent No. 43506) on March 23, 1906, to Hogan and Babbitt, the certificate bearing the signature of President Theodore Roosevelt.<sup>7</sup>

Within months of the approval of the patent President Theodore Roosevelt took the first of several steps to provide protection for the Grand Canyon. Two executive orders, establishment of the Grand Canyon Game Reserve on November 28, 1906, and establishment of Grand Canyon National Monument on January 11, 1908, had the effect of prohibiting prospecting and mining on all lands in the canyon which were not already covered by valid claims. Later on February 26, 1919, Congress established Grand Canyon National Park, and on August 15, 1919, the national park was transferred from the administration of the U.S. Forest Service, a bureau in the Department of Agriculture, to the newly-established National Park Service (NPS) under the Department of the Interior.<sup>8</sup>

During the early decades of the 20th century Hogan, a resident of Flagstaff, continued to conduct periodic mining operations at the Orphan Mine as "a side line." Hogan reportedly had a series of partners for his mining ventures, including the aforementioned Babbitt, Sam Finley, who later operated a hardware store in Phoenix, and Charles Mills from Ajo, who later became president of the Valley Bank at Phoenix. When Hogan managed to get ore to the top of his claim on the canyon rim, he would stockpile it preparatory to packing it off via railway to El Paso, the freight costs virtually eliminating any profits from the copper, gold, and silver derived from the workings. Hogan, who would serve as chief of one of early hose fire companies and mayor of Flagstaff, devoted most of his time to his construction business, and he built several structures

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<sup>5</sup> Billingsley, "Prospector's Proving Ground," p. 80, and Chenoweth, "Orphan Lode Mine," p. 9.

<sup>6</sup> A copy of mineral survey may be found in "Orphan Mine," L 3023-2.0 and L 3023-3.0, File 2 of 2, Files, Division of Resources Management Grand Canyon National Park. Also see, U.S. Atomic Energy Commission, Report C-731, "Certification of the Orphan Lode Claim, Arizona District, Coconino County, Arizona (Application No. 705)," by J.F. Brown, 1955, pp. 1-6.

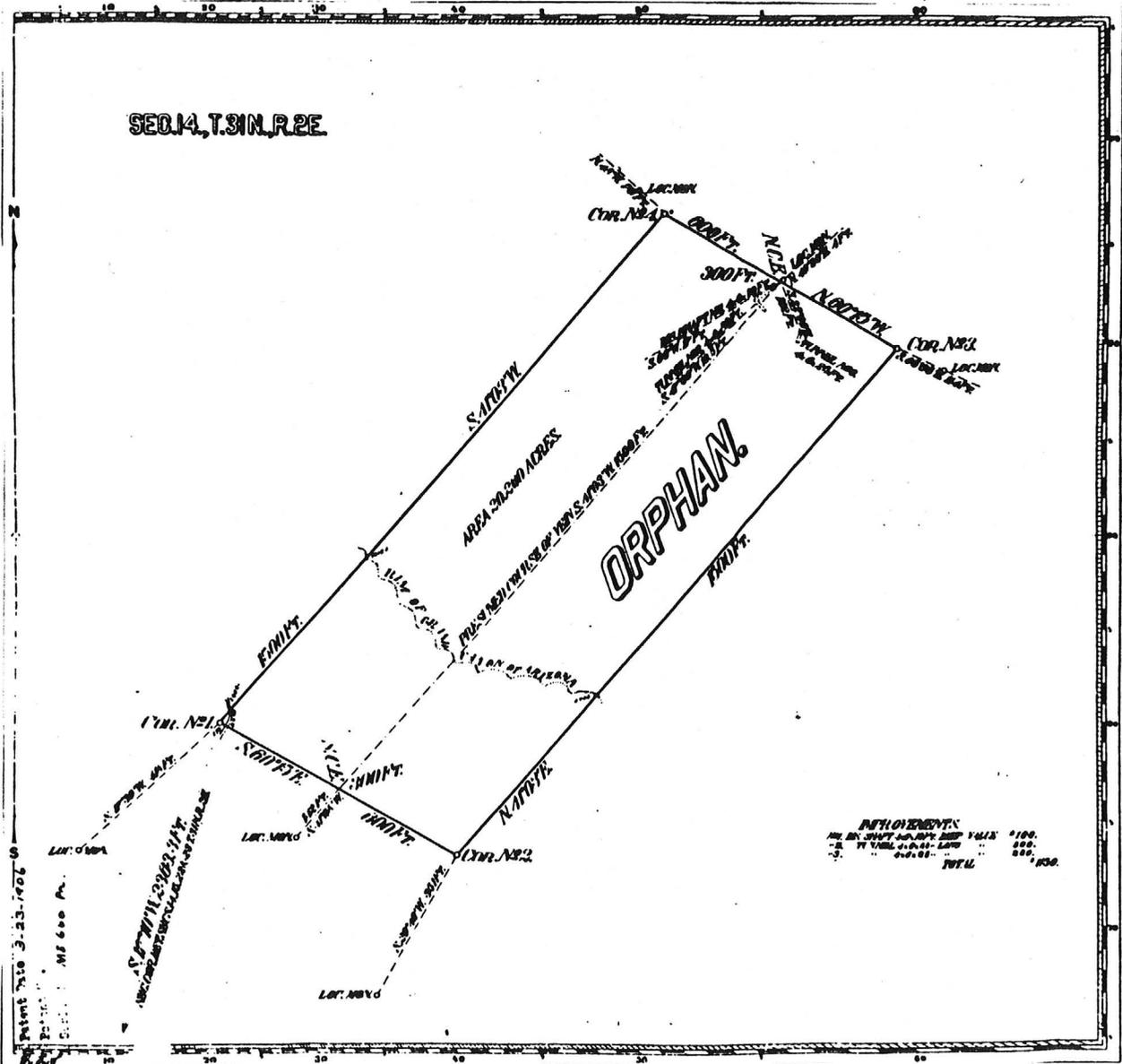
<sup>7</sup> General Land Office No. 43506, Certificate No. 660, Book 32, Deeds, pp. 278-80, Coconino County, Arizona, Records, General Land Office, Volume 430, pp. 205-08. (Copy on file in File L-1425, Grand Canyon National Park).

<sup>8</sup> U.S. Department of the Interior, National Park Service, The National Parks: Index 1991 (Washington, 1991), p. 21.

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Claim located  
Mineral S

D.L. HOGAN

IN GRAND (COCOVIA) containing an...  
Scale  
No. 21  
STRIED

The Original Map  
W.L. Hogan  
known as the

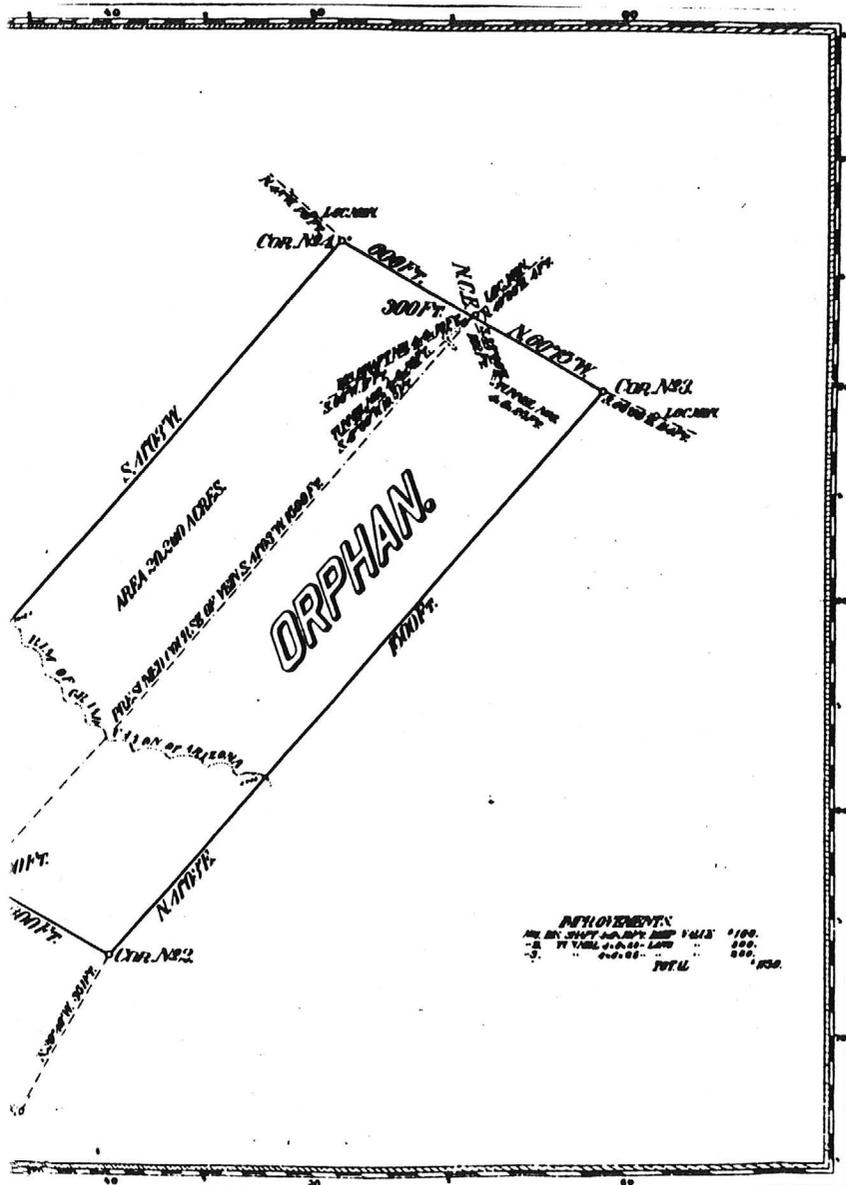
(Note: which the...  
has been...  
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were...  
is made...  
as well...  
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been...  
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that the location...  
upon this...  
provements...  
there...  
and...  
claim...  
thereof...

W.L. Hogan  
Phoenix, AZ  
April 11

e Interior

Historic Places



Claim Located Feb. 24th, 1905.

Mineral Survey No. 2004

Lot No. Proceed Land District

**PLAT**

OF THE CLAIM OF  
**D.L. HOGAN** & **C. J. BRITT**.

KNOWN AS THE

**ORPHAN**

IN GRAND CANYON MINING DISTRICT,  
 COCHISE COUNTY, ARIZONA

Containing an Area of 30.200 Acres  
 Scale of 800 Feet to the Inch.  
 Mean Variation 10° 05' 30" E.

STRIKEN Nov. 13-20 1905 BY  
 Geo. F. Hooper  
 U.S. Deputy Mineral Surveyor.

The Original Field Notes of the Survey of the Mining Claim of  
 D.L. Hogan & C. J. Britt  
 known as the  
**ORPHAN**

From which this plat has been made under my direction & supervision examined and approved, and are on file in this Office, and I hereby certify that they furnish such an accurate description of said Mining Claim as well, if incorporated into a patent, as will fully identify the premises, and that such references are made therein to natural objects or permanent monuments as will perpetuate and fix the locus thereof.

I further certify that Five Hundred Dollars worth of labor has been expended or improvements made upon said Mining Claim by claimants or their grantors, and that said improvements consist of (see table)

that the location of said improvements is correctly shown upon this plat, and that no portion of said labor or improvements has been included in the estimate of expenditures upon any other claim.

And I further certify that this is a correct plat of said Mining Claim made in conformity with said original field notes of the survey thereof, and the same is hereby approved.

U.S. Surveyor General in Charge *Frank S. Ingalls*  
 Phoenix, Arizona U.S. Survey General in Charge  
 April 11th, 1905 Arizona.  
 (1205)

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on the Arizona Normal School (now Northern Arizona University) campus, a bank in Kingman, the Bank of Arizona in Flagstaff, an Indian training school at Leupe, and the Coconino County courthouse and sheriff's office in Flagstaff.<sup>9</sup>

Hogan's periodic mining operations at the Orphan appear to have been generally unsuccessful. Several photographs of the of the Hogan property dating from the 1930s are located in the Photograph Collection at Grand Canyon National Park. Two photos dated 1931 and 1936 show one or two small corrugated metal buildings (the buildings are similar but the window and door configurations are different) beside an oiled/asphalted road that is apparently some distance back from the canyon rim. A photo dated September 1931 indicates that Hogan was attempting to sell the property, the sign reading "The Only Land on Rim for Sale -- See Owner on ground or Ed Hamilton at Rowe Well." Notes taken during an interview with Hogan on February 3, 1939, attest to the difficulties and small-scale nature of his mining operations:

His mine yields copper, gold and silver, and assays about 17% copper. It is about 1000 feet below the rim, and since the ore bodies extend back toward the rim (naturally into the slope of the cliffs) his patented area or claim extends 1500 feet back from the head of the diggings, and thus includes a small area of the actual rim, that on which his buildings are located. His mine is in the center of the 600 feet wide claim, at the lower end.<sup>10</sup>

A National Park Service study of mineral potential in Grand Canyon National Park in 1942 described the problems that Hogan and other prospectors had encountered in their efforts to extract copper and other mineral deposits from the area. The study concluded:

Copper has long attracted prospectors and speculators to Grand Canyon. All attempts to work the deposits have resulted in failure because of the character of the ore, the small size and irregularity of the deposit, and the extreme inaccessibility of the workings.

As long as the large copper mining developments in Arizona, Utah, and Montana were in operation, there "could be no conceivable reason for considering the insignificant properties of the Grand Canyon region as anything but a very weak

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<sup>9</sup> Arizona Daily Sun, May 13, 1957, Files, Library, Grand Canyon National Park; Mott Dodge and John W. McKlvean, "Hogan's Orphan Mine," True West, November - December 1978, pp. 6-10, 40, 42; and Unidentified newspaper clipping, ca. April 1934, Gladwell Richardson Collection, Box 37, Folder 67, File - "Hogan Daniel," Special Collections and Archives, Cline Library, North Arizona University, Flagstaff.

<sup>10</sup> Daniel L. Hogan -- Interview, February 3, 1939, Files, Library, Grand Canyon National Park.

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and remote reserve."<sup>11</sup>

Since the profits from the Orphan Mine were minimal, Hogan began to consider use of the acreage of his claim on the rim for tourist accommodations. In 1930 Grand Canyon Airlines had been established, operating from an airport (now Valle Airport) some 28 miles south of Grand Canyon Village. Owners of this pioneer airline were C.E. Ruckstill and Irving Kravitz, the former having invented a no-gear-shift axle for automobiles. Hoping to capitalize on the burgeoning tourist business at Grand Canyon, Ruckstill sought a hotel site on the rim free of National Park Service supervision. Thus, he arranged a lease-purchase option arrangement for the portions of Hogan's claim on the rim. Ruckstill's building program never materialized, however, as the lack of an adequate water supply became a significant deterring factor to construction of tourist accommodations.<sup>12</sup>

Soon after Ruckstill's abortive venture, Hogan began construction of a tourist facility on his mining claim. During the spring and summer of 1936 he commenced the conversion of a former barn near the rim into a lodge. On July 6, 1936, Minor R. Tillotson, Superintendent of Grand Canyon National Park, informed Arno B. Cammerer, Director of the National Park Service, that Hogan was constructing a building "on his property along the Rim of the Canyon, close to the Powell Memorial." With some concern Tillotson observed:

Since my last letter, Mr. Hogan has continued the construction, by himself, of the building. The park officers who have visited with Mr. Hogan recently have the impression that he is constructing some sort of a small hotel unit as the second floor of his building is designed to provide for six rooms. The main floor, no doubt, is planned for a business activity such as the possible sale of curios, a dance pavilion, or a saloon. The basement has sufficient depth to comfortably house two cars and provide for a considerable storage space.

The building constructed by Mr. Hogan is quite prominent along the Rim and is close to the footpath leading to the Powell Memorial, and commands a good view of the Canyon.<sup>13</sup>

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<sup>11</sup> H.E. Rothrock, "Grand Canyon National Park" [Mineral Survey], March 1942, pp. 1-2, Files, Technical Information Center, Denver Service Center, National Park Service.

<sup>12</sup> Clyde M. Brundy, "Orphan With a Midas Touch," Empire Magazine, Sunday Denver Post, November 27, 1977, p. 12.

<sup>13</sup> M. R. Tillotson, Superintendent to the Director, National Park Service, July 8, 1936, Orphan Mine/Grand Canyon Inn/Hogan Property Papers, 1927-69, Archival/Manuscript Collections, Grand Canyon National Park.

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The tourist lodge building was completed by Hogan in 1936 and was originally known as the Grand Canyon Trading Post. After its completion Hogan leased operation of the facility to James Turpin. The basement served as a restaurant/night club, the first floor as a sales area, and the second floor had five sleeping rooms, a bathroom, and a prefabricated shower stall. During 1936 Hogan also built a small power plant (frame and rock wall; 8 feet x 15 feet), two frame stucco cottages (16 feet x 26 feet), one frame stucco cottage (18 feet x 30 feet), a dugout-type storeroom (10 feet x 10 feet), and a garage (19 feet x 15 feet). Three years later in 1939 Hogan constructed four additional frame stucco two-room cottages (14 feet 6 inches x 28 feet), a frame stucco structure containing six two-room units, five garages, four restrooms, and a laundry (20.6 feet x 145 feet), and a frame workshop (8 feet x 10 feet). Other improvements to the property by Hogan during the pre-World War II years included a 10,000-gallon cistern, a septic tank and field drain, two butane tanks, electric powerlines, and several generating units and water pipes. A dirt road led from the lodge to West Rim Drive. The main lodge structure and four of the cabins were located within 75-100 feet of the rim on the southwest side of the mining claim while the other structures were south and further from the rim.<sup>14</sup>

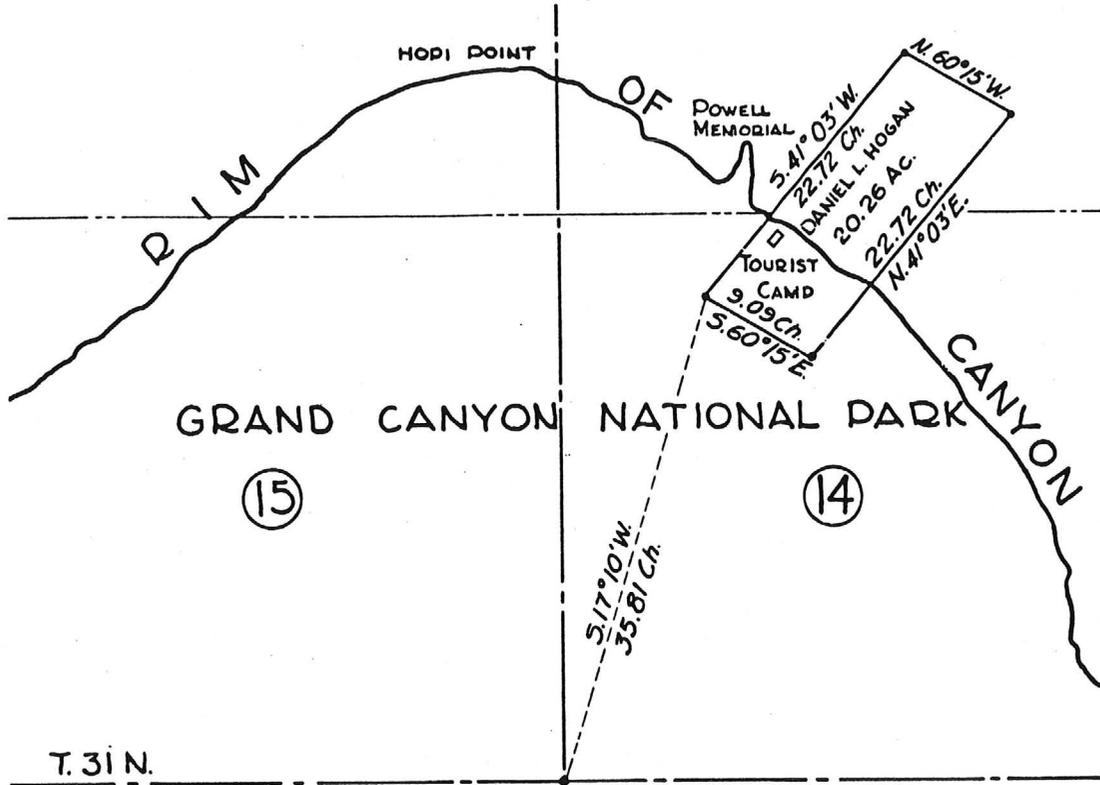
Because it was located on the only remaining privately-owned land on the rim of the Grand Canyon and within sight of the heavily-visited Powell Memorial and Maricopa Point viewing areas along West Rim Drive, Hogan's lodge was considered a nuisance and eyesore by the National Park Service. As a result the bureau derived a series of restrictions that would impact the operations of the tourist facility. All water had to be hauled in from outside the park. The transportation of guests along the rim was prohibited, and horses maintained by the lodge for guests could not use park trails. During the 1940s and 1950s the National Park Service would make several attempts to purchase the property, but all negotiations ended in failure. Because of declining tourism during World War II and continuing friction with Park Service officials, Hogan sold the Orphan Mine claim to Bertha Madeleine Jacobs, a wealthy rancher in the Prescott area, on August 1, 1946, for \$55,000. Never able to turn a profit and giving up her initial plans to expand the tourist facility, Jacobs entered into a 20-year lease-option to purchase agreement on September 16, 1949, with Will

<sup>14</sup> "Appraisal for United States Department of the Interior, National Park Service, Grand Canyon National Park, Grand Canyon, Arizona," by Kelly and Kelly, Realtors and Appraisers, Phoenix, Arizona, as of January 3, 1951; U.S. Department of the Interior, National Park Service, Grand Canyon National Park, "Plat Showing Location of D.L. Hogan Mining Claim," Office of the Superintendent, January 18, 1944 (a copy of the plat may be seen on the following page); "An Appraisal of the Market Value of 20 Acre 'Hogan Property' Tract, Grand Canyon National Park, Grand Canyon, Arizona," Prepared for United States Department of the Interior, National Park Service, Grand Canyon, Arizona, by J. Leslie Hansen, Phoenix, Arizona, November 8, 1950; and "The Grand Canyon Inn and Western Gold and Uranium Orphan Mine, Existing as Shown, August 10, 1959; Orphan Mine/Grand Canyon Inn/Hogan Property Papers, Archival/Manuscript Collections, Grand Canyon National Park. Also see Dodge and McXlveen, "Hogan's Orphan Mine," p. 10.

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COPY FROM BLUE PRINT

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23

US DEPT. OF THE INT. NATIONAL PARK SERVICE  
GRAND CANYON NATIONAL PARK  
**PLAT SHOWING LOCATION OF  
DL HOGAN MINING CLAIM**  
OFFICE OF THE SUPERINTENDENT JAN. 18, 1944  
SCALE 1"=10 CHAINS  
CMC. (LDC - 1-13-55)

R. 2 E.

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Rogers, Jr., son of the well-known Will Rogers, at annual rentals ranging from \$10,800 for the first year to \$15,000 per year. The purchase option figure was set at \$250,000. Rogers operated a curio shop, known as "Roger's Place," in the main lodge structure for about a year, but he could not turn a profit. He withdrew from the contract and vacated the property on September 15, 1950.<sup>15</sup>

Early in 1951 anomalous radioactivity was detected by amateur prospectors on the Jacobs property near the head of Hogan's old trail where he had stockpiled his copper ore preparatory to shipping it out for assay. This discovery gave rise to speculation that the claim contained uranium deposits, and further exploration and development would lead to significant uranium mining operations on the claim within several years.<sup>16</sup>

While the uranium potential of the property was being studied during the early 1950s, several attempts were undertaken to resuscitate the lodge operation. Aware of the uranium potential of the property, Jacobs sold the surface rights to the portion of the claim on the rim to David S. and James D. Barrington of California for \$125,000 on June 1, 1951.<sup>17</sup> During the next two years the Barrington brothers enlarged and remodeled the main lodge building, which they renamed the Kachina Lodge. The principal addition to the structure was a dining room featuring an open-pit barbecue kitchen. The Barringtons also modernized a number of the cottages with Pullman-type toilets, showers, and lavatories. Following their purchase of the surface rights to the Jacobs property, the Barringtons leased property at Rowe Well and purchased the state liquor license for that establishment, subsequently transferring it to their operation at the Kachina Lodge. Unable to make a profit the Barringtons withdrew from their contract with Jacobs in early 1954, and on June 1 she sold the surface rights to the property to William R. and Viola S. Grant for \$116,000. Grant incorporated the lodge facility as Grand Canyon Inn, Inc. and retained the Barrington brothers as managers of the operation. During 1954 further efforts were undertaken to remodel and redecorate the main lodge building, construct a terrace swimming pool near the rim, and surface the spur road to West Rim Drive with asphalt. By 1956 the Grants had fallen into debt, and on November 20, 1956, they sold the surface rights, including the deteriorating facilities of the Grand Canyon Inn, to the Golden Crown Mining

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<sup>15</sup> Brown, "Certification of the Orphan Lode Claim," pp. 1-6, and "An Appraisal of the Market Value of 20 Acre 'Hogan Property' Tract," November 8, 1950.

<sup>16</sup> Max E. Koffard, "The Orphan Mine," in Four Corners Geological Society, Four Corners Geological Society Guidebook, Geology and National History of the Fifth Field Conference, Powell Centennial River Expedition, 1969, p. 190.

<sup>17</sup> Brown, "Certification of the Orphan Lode Claim," pp. 1-6.

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Company.<sup>18</sup>

On August 1, 1957, Western Gold & Uranium, Inc. a New York City-based corporation that had held a majority interest in the Golden Crown Mining Company, acquired full ownership of the Golden Crown. Western Gold established the Grand Canyon Inn Corporation as a subsidiary to operate the resort on the south rim. Andrew B. Pace managed the tourist accommodations and turned a small profit after income taxes of \$5,659 during 1957.<sup>19</sup>

An appraisal of the Grand Canyon Inn in December 1959 indicates that its facilities had become obsolete. The improvements included 7 small cottages, each containing 2 units or rooms, 1 building containing 13 hotel rooms and laundry and utility facilities, the lodge building, housing lobby, curio store, bar, cocktail lounge, dining room, kitchen, office, and a third-floor employees dormitory, 1 tepee, 1 tool house, and some small miscellaneous sheds. The cottages and 13-unit building were frame stucco with corrugated metal roofs, while the lodge was a "hodgepodge structure, partly three stories in height, mostly frame, some stucco and some masonry walls, with corrugated iron roof." Some of the cottages had recent additions, and those in the vicinity of the water tank were "close together and the immediate area" was "clutter[ed] up with small sheds and fencing." All of the buildings were maintained "in pretty good condition, but all of the rental units" were "obsolete."<sup>20</sup>

2. URANIUM MINING OPERATIONS AT THE ORPHAN LODGE MINE: 1950s-1960s

A. OVERVIEW OF ATOMIC ENERGY COMMISSION'S RAW MATERIALS PROGRAMS: 1947-70

Because the post-World War II development of the Orphan Mine was influenced by the programs and policies of the U.S. Atomic Energy Commission, a summary of the agency's raw materials programs is critical to an understanding of the significant role the mine played in contributing to our nation's nuclear

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<sup>18</sup> Report on Hogan Property, Grand Canyon National Park, December 30, 1954, Orphan Mine/Grand Canyon Inn/Hogan Property Papers, Archival/Manuscript Collections, Grand Canyon National Park, and Brown, "Certification of the Orphan Lode Claim," pp. 1-6.

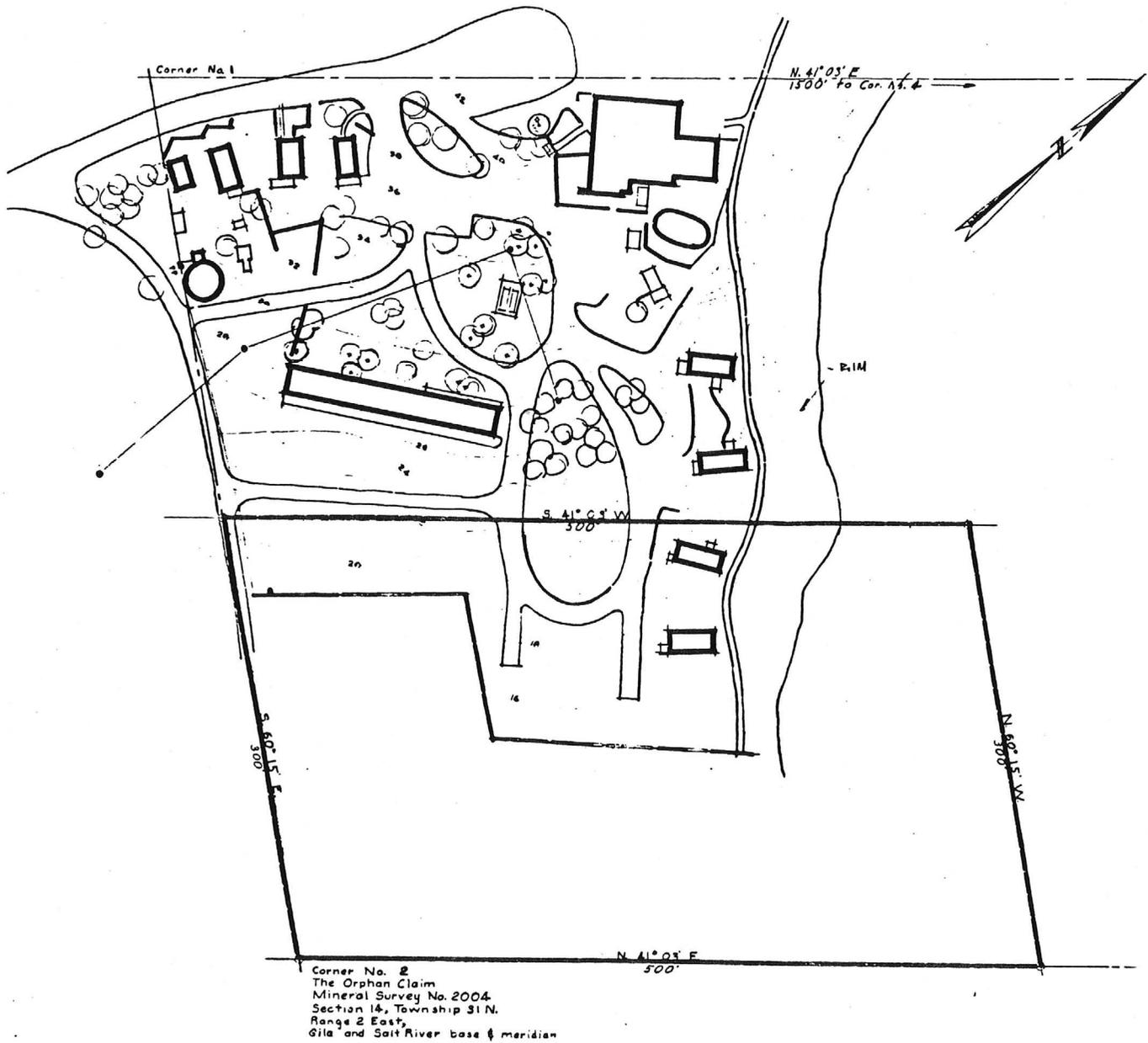
<sup>19</sup> Western Gold and Uranium, Incorporated, Annual Report Fiscal Year Ended January 31, 1958, n.p., Orphan Mine Collection, Archival/Manuscript Collections, Grand Canyon National Park.

<sup>20</sup> "Appraisal Report Compiled by H.B. Embach, Senior Member, American Society of Appraisers, Rooms 220-224 Central Madison Building, 132 South Central Avenue, Phoenix, Arizona, The Orphan Lode Mining Claim (Surface Rights Only) in Coconino County, Arizona, Dated December 16, 1959, for National Park Service, Grand Canyon National Park, Grand Canyon, Arizona," Orphan Mine/Grand Canyon Inn/Hogan Property Papers, Archival/Manuscript Collections, Grand Canyon National Park. See the following page for a layout map of the Grand Canyon Inn complex dated approximately March 1960.

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capabilities during the Cold War. Under authority of the Atomic Energy Act of 1946, the AEC, consisting of five civilians nominated by the president and confirmed by the Senate, was established on January 1, 1947, and invested with full control over all materials, facilities, production, research, and information relating to nuclear fission. Prior to establishment of the AEC, control of the nation's nuclear program had been exercised by the U.S. War Department.<sup>21</sup>

During the period 1947-70 the AEC purchased uranium concentrate from private companies primarily for use in military weapons programs. Prior to April 1, 1962, the AEC also purchased uranium ores and guaranteed the prices paid by the milling companies as an incentive to the uranium mining industries to continue shipping ores to the processing mills. The prices paid by the AEC for uranium concentrate were negotiated independently with each milling company.

During the early years of the AEC program ore producers were paid under the terms of the AEC's Circular 5, Revised. This schedule contained a base price of \$3.50 per pound of uranium oxide ( $U_3O_8$ ) for ores containing 0.20 percent  $U_3O_8$  or greater. Ores containing less than that amount of uranium oxide received a base price grading down to \$1.50 per pound of  $U_3O_8$  in ores containing the minimum acceptable grade of 0.10 percent  $U_3O_8$ . All ores received a mine development allowance of 50 cents per pound, and ores containing 0.21 percent  $U_3O_8$  or more received 75 cents per pound grade premium. Vanadium-bearing ores received 31 cents per pound of vanadium oxide ( $V_2O_5$ ) for their vanadium content. The AEC also paid 6 cents per ton-mile haulage allowance for the first 100 miles. A \$35,000 bonus was paid on the first 10,000 pounds  $U_3O_8$  delivered from new discoveries. Buying stations were established in areas where there were no mills or where mills were under construction. The copper content of uranium ores was purchased at the Marysvale and Monticello, Utah, stations.

These government programs led to a massive prospecting effort during the post-World War II years. Exploration spread from the Colorado Plateau to the entire western United States and, to a lesser extent, the eastern states.<sup>22</sup>

On May 24, 1956, the AEC announced establishment of a new domestic uranium procurement program for the period April 1, 1962, through December 31, 1966. The new program guaranteed to a government market for 500 tons of  $U_3O_8$  in concentrate (yellow-cake) per year from any one mining property or operation at a flat price of \$8 per pound. The prices, premiums, and allowances paid under Circular 5, Revised would be eliminated under the new program, the AEC requiring that mill operators merely pay "reasonable" prices.

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<sup>21</sup> Richard B. Morris, ed., Encyclopedia of American History, Bicentennial Edition (New York, Hagerstown, San Francisco, London, Harper and Row, Publishers, 1976), p. 466.

<sup>22</sup> For more data on this exploratory bonanza see Raye C. Ringholz, Uranium Frenzy: Boom and Bust on the Colorado Plateau (New York, London, W.W. Norton and Company, 1989).

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By late 1957 dramatic increases in reported ore reserves and milling capacity prompted an AEC announcement that it was no longer in the government's interest to expand uranium concentrate production. In November 1958 the AEC placed limits on its 1962-66 procurement program by redefining and withdrawing portions of the price structure announced in May 1956. The AEC announced that it would purchase during the 1962-66 period only "appropriate quantities of concentrate derived from ore reserves developed prior to November 24, 1958, in reliance upon the May 24, 1956, announcement." Some aspects of the program announced in 1956 would be retained. The AEC would purchase concentrate only; the  $U_3O_8$  price would remain at \$8 per pound; ores would not be purchased nor would ore prices be guaranteed. Independent producers were required to negotiate ore purchase contracts with milling companies to sell their ores. As a result of the November 1958 announcement, exploration for new uranium deposits throughout the United States virtually ceased.

In 1962 the AEC became convinced that the private market for uranium concentrates would not be sufficient to sustain a viable domestic uranium industry by the end of 1966 when the procurement program was scheduled to end. On November 20, 1962, the AEC announced a "stretch-out" program for the years 1967-70. Milling companies could voluntarily defer delivery of a portion of their 1963-66 contract commitments until 1967 and 1968 in return for an AEC commitment to purchase, in 1969 and 1970, an additional amount of  $U_3O_8$  equal to the quantity deferred. The "stretch-out" program, in which the Orphan Lode Mine did not participate, was the last of the major policy changes in the AEC uranium procurement program. Since January 1, 1971, uranium produced in the United States has been utilized primarily for the electric utility industry, both domestic and foreign.<sup>23</sup>

B. INITIAL MINING VENTURES: 1951-57

As interest in the uranium deposits of the United States increased after World War II, owing to the immediate need for fissionable materials, the U.S. Geological Survey (USGS) examined known and reported occurrences of uranium and searched for new deposits on the basis of geologic evidence. Hearing of the anomalous radioactivity findings at the Orphan Lode Mine, Geologist Harry C. Granger contacted Jacobs, owner of the Orphan. Samples in Jacob's possession were examined by Granger but were found to be low in radioactivity. Nevertheless, Granger traveled to Grand Canyon to study the old Hogan workings on April 22, 1951. At the time of his examination Granger found three small

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<sup>23</sup> Material for this section was extracted primarily from U.S. Department of the Interior, Geological Survey, Open-File Report 85-0648, "The Production History and Geology of the Hacks, Ridenour, and Chapel Breccia Pipes, Northwestern Arizona," by William L. Chenoweth, pp. 6-7.

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developments on the claim, all dating from Hogan's copper mining operations. According to U.S. Geological Survey Bulletin 1147-A he made the following findings:

The upper working was a small pit about 5 feet deep at the contact between the Coconino sandstone and the Hermit shale, about 35 feet southeast of the collapse structure. A small pool of water in it suggested that the pit may have been dug primarily as a source of water. A little efflorescent material on the walls was weakly radioactive.

The middle working, which was about 80 feet lower than the upper working, was in Coconino sandstone along the southeast margin of the collapse structure. The main adit trended S. 20° W. for about 25 feet, and a 15-foot working branched from the main adit near the portal. A fracture in the main adit contained malachite and iron oxides, but other nearby fractures were essentially barren. The sandstone contained blebs and streaks of copper sulfate minerals, chrysocolla, hematite, and some sulfide minerals. The walls of the adit were covered with efflorescent iron and copper minerals associated with gypsum. A composite sample composed of rock chips taken every 5 feet along the walls of the main adit contained 0.043 percent U and 0.064 percent eU.

The lower working was in the lowest outcropping part of the collapse structure, about 150 feet lower than the normal base of the Coconino sandstone. An adit extended S. 55° - 50° W. for 45 feet, then turned sharply and extended S. 28° E. for 25 feet. Within the adit nearly all the sandstone was impregnated with pyrite, arsenopyrite, chalcopyrite, and hematite; secondary and efflorescent minerals were chrysocolla, chalcantite, or brochantite, and gypsum. At the portal of the adit was a vertical iron-stained shear zone about 5 feet wide that locally contained torbernite. The strike of this shear zone was about N. 25° W., nearly normal to the trend of the adit.

A composite sample composed of rock chips taken every 10 feet along the walls of the lower adit contained only 0.006 percent U. In sharp contrast, 3 channel samples cut across the torbernite-bearing shear zone near the portal contained 0.093 to 0.72 percent U, and 0.21 to 1.00 percent eU. A selected sample of iron-stained rock on a weathered wall of the shear zone contained only 0.039 percent U but 12.5 percent eU.<sup>24</sup>

After learning that the claim contained high-grade uranium deposits, Jacobs leased the mineral rights to several small mining companies. Lack of adequate capital to finance high development costs, coupled with the inaccessibility of the lower mine workings, however, hampered development of the deposit for

<sup>24</sup> U.S. Department of the Interior, Geological Survey, Bulletin 1147-A, Reconnaissance Study of Uranium Deposits in Arizona, by H.C. Granger and R.B. Ramp (Washington, Government Printing Office, 1962), pp. A-7-A-9.

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several years.<sup>25</sup>

Through the auspices of Arthur R. Still, a consulting USGS geologist in Prescott, the Golden Crown Mining Company, a subsidiary (60 percent owned) of New York City-based Western Gold & Uranium, Inc., leased the mineral rights to the Orphan Mine on September 29, 1953. Western Gold, whose western headquarters were at St. George, Utah, was operating a small silver-uranium mine in the Silver Reef near Leeds, Utah. The lease carried a 10 percent royalty with an option to purchase the mineral rights for \$20,000.<sup>26</sup>

After resolving a dispute with Jacobs, the Golden Crown completed the lease and option and acquired the mineral rights to the property on November 20, 1956. As part of the same transaction the company, as aforementioned, acquired the surface rights to the property. Thus, the Orphan Lode became the only active mining operation within the boundaries of Grand Canyon National Park.<sup>27</sup>

To test the amenability of the ore at the Orphan claim with conventional uranium milling circuits, Golden Crown submitted a 350-pound sample to the Atomic Energy Commission's Grand Junction Office during the summer of 1954. The sample consisted of a composite collected in one of Hogan's old adits. Analysis by the National Lead Company's Raw Materials Development Laboratory at Winchester, Massachusetts, indicated the sample contained 0.217 percent uranium oxide ( $U_3O_8$ ), 1.45 percent vanadium oxide ( $V_2O_5$ ), 0.81 percent copper, and 3.6 ounces of silver per ton. The sample was amenable to both acid and alkaline leaching.<sup>28</sup>

Geologic mapping of the former Hogan adits began, and exploratory diamond drilling commenced in October 1955 under the supervision of Max E. Kofford, a mining geologist from Tempe, Arizona. On December 14, 1955, the Golden Crown Mining Company announcing that a major uranium deposit had been located on the Orphan Mine claim. The deposit reportedly contained between 100,000 and 300,000 tons of ore averaging 0.45 percent  $U_3O_8$ , providing anticipated profits of some \$30 per ton. The company's geological staff had determined that the structure was "of a pipe nature; mineralization has occurred around the perimeter of the structure with minable vein width of 30 to 40 feet." The report concluded:

The Orphan thus appears to be one of about 25 uranium finds in the U.S. of more than 100,000 tons, and also one of the very few sizeable pitchblende deposits found in this country. Because the ore body is many times the size originally expected, initial production will be delayed

<sup>25</sup> Chenoweth, "Orphan Lode Mine," p. 13.

<sup>26</sup> Brown, "Certification of the Orphan Lode Claim," pp. 1-6.

<sup>27</sup> "Appraisal Report Compiled by H.B. Embach... the Orphan Lode Mining Claim," December 16, 1959.

<sup>28</sup> Chenoweth, "Orphan Lode Mine," pp. 13-14.

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somewhat, with the first ore to be marketed in the spring. It will be trucked 85 miles to the new AEC ore-buying station at Tuba City, Arizona.<sup>29</sup>

On February 16, 1956, the company released the core analysis from the first 14 holes of exploration diamond drilling. On the basis of the drilling results and favorable geological prospects, construction of a three-tower aerial tram from the rim to the north end of the claim was begun in March 1956 (a copy of a map of the claim which may be found in Chenoweth, "Orphan Lode Mine," p.16, showing the route of the aerial tram may be seen on the following page).

The tramway featured an elevated wood control and dump tower with a hoist house and bin at its upper terminal on the rim.<sup>30</sup> The initial shipment of ore from the Orphan to the AEC's purchasing station (operated by Lucius Pitkin, Incorporated) near Tuba City, Arizona, was made on April 25, 1956. The shipment consisted of 20.89 tons of ore that averaged 0.53 percent uranium oxide.<sup>31</sup>

The Rare Metals Corporation of America, which possessed proven reserves in the Cameron, Arizona, area, began construction of a uranium processing mill six miles northeast of Tuba City, in late 1955. While the mill was under construction, the AEC opened an ore buying station in July 1956, one month after the mill began operation. Ores from the buying station were purchased and processed by Rare Metals. The mill had a 300-ton capacity per day and a sulphuric acid leaching process to extract the uranium. Uranium concentrates produced by Rare Metals were sold to the AEC under contract. Ores from independent producers, including the Orphan Lode, were purchased by Rare Metals under the terms of the AEC's Circular 5, Revised.

Ore from the Orphan Lode was trucked to Tuba City by the G.L. Gibbons Trucking Company of Cameron. The NPS, which viewed the mining operation as a visible intrusion on the south rim of the Grand Canyon, charged Golden Crown a fee of 2 cents per-ton-mile for use of roads within the national park. Since there was no room on the claim to dump waste near the adit, and the National Park Service prohibited all mining-related activity off the claim, all waste from development was disposed of underground by backfilling stopes and other mined out areas.

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<sup>29</sup> Ralph G. Brown, President, Western Gold and Uranium, Incorporated, December 14, 1955, a copy of which may be found in Chenoweth, "Orphan Lode Mine," p. A-6.

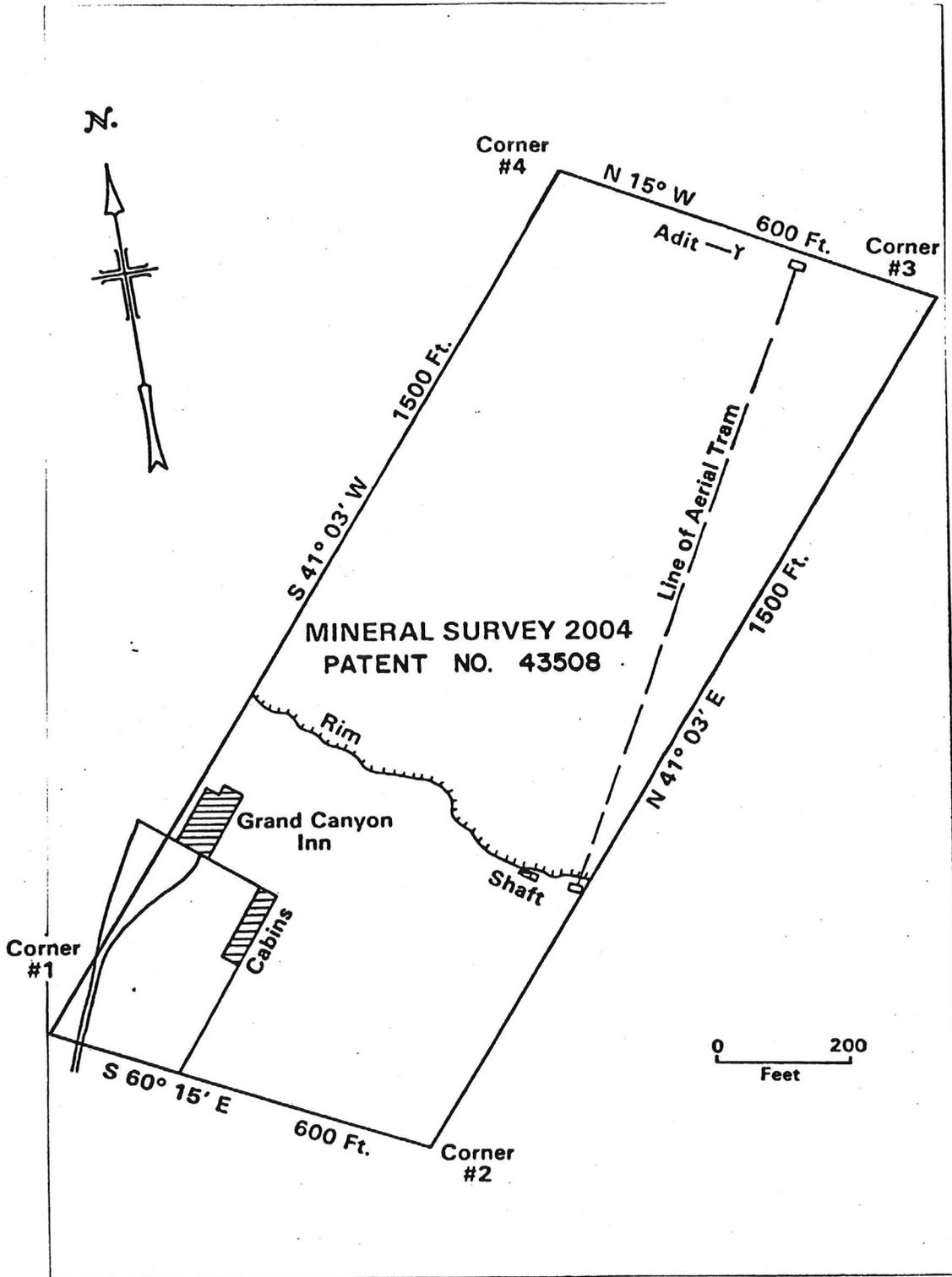
<sup>30</sup> Several photos in the Photograph Collection at Grand Canyon National Park show the elevated hoist house near where the present steel headframe is located.

<sup>31</sup> Chenoweth, "Orphan Lode Mine," p. 14.

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Among the development efforts at the Orphan during 1956 was replacement of the original aerial tram that had proven to be ineffective. A new Riblet tram was completed in May 1956 at a cost of \$61,800. Material for the tramway was purchased from the Riblet Tramway Company of Spokane, Washington, and erected by Western Gold & Uranium. The tram was 1,800 feet long, using an endless steel rope supported on eight towers embedded in concrete, and descended some 1,100 feet at slopes of 37° and 57°. Two tram buckets, each with a capacity of 8 cubic feet (800 pounds), operated in tandem and required 4 minutes for the trip. The tram was powered by a 20-horsepower electric motor located below the control tower at the upper terminal. Mine personnel and equipment were taken to and from the lower mine workings via the tram buckets. Sustained production using the new aerial tram commenced in August 1956. When operating smoothly it could move 45 tons of ore per day to the rim.<sup>32</sup>

During the late 1950s a number of structures were built on the southeast section of the canyon rim portion of the mining claim. Among the buildings, which were primarily corrugated metal structures on cement slab foundations or concrete footings, were a lab building, warehouse, mess hall and recreation building, office, core house, timber and framing sheds, shop, and supporting structures and ore loading facilities. A 60,000-gallon water tank placed atop a tower to hold water that would have to be trucked some 55 miles from Williams was erected along the entrance road to the claim from West Rim Drive. A bunkhouse, mess hall, and tent frame were built near the lower workings.<sup>33</sup>

A new adit was driven parallel to the Hogan adit, and a two-compartment, vertical exploration winze was started about 90 feet from the portal in September 1956. By the following March the winze had reached a depth of 175 feet (the 175 level). At the Orphan mine levels refer to the depth below the adit level. (See two drawings of the Orphan Lode Mine on the following pages; the drawings may be found in Chenoweth, "Orphan Lode Mine," pp.21 and 74, respectively).

Exploration drilling during 1956-57 from the 100 and 175 levels continued to locate ore on the north side of the breccia pipe as well as within the pipe. Some 25 holes totaling 4,000 feet of drilling was undertaken. Company personnel referred to the high grade ore on the north perimeter of the pipe as the A zone and the lower grade ore in the pipe as the B zone. Initial mining at the Orphan concentrated on the high grade ore, consisting of Coconino sand fill cemented by uraninite.

During 1956-57 exploration drilling and mining operations continued at the Orphan Lode. In 1956 production totaled 1,666 tons of ore averaging 0.45 percent U<sub>3</sub>O<sub>8</sub>. Western Gold & Uranium acquired full control of the Golden Crown Mining Company on August 1, 1957. That year drilling indicated that the ore

<sup>32</sup> "How Western Gold Mines Uranium in Grand Canyon," Mining World, January 1959, n.p.

<sup>33</sup> Brundy, "Orphan with a Midas Touch," p. 13, and "Appraisal Report Compiled by H.B. Embach...the Orphan Lode Mining Claim...December 16, 1959."

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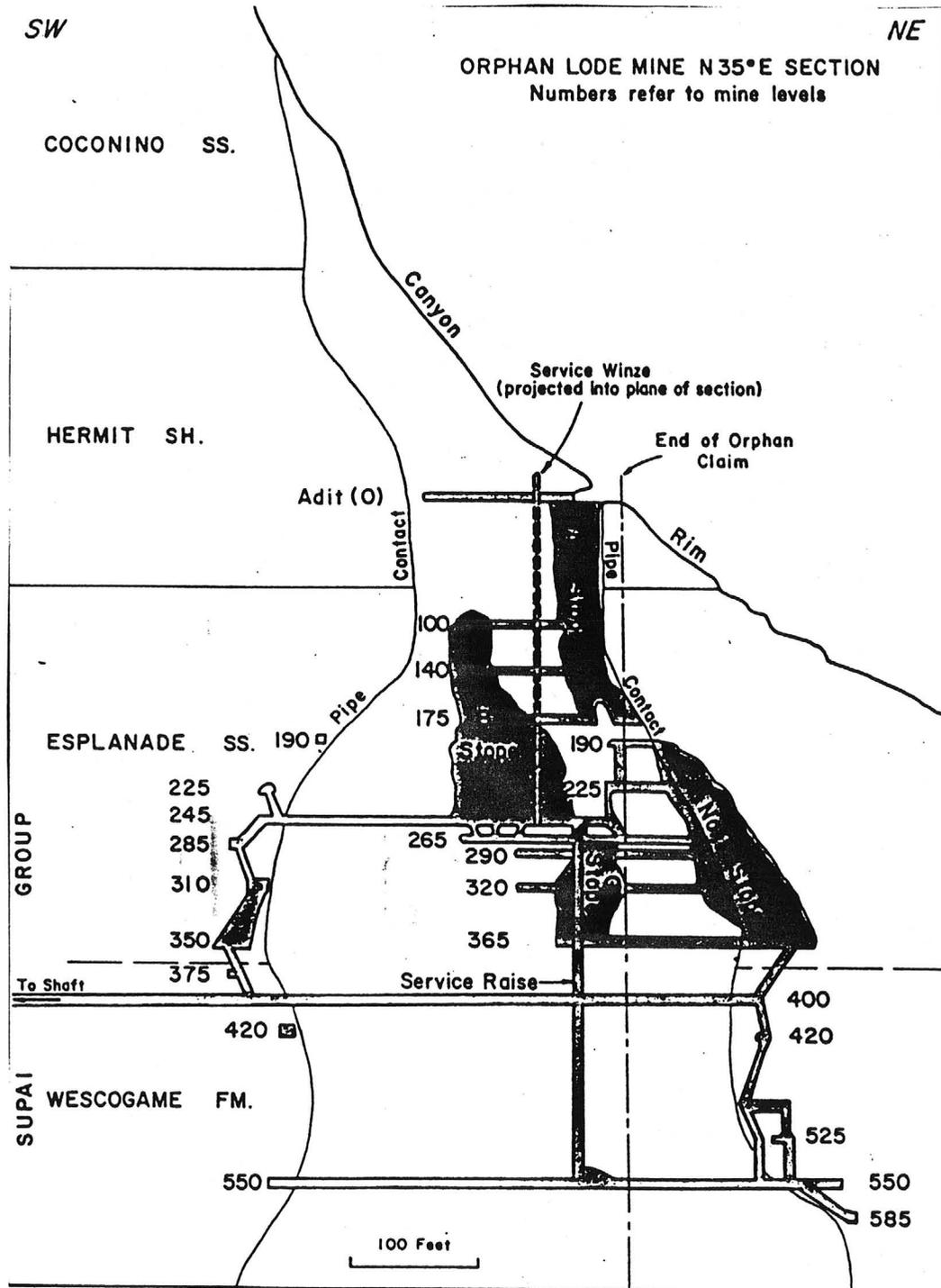
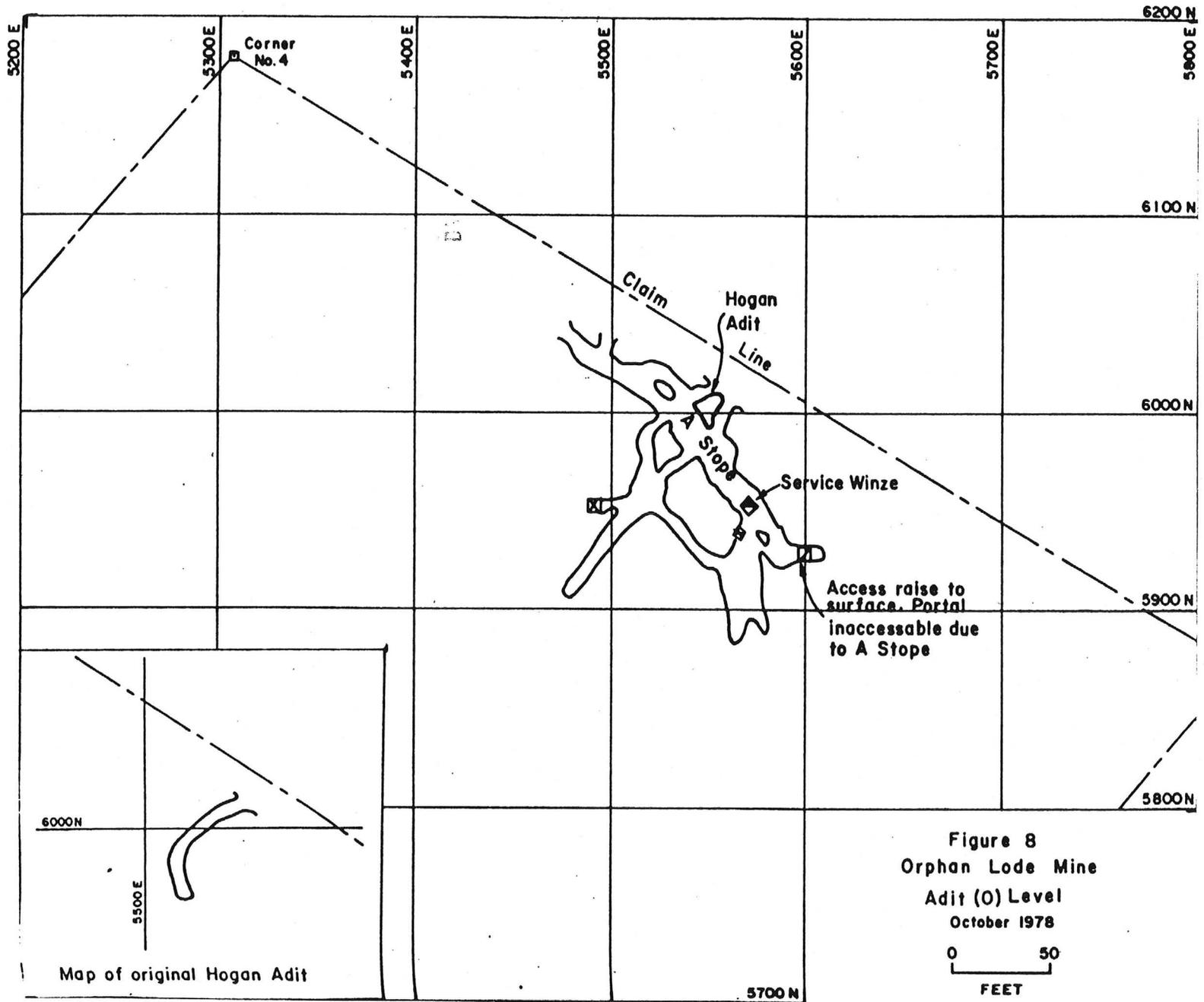


Figure 5. Cross Section, Orphan Lode Mine (Modified from Gornitz and Kerr, 1970)

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body on the north side of the breccia pipe in the upper levels of the mine plunged to the north and west off the claim into the national park. During 1957 the service winze was deepened to the 245 level, and drilling intercepted ore grade material as deep as the 400 level within the pipe. Production during 1957 was 152,916 pounds  $U_3O_8$ . Shipments for January 1957 totalled 726 tons averaging 2.29 percent  $U_3O_8$ , the highest monthly grade ever achieved by the Orphan Lode.

As exploration and mining developed in the high grade A ore body, the ore from that zone was dropped to the 245 level through ore passes. There it was loaded in 16-cubic-foot-capacity ore cars and hoisted up the service winze to the adit level to be put in ore bins at the lower tramway terminal.<sup>34</sup>

C. DEVELOPMENTAL YEARS: 1958-61

Under the direction of mine manager Maurice Castagne significant development of the Orphan Mine was undertaken during 1958-61.<sup>35</sup> In April 1958 Western Gold & Uranium obtained a special use permit from the National Park Service to establish two surface drill stations north of the claim in the national park. A series of core holes was drilled in a southerly direction into the pipe from the two stations. Ten holes with a total footage of 6,175 feet were drilled between July and October by Boyles Brothers, a drilling contractor. The drilling demonstrated that the pipe increased in diameter at the Hermit-Supai contact near the 175 level, a large ore body was present on the north side of the pipe extending off the Orphan claim, ore was present on the south side of the pipe, and ore in the pipe extended below the 245 level. Simultaneously, a long and short hole percussion drilling program was initiated underground to outline the low grade ore surrounding the high grade ore bodies on the 140, 175, and 245 levels.

On May 15, 1958, Western Gold & Uranium reported to its stockholders that its first quarter (ended April 30, 1958) gross income was approximately \$331,012 with net earnings of about \$130,300. These figures were based on production of 3,072 tons of ore from the Orphan Mine containing some 30 tons of uranium oxide. The average grade for all three months topped 0.95 percent  $U_3O_8$ , nearly four times the national average. Orphan production for the fiscal year ended January 31 totalled 7,303 dry tons of ore averaging 0.86 percent  $U_3O_8$ .

The company also reported on the estimated reserves of the Orphan. Among other observations, it noted:

While reserves at the Orphan are still extremely difficult to estimate, two cross-cuts inland from the main ore body have, in the last six weeks, disclosed an additional ore zone of major importance. This new find

<sup>34</sup> Chenoweth, "Orphan Lode Claim," pp. 18-22.

<sup>35</sup> The Archival/Manuscript Collections at Grand Canyon National Park contains an Orphan Mine Blueprints and Maps Collection, consisting of 33 containers of drawings, maps, and blueprints covering the period from 1958-79.

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appears to be comparable in grade and tonnage to the ore body which has furnished all of the Orphan's production to date. Orphan reserves in the original ore body had previously been estimated conservatively at 100,000 tons down to a level of 300 feet below the present mine entrance (which is itself 1100 feet below the Canyon rim surface). Your company's geological department considers the Orphan to be a breccia pipe, or diatreme--this is of volcanic origin with "roots" extending to substantial depths. Core drillings have, in fact, shown good grade ore as deep as 625 feet in one hole and uranium mineralization as deep as 875 feet in another. No reserves below the 300-foot level have yet been estimated, however.<sup>36</sup>

The January 1959 issue of Mining World contained an article providing a detailed description of the mining operations at the Orphan. The article noted:

The winze has one 4-by-4-foot hoisting compartment and a 30-by-48-inch manway, and is timbered throughout. A 25-horsepower Ottumwa hoist is used to lift the 3/4-ton mine cars. An additional development winze is offset 30 feet from the bottom of the first and goes down another 75 feet and is part of the project developing the 250-foot level.

Mining is presently carried on in the drifts on the 100-foot level and in a stope on the 175-foot level. Vertical manways have been driven to connect the workings on the two levels and to improve ventilation.

Six-foot Coromant steel is used with Atlas Copco drills. The water is normally piped down from the rim, but during wet weather some seepage water is caught and utilized. Compressed air is furnished by two compressors. One is an Atlas Copco rated at 620 cubic feet per minute and is located on the surface, while the other is an Ingersoll-Rand 500 cubic feet per minute compressor located in an adit driven by Daniel Hogan, the prospector who originally located the claim, and is electric driven. Apache 45 percent powder is used for blasting and is fired by fuse and cap.

In the drifts, an Eimco Model 12-B mucking machine is used to load the ore into 16-cubic-foot ore cars, which are hand-trammed to the cage, where they are hoisted to the adit level and trammed to the portal. The cars are dumped into an air-operated skip, which is lifted 50 feet to the lower tramway terminal and dumped into two divided bins, which in turn

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<sup>36</sup> Western Gold and Uranium, Incorporated, Annual Report Fiscal Year Ended January 31 1958, May 15, 1968, n.p., Orphan Mine Collection, Archival/Manuscript Collections, Grand Canyon National Park. A brochure prepared by the company for national park visitors stated that the uranium ore produced at the mine was "of the highest grade produced on the North American continent." "The Story of the Orphan Mine," [ca. 1958], Vertical Files -- "Grand Canyon National Park," Special Collections and Archives, Northern Arizona University.

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empty into the tramway buckets.

There are good backs in the drifts, with no bolting or extra support required. Production from the drifts and stopes is regulated to keep the tramway working at full capacity.

Thus far, the cut and fill method used in the stopes has permitted all waste to be disposed of underground. In fact additional waste rock has been brought in from the outside.

Ventilation is provided by an 8-inch electric blower, driven by a 10-horsepower motor, and located on the adit level. Eight-inch vent lines are run down the winze.<sup>37</sup>

In May 1958 the Centennial Development Company, of Eureka, Utah, began sinking a 2 1/2-compartment shaft from the rim to the lower mine workings. The shaft had two 5x5-foot hoisting compartments and a 3x5-manway. The shaft had a concrete collar and used steel shaft sets and fireproof wooden lagging. An 80-foot-high steel headframe was constructed above the shaft near the edge of the canyon rim. The shaft was completed to a depth of 1,590 feet in January 1959 with a station cut at 1,502 feet. The reported cost of the shaft was \$800,000.

A crosscut from the shaft station to the 400 level of the pipe was started on March 20, 1959. The crosscut was completed to the end line of the claim in August 1959.

All waste from the shaft and crosscut was hauled to a dump site the company leased from the U.S. Forest Service near Rowe Well. The NPS charged 2 cents per-ton-mile for haulage of the waste. Considerable quantities of the waste, however, were purchased by the NPS for road ballast and fill for railroad tracks in the park.

In June 1958 Rare Metals limited the Orphan Lode to 16,950 pounds of U<sub>3</sub>O<sub>8</sub> per month that would be accepted at the Tuba City mill. Thus, Western Gold sought markets at other mills, making shipments to Vitro Corporation at Salt Lake City, Texas-Zinc Minerals at Mexican Hat, Utah, and Kermac Nuclear Fuels at Ambrosia Lake, New Mexico. The production limitation at Tuba City was increased to 18,000 pounds of U<sub>3</sub>O<sub>8</sub> per month in November 1958.

The following month Western Gold obtained a special use permit from the NPS to construct 2.5 miles of new road in the park. This road provided access from the Orphan claim to a railroad siding near Grand Canyon Village on the Atchison, Topeka and Santa Fe Railway right-of-way within the park. A loading ramp was constructed to facilitate shipments to mills in New Mexico.

Another series of core holes on the 175 level began in December 1958.

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<sup>37</sup> "How Western Gold Mines Uranium in Grand Canyon," Mining World, January 1959, n.p.

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The drilling demonstrated that (1) ore within the pipe was restricted to above the 375 level with the higher grade occurring above the 245 level, and (2) ore at the 310-350 levels was believed to be continuous around the perimeter of the pipe which had a diameter of approximately 450 feet. Thus, the concept of annular ring ore bodies was developed. Further drilling, however, would locate ore only in the lower levels of the pipe in the annular ring.

In 1958 production totalled 11,846 tons averaging 1.17 percent  $U_3O_8$  and containing 276,258 pounds  $U_3O_8$ , a sharp increase over 1957. The dramatic increase in national uranium ore reserves, of which the Orphan Mine was part, became an increasing concern to the AEC by late 1958. Thus, the agency's curtailment of its 1962-66 uranium procurement program that was announced on November 24, 1958, would have major ramifications for the Orphan Mine.<sup>38</sup>

Although Western Gold & Uranium calculated its reserves for the Orphan Lode as 1,543,000 tons averaging 0.42 percent  $U_3O_8$ , official AEC statistics dated November 24, 1958, showed that there were 296,000 tons of indicated and inferred reserves averaging 0.38 percent  $U_3O_8$  on the claim and 228,000 tons averaging 0.51 per cent  $U_3O_8$  indicated and inferred reserves on national park land. The uranium ore reserves under park land, which the AEC considered the property of the U.S. Government, were valued at \$9,800,000.<sup>39</sup> Without access to uranium ore under park property the financial future of Western Gold's Orphan Lode operations was questionable.

Western Gold sought to obtain the park reserves using legal arguments based on extralateral rights.<sup>40</sup> Under the apex law ore can be mined legally downdip on a lode even if it passes beyond the vertical plane of the side line of a claim. This is not permissible, however, across an end line. Western Gold faced a lengthy legal battle to establish that in the case of the Orphan Lode breccia pipe, the end lines of the claim were actually the side lines. Rather than engage in such a legal skirmish the company determined to negotiate with the Park Service for the ore.

Meanwhile, development, exploration, and drilling work at the Orphan continued in 1959 preparatory to starting production through the new crosscut and shaft. Production via the new shaft began in October 1959, giving the Orphan Lode the capability to hoist 8,000 tons-per-month instead of the 1,000

<sup>38</sup> Chenoweth, "Orphan Lode Mine," pp.23-26.

<sup>39</sup> U.S. Congress, House, Committee on Interior and Insular Affairs, Providing For the Acquisition of a Patented Mining Claim on the South Rim of Grand Canyon National Park, 87th Cong., 2d Sess., 1962, H.Rept. 1286, p.6.

<sup>40</sup> For more data on the legal questions relating to extralateral rights, see Memorandum, K.R. Garrett, Legal Assistant to Chief of Lands, September 29, 1958 (and attachment), L 1415 Orphan Mine Survey 1955, Files, Library, Grand Canyon National Park, and U.S. Congress, Senate, Committee on Interior and Insular Affairs, Acquisition of Patented Mining Claim in Grand Canyon National Park, Arizona, 87th Cong., 1st Sess., 1961, S. Rept. 1039, pp.4-5.

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tons-per-month capacity of the aerial tram. Use of the aerial tram to hoist ore was discontinued once the shaft became operational. In its annual report to the stockholders in 1959 Western Gold reported that it had invested \$1,200,000 in the new developments to transform the Orphan Lode into a full-fledged modern mining operation.

With its operations at the Orphan Mine expanding Western Gold acquired a site several miles south of the national park near the settlement of Tusayan to build a mobile home park for its employees. This mine housing development would become known as Western Village.

The company provided transportation between Western Village and the Orphan Mine. During its most productive years in the mid-1960s the Orphan Mine employed about 100 men. The miners worked in two shifts (7 a.m. - 4 p.m. and 5 p.m. - 1 a.m.). Each man worked the day shift for two weeks and then spent two weeks on the night shift. Each shift consisted of some 25 miners, 4 train crew, a shaft operator, hoistmen, slusher operators, and other miscellaneous personnel.<sup>41</sup>

In July 1959 Western Gold signed an ore purchase agreement with Rare Metals specifying that the Tuba City mill would purchase 8,300 tons-per-month of Orphan Lode ore averaging 0.30 per cent  $U_3O_8$  until the spring of 1962. Western Gold also negotiated an ore purchase agreement with the Phillips Petroleum Company to ship 500 tons-per-month to their mill at Ambrosia Lake, New Mexico. The Phillips mill had an alkaline leaching circuit and could treat high lime ores, such as those of the Orphan Lode, with little difficulty.

Production of the Orphan Mine in 1959 was 26,124 tons of ore averaging 0.56 percent  $U_3O_8$  and containing 291,841 pounds of  $U_3O_8$ . Although the tons of ore more than doubled the 1958 totals, the pounds of uranium oxide increased only slightly since the average grade dropped by more than 50 percent.

In February 1960 U.S. Senators Carl Hayden and Barry Goldwater of Arizona introduced Senate Bill S-3094 which gave Western Gold the right to mine ore in the national park adjacent to the Orphan claim in return for acquisition of the claim by the U.S. Government in 35 years. The AEC approved the bill which would preserve the viability of north central Arizona's uranium industry into the mid-1960s.

In anticipation of the passage of the bill, and after receiving a satisfactory allocation from the AEC, Western Gold & Uranium and the Rare Metals Corporation of America negotiated an agreement whereby Rare Metals would install an alkaline leaching circuit at Tuba City to treat all ore mined at the Orphan Lode through 1966. The Senate bill, however, received little attention in Congress and died from inaction.

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<sup>41</sup> "Orphan Mine Information," Interview of Dick Patton by Jim Stroger, July 1983, p.2, File, Library, Grand Canyon National Park.

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During 1960 exploration drilling and the sinking of an exploration winze from the 400 to the 550 levels were undertaken. The mine's production increased to 77,901 tons of ore containing 473,935 pounds of  $U_3O_8$  averaging 0.30 percent  $U_3O_8$ . The increase over 1959 was the result of all ore being hoisted through the new shaft and development raises that had been completed throughout the lower levels of the mine. During July the mine set an all-time record to date when 7,733 tons were shipped.

During 1960 shipments of high-lime ore (20-30 percent  $CaCO_3$ ) to the Phillips mill in New Mexico increased to 1,000 tons-per-month. Low lime material from the mine was blended with annular ring ore to decrease the overall lime content of the ore shipped to Rare Metals, which still averaged about 12 per cent  $CaCO_3$ . The company reported that lime penalties during 1960 averaged \$3.16 per ton as mandated by AEC directives due to excessive acid consumption.

The Orphan Mine bill was reintroduced in Congress as S-383 in January 1961. In a move that was labeled as political blackmail Western Gold released an artistic sketch of a luxury resort hotel it planned to build on the claim if the bill was not enacted into law. The proposed 800-room hotel stair-stepped down the south rim of the canyon with a massive swimming pool facility at the bottom. Despite the dubious merits of the proposal the plan alerted Congress to the potential significance of the Orphan bill.<sup>42</sup>

During 1961 the exploration winze from the 400 to the 550 level was completed, and a new series of core holes was drilled from a station on the 550 level. Thirteen holes were drilled, including a 1,914-foot-deep vertical hole which bottomed in the Tapeats Sandstone. This hole, begun in April 1961, was completed in May 1962 at a reported cost of \$50,000.

During 1961 a series of holes was drilled in the adit level, and a new adit was started 150 feet above the original adit to develop ore in the uppermost parts of the pipe. Results of this work were disappointing, but the drilling confirmed that the pipe was more circular at that level than originally thought.

The mining methods employed at the Orphan Mine were described in a 1961 study prepared by Dan N. Magleby of the Grand Junction Office of the U.S. Atomic Energy Commission. Magleby observed (profiles of the Orphan Lode from his study may be seen on the following page):

Different mining methods are used in the "B" ore body and the annular ring ore body.

The initial slot stope has been cut adjacent to the northeast claim end line in the lower "B" zone between the 290 and 320 levels. This slot eventually will be extended to the 245 level and three additional slots

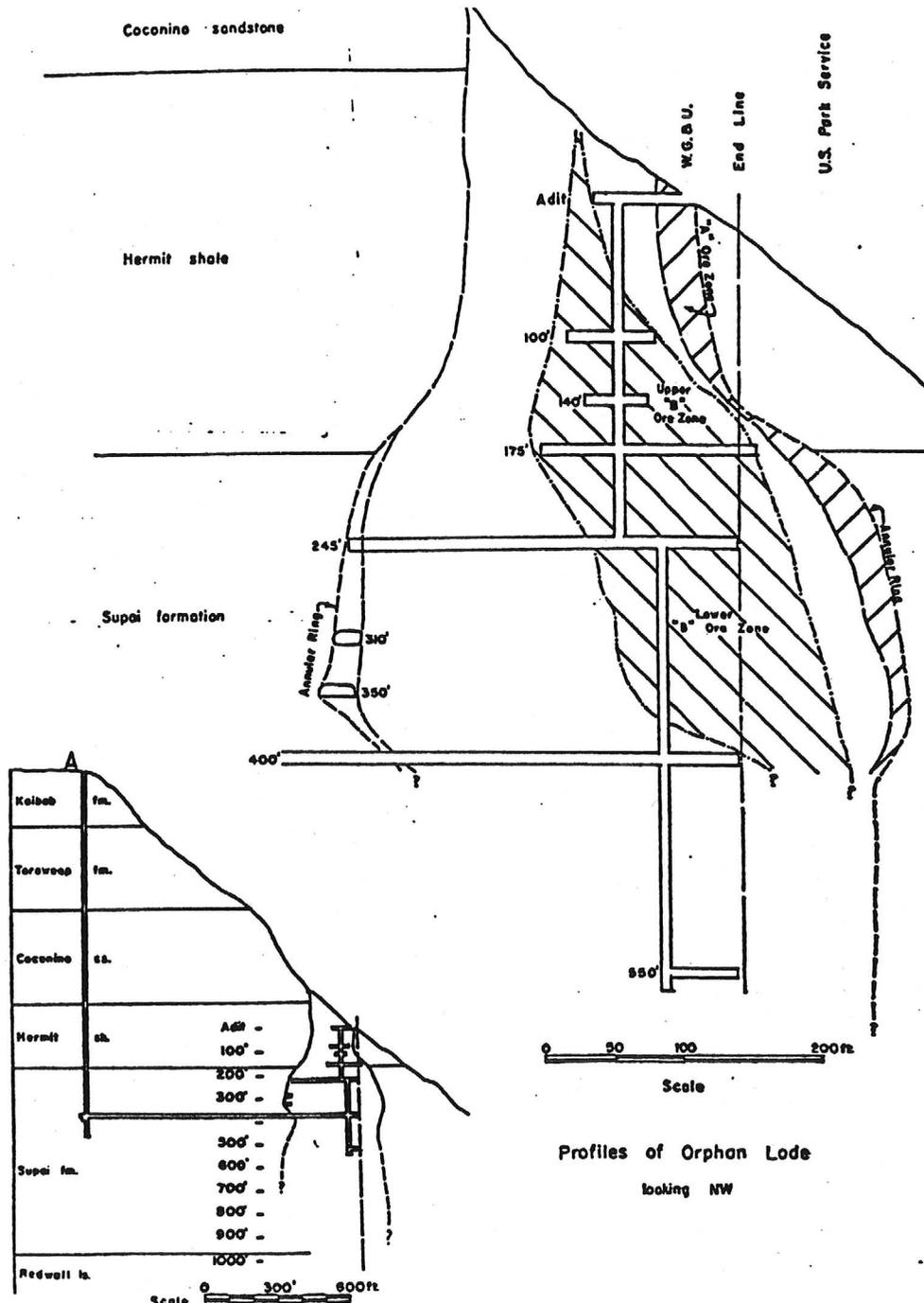
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<sup>42</sup> "Bizarre Hotel Proposed for Grand Canyon Rim," National Parks Magazine, XXXV (September 1961), p.16.

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are planned to mine the entire lower "B" ore body. The grizzly is on the 365 level and from here the ore is passed to the 400 level where it is loaded and trammed to the shaft station. The large scale stoping being carried out in this low grade ore body is producing rock running 0.10%  $U_3O_8$ , even lower than was anticipated.

Above the 245 level (upper "B" zone) this massive ore body is broken with long holes drilled horizontally from vertical raises located in or at the edge of the ore body. The high grade shaft pillar above the 245 is being removed and backfilled with waste to keep the old shaft from the adit in its original position. No timbering or roof bolts are used in the stopes--the walls stand well. All ore is passed to the main haulage level on the 400 level. Ore in the upper "B" zone may become inaccessible for mining if it is not mined out prior to the completion of another slot in the lower "B" zone.

Ore in the annual ring is being developed by untimbered drifts on the 245, 310, and 350 levels which circumscribe about three quarters of the pipe. A drift at the 325 sublevel is being driven to mine the ore above the barren shale horizon in the south and southeast portions of the ring. Several subdrifts will be used to mine the ore horizons between the 310 and 245 levels. Several raises are being run above the 245 level to reach the ore in the northwest segment. Underhand stoping in the "annular ring" has gone all the way from the 310 to the 350 level on the northwest segment of the pipe where the ore is not interrupted by mudstone seams. Slushers and hand tramping are used to move the ore to transfer raises which drop the ore to the main haulage on the 400 level where it is loaded in cars and trammed to the shaft station by a 3-ton Mancha trammer. At the shaft station ore is side dumped into a slusher trench where it is loaded and hoisted to the surface and dumped into storage bins.<sup>43</sup>

In May 1961 heavy rains resulted in major surface runoff and flooding of the mine. Activity above the 245 level was stopped for several days, and when the flooding had ceased there was a foot of water on the 400 level.

Blending of the lower grade, low-lime material from within the pipe with the higher grade, high-lime annular ring zone material continued during 1961. The lime content of the April shipment, however, reached an all-time record of 20.99 percent  $C_aCO_3$ , resulting in penalties for the company. By late 1961 portions of the Orphan were largely mined out, and the production grade of  $U_3O_8$  from other sections was declining. The need to acquire the ore on park land thus became increasingly important to the continued operation of the Orphan Mine.

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<sup>43</sup> U.S. Atomic Energy Commission, Flagstaff Section, Grants Branch, Production Evaluation Division, Grand Junction Office, "Orphan Lode Uranium Mine, Grand Canyon, Arizona," by Dan N. Magleby, March 1961, p.6.

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During August 1961 the Orphan claim was resurveyed. The original corners Nos. 3 and 4 were located, but a small error in the original tie from Corner No. 1 to the southwest section corner of Section 14 was found. As a result of this resurvey, the claim was found to contain 20.64 acres, rather than the 20.26 acres denoted on the original patent.

Western Gold & Uranium, Inc., was acquired by Lee Ackerman of Scottsdale, Arizona, as the result of a stock exchange on September 6, 1961. Ackerman, who had recently made an unsuccessful bid for the governorship of Arizona, owned the Lee Ackerman Investment Company. In November the name of the reorganized company was changed to Western Equities, Inc.<sup>44</sup>

The ore bin on the headframe of the Orphan Mine shaft collapsed on December 22, 1961. While there were no injuries and the miners were evacuated via the aerial tram, several hundred tons of ore plummeted down the shaft and damage to the headframe and shaft were estimated to be between \$25,000 and \$30,000. Upon inspection it was determined that the collapse was caused by a design error in the bin. Mining was stopped for several months while the damage was repaired. The 1961 production, however, was 70,289 tons of ore, averaging 0.28 percent U<sub>3</sub>O<sub>8</sub> and containing 398,699 pounds U<sub>3</sub>O<sub>8</sub>.<sup>45</sup>

D. PRODUCTIVE YEARS: 1962-66

Shipments to the Tuba City mill ceased in January 1962, when the surface stockpile at the Orphan Lode was depleted. The mill closed in May 1962 for lack of ore, thus underscoring the need for the Orphan Mine to gain access to the uranium deposits beyond the claim's borders on national park land.

On May 28, 1962, President John F. Kennedy signed legislation, Public Law 87-457, permitting Western Equities to mine uranium ore in Grand Canyon National Park adjacent to the Orphan claim with the proviso that title to the claim would be transferred to the federal government in 25 years (1987). The law provided that

1. All mining would be underground.
2. The aerial tram could be operated for a maximum of two years.
3. Western Equities could operate the Grand Canyon Inn resort through 1966 after which it would revert to the National Park Service.
4. After 1966 Western Equities would have surface rights on the rim to only three acres in the southeast corner of the claim, and any structures on this portion of the property were to be no more than two stories in height and were to be designed "as to be appropriate to the region."

<sup>44</sup> Brundy, "Orphan with a Midas Touch," p.15.

<sup>45</sup> Chenoweth, "Orphan Lode Mine," pp. 23-36.

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5. Throughout the 25-year period Western Equities could operate and maintain a 60,000-gallon water tank on the property, the access road across the claim to the mine area, the "partial area of the present adit," and any ventilators as required for mine safety.
6. Western Equities was permitted to haul ore on park roads subject to charges negotiated with the NPS.
7. The federal government would receive a "royalty percentage of mine value per dry ton" ranging from 5 to 10 percent.<sup>46</sup>

After passage of the law the AEC negotiated a new contract with the El Paso Natural Gas Company, which had acquired Rare Metals by merger in July 1962. The new contract, signed on November 19, 1962, was effective for the period between September 10, 1962, and December 31, 1966. The Tuba City mill was modified with the installation of a carbonate leaching circuit and a sulfide flotation cell to recover copper and treat high lime ores, which the lime Orphan was increasingly producing. The AEC granted Western Equities an allocation of 572,766 pounds of U<sub>3</sub>O<sub>8</sub> per year under its November 24, 1958, announcement.

Mining resumed at the Orphan Lode on November 20, 1962, along with transport of the ore to the Tuba City millsite. Five crosscuts and drifts were driven to test the ore on park land, while development of the remaining high lime ore in the annular ring on the claim also commenced. When mining resumed, all ore hoisted up the shaft was stockpiled on the ground, and the use of the ore bin was discontinued.

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<sup>46</sup> "An Act to provide for the acquisition of a patented mining claim on the south rim of Grand Canyon National Park, and for other purposes, approved May 28, 1962 (76 Stat. 79), in U.S. Department of the Interior, National Park Service, Laws Relating to the National Park Service, Supplement II, May 1944 to January 1963, comp. by Hillory A. Tolson (Washington, Government Printing Office, 1963), pp.115-18. On August 8, 1962, a deed was executed whereby Western Equities, Inc., formally conveyed the Orphan Lode claim to the United States. The deed was accepted by the NPS on November 19, 1962, and was recorded in Docket No. 197, pages 316-20, Deed Records, Coconino County, Arizona, on December 12, 1962. After the Grand Canyon Inn facilities reverted to the National Park Service at the end of 1966, the bureau razed the entire building complex during the next two years, leaving few traces of the resort on the mining claim.

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In April 1963 the Tuba City mill began processing Orphan Mine ore. The sulfide flotation concentrate contained sufficient sulfide copper to be marketable at a copper smelter. A small amount of silver was also present in the concentrate. In addition, a small amount of copper, solubilized with the uranium, was recovered, using powdered iron as cement copper in the ion-exchange circuit. Both products were trucked to a smelter at Inspiration, Arizona.

During the fall of 1963 an incline was driven from the 550 to the 585 level of the annular ring on the northeastern perimeter of the pipe. This was the lowest level of the deposit to be developed and mined.

During the spring of 1966 Western Equities was sold to the Geo Space Corporation of Houston, Texas, which in turn was merged into Westec Corporation of Houston. On August 25 of that year Westec's stock was suspended from trading on the American Stock Exchange, the company declaring bankruptcy and closing the Orphan Mine. As a result El Paso's mill at Tuba City closed in September, three months before its AEC contract was to expire. The last concentrate from the mill was delivered to the AEC in November 1966.

Production levels at the Orphan Mine reached their highest totals during the 1963-66 period. In 1963 the Orphan Lode produced 614,858 pounds of  $U_3O_8$ . Of this total some 47 percent came from ore mined on park land.

Some 592,047 pounds of  $U_3O_8$  were produced in 1964, the Orphan ore averaging about 1.30 percent copper. Some 75 percent of the total copper or 90 percent of the sulfide copper was recovered. The sulfide concentrate averaged 20 percent copper and 10 ounces of silver per ton.

Production from the Orphan Lode reached an all-time yearly high in 1965 when some 680,746 pounds of  $U_3O_8$  were produced. Of the total pounds of uranium oxide, some 75 percent came from national park land. Ore in the annular ring on the northern side of the pipe within the park proved to be nearly continuous from the 225 to the 365 levels. Here the large No. 1 stope was developed in bleached, brecciated, and unbrecciated Esplanade Sandstone.

In 1966 Orphan Mine production declined dramatically, its output of 32,620 tons of ore containing 268,698 pounds of  $U_3O_8$  and averaging 0.41 percent  $U_3O_8$ . Nearly 60 percent of the uranium oxide came from park land.<sup>47</sup>

E. FINAL YEARS OF PRODUCTION: 1967-69

Following its declaration of bankruptcy on August 31, 1967, Westec requested permission from the U.S. District Court in Houston, Texas, to sell the Orphan claim and related properties to the Cotter Corporation of Roswell, New Mexico, and Canon City, Colorado. Reportedly, Cotter paid \$875,000 in cash for the Orphan claim and Western Village, with Westec retaining a 4.2 percent

<sup>47</sup> Chenoweth, "Orphan Lode Mine," pp.36-40.

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royalty an ore produced.<sup>48</sup> According to the Engineering and Mining Journal, the Orphan Mine had some 500,000 tons of ore averaging 0.35 percent  $U_3O_8$  blocked out when Cotter acquired it.<sup>49</sup>

During 1967 the Cotter Corporation enlarged its mill at Canon City to process 400 tons of uranium oxide per day in an alkaline leaching circuit. A flotation cell was added to remove iron and copper sulfide minerals from the ore prior to alkaline leaching. These sulfides were acid-leached to remove uranium before shipment to the smelter.

Cotter commenced operation of the Orphan Mine in September 1967. The first ore to be shipped to Cotter's Canon City mill was loaded on rail cars at the Atchison, Topeka and Santa Fe Railway Company's siding near Grand Canyon Village on September 27, 1967. Since Cotter's AEC contract had expired on February 28, 1965, all uranium produced after that date was sold to electrical utilities on the private market.

Production at the Orphan Lode in 1968 was reported to be 43,147 tons of ore containing 321,174 pounds of  $U_3O_8$  and averaging 0.37 percent  $U_3O_8$  with nearly equal amounts coming from the claim and park.<sup>50</sup>

The Orphan Mine closed for the last time on April 25, 1969. Cotter attributed the shut down to a freight charge of \$12.96 per ton to transport the ore by rail some 750 miles to its Canon City, Colorado, processing plant. The depressed market for uranium also contributed to the decision to close the mine. All useable equipment and machinery at the mine was subsequently removed from the claim and transferred to other active operations.<sup>51</sup>

After the mine closed the AEC estimated that 500,000 pounds of uranium oxide remained in the mine in low grade material averaging 0.11 percent  $U_3O_8$ . All of the estimated uranium was above the 400 level, and the majority was within the breccia pipe.<sup>52</sup>

<sup>48</sup> Brundy, "Orphan With a Midas Touch," p.16.

<sup>49</sup> "Arizona," Engineering and Mining Journal, CLXIX No.1, 1968, p.122.

<sup>50</sup> Chenoweth, "Orphan Lode Mine" pp.40-41.

<sup>51</sup> "Orphan Mine Information," p.1.

<sup>52</sup> Chenoweth, "Orphan Lode Mine," p.41.

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F. POST MINING YEARS: 1969-PRESENT

After the Orphan Mine closed in 1969 the developments on the three-acre site of the claim on the canyon rim deteriorated. The Park Service viewed the site as "an ugly intrusion" on "the park landscape." The security fence around the three-acre site was in poor repair, and the mine was "a safety hazard to curiosity seekers." While the Cotter Corporation experienced considerable theft and vandalism, it did not employ the services of a security guard to protect its property. A local custodian made periodic checks of the property and reported acts of vandalism.

NPS mining engineers observed in July 1972 that uranium prices would have to increase significantly before any value could be associated with the Orphan Mine ore reserves. The value of the mine developments on the rim was estimated at \$140,000 in March 1973.<sup>53</sup>

During the mid-1970s a dramatic increase in the price of uranium resulted in renewed interest in the Orphan Mine. The Cotter Corporation conducted several feasibility studies concerning the reopening of the mine in 1978 and construction of a uranium processing plant in the Williams, Arizona, vicinity was considered. However, the high costs of mine development and ore shipment, coupled with environmental restrictions and the value of the remaining lower grade ore, served to curtail optimism about the possibility of reopening the mine, and it remained closed.<sup>54</sup>

The Western Village site at Tusayan became increasingly valuable real estate during the 1970s and early 1980s. On February 18, 1981, Republic Mining Enterprises, Inc., of Seattle, Washington, headed by John R. Siebold of Grand Canyon, Arizona, and Elling Halvorson of Redmond, Washington, acquired the Western Village property and the Orphan claim, reportedly paying the Cotter Corporation some \$800,000 for the acquisition. The new owners apparently did little with the Orphan Mine, and the U.S. Government received full title to the claim on May 28, 1987.<sup>55</sup>

By January 1988 most of the structures on the three-acre site on the rim were removed by the Park Service, leaving only the 80-foot-high steel headframe, a corrugated metal compressor building, a cinder block wall,

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<sup>53</sup> "Status Report, Orphan Lode Mine," March 28, 1974, File - "Orphan Mine," L3023-2.0 and L 3023-3.0, File 2 of 2, Division of Resource Management, Grand Canyon National Park.

<sup>54</sup> "Orphan Mine Information," p. 2.

<sup>55</sup> See the following page for a general arrangement of the three-acre Orphan Mine site on the south rim made by Landmark Reclamation, Inc., in 1986. A series of photographs in the Photograph Collection at Grand Canyon National Park taken in 1987 show the structures on the three-acre portion of the claim on the rim.

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hoisting facilities, a powerline, and a part of one cinder block structure standing. Numerous foundations of previously standing buildings, remnants of water and septic tanks, ore storage pads, and various concrete and asphalt pads, as well as considerable quantities of mining-related machinery parts, piping, and debris, are scattered over the three-acre site at present. The three-acre site is enclosed by a chain link fence that is in poor repair, thus making it only partly effective in keeping out curious visitors.

The remaining structures, foundations, and mining-related debris present safety hazards. More serious, however, are the elevated radiation levels throughout the claim, particularly at several locations on the three-acre site on the rim and near the adits and "glory hole" at the lower mine workings.<sup>56</sup>

G. PRODUCTION SUMMARY

Records of the AEC show that between 1956 and 1969 the Orphan Mine produced 495,106.63 dry tons of ore containing 4,266,264.47 pounds (1,640,000 kilograms) of uranium oxide and averaging 0.43 percent U<sub>3</sub>O<sub>8</sub>. Of the total uranium oxide produced some 1,376,615 pounds, or 32 percent, came from ore bodies on national park land adjacent to the claim boundaries. When the mine closed in 1969, the Cotter Corporation estimated the value of the uranium produced to be some \$40,000,000.<sup>57</sup>

The production statistics for the Orphan Mine show that it was by far the leading uranium producer in northwestern Arizona during the AEC procurement program in the 1950s and 1960s. During those years five breccia pipes in Coconino and Mojave counties produced uranium. Besides the Orphan the other uranium miner in those counties were the Riverview near Cameron, the Chapel in the Parashont Wash area on the north rim, the Ridenour on the Hualapai

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<sup>56</sup> U.S. Department of Labor, Mine Safety and Health Administration, Metal and Nonmetal Mine Safety and Health, Western District, "Report of Radiation Survey, Orphan Mine, Grand Canyon National Park, Arizona, November 5-7, 1981, pp.1-5; Landmark Reclamation, Inc., "Proposal to the National Park Service, Grand Canyon National Park, Far Reclamation of the Orphan Mine Site, [1986], n.p.; U.S. Department of the Interior, Bureau of Land Management, Phoenix District Office, Division of Mineral Resources, "Reclamation Report, Orphan Mine, Grand Canyon National Park, Arizona," June 1986, pp. 1-25; and National Park Service, "Solid Minerals Operations Monitoring Checklist," Orphan Mine, Grand Canyon National Park, February 1, 1988 (copies of the documents are on file in the Division of Resource Management at Grand Canyon National Park). Also see Harding Lawson Associates, "Orphan Mine - Preliminary Assessment of Hazardous Materials, Phase I, Grand Canyon National Park, Arizona, HLA Project No. 22040-002, "December 4, 1992 [Draft] (copy on file in Branch of Design, Western Team, Denver Service Center).

<sup>57</sup> Chenoweth, "Orphan Lode Mine," pp. 43-44.

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Reservation on the south rim, and the Hack Canyon along a tributary of Kanab Creek on the north side of Grand Canyon. AEC records show the following comparative statistics for these mines:

PROPERTY	YEAR(S) OF PRODUCTION	ORE (TONS)	U <sub>3</sub> O <sub>8</sub> (%)	U <sub>3</sub> O <sub>8</sub> POUNDS
Hack Canyon	1951-1954, 1964	1,375.94	0.18	4,993.14
Chapel	1954	1.08	0.23	4.96
Riverview	1956-1957	508.41	0.38	3,839.15
Orphan Lode	1956-1969	495,106.63	0.43	4,266,264.47
Ridenour	1961	14.14	0.15	42.05
		497,006.20	0.43	4,275,143.77 <sup>58</sup>

Data on the content of other minerals in the Orphan Lode ores is meager. In addition to uranium, the Orphan yielded 6,680,000 pounds (3,030,000 kilograms) of copper, 107,000 ounces (3,000 kilograms) of silver, 3,400 pounds (870 kilograms) of vanadium oxide, and small amounts of calcium carbonate.<sup>59</sup>

#### H. SCIENTIFIC STUDY OF THE ORPHAN LODE

Since the 1950s the demand for uranium as a source of atomic energy has prompted geologists to undertake research and exploration to determine mechanisms by which uranium has concentrated in the earth's crust and discover new deposits. The principal uranium deposits in the United States occur in terrestrial sandstones, mudstones, and limestones on the Colorado Plateau and along the fringes of the plateau in Arizona, New Mexico, Utah, Colorado, North Dakota, South Dakota, Wyoming, and Nevada. The question of the origin of these deposits has generated various interpretations during the past four decades.

The Orphan Lode became the focus of considerable interest for geological research during the 1950s because its ore body occurs in an unusual structural setting, mainly within a vertical, nearly circular breccia pipe which penetrates horizontal Pennsylvanian and Permian strata in the Grand Canyon. Furthermore, the deposit combines characteristics of sedimentary Colorado Plateau uranium deposits with structural features suggestive of hydrothermal veins. The pipe is filled with sedimentary rock fragments, mainly Coconino Sandstone, which collapsed into a solution cavity formed in the Redwall Limestone. The pipe has a mean diameter of approximately 230 feet down through the Hermit Shale from the lower Coconino Sandstone in which the pipe outcrops. The pipe then flares out to a mean diameter of 400 to 500 feet in the upper Supai Formation.

<sup>58</sup> Chenoweth, "Production History and Geology of the Hacko, Ridenour, Riverview, and Chapel Breccia Pipes," p.5.

<sup>59</sup> Karen J. Wenrich and Hoyt B. Sutphia, "Recognition of Breccia Pipes in Northern Arizona," Arizona Bureau of Geology and Mineral Technology Fieldnotes, XVIII (Spring 1988), 1-5, 11. A list of the minerals found in the Orphan Lode may be seen on the following page.

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Elements and Minerals Found in the Orphan Pipe

I. Metallic Minerals & Elements:

Metal	Identified by	Mineral(s)	Primary	Secondary
Uranium	AEC	Uraninite-Pitchblende	X	X
	AEC	Coffinite	X	
	AEC	Tobernite, Meta-tobernite		X
	AEC	Aeunerite, Meta-zeunerite		X
	AEC	Gummite		X
	McLeod(1987)	Hydrous Uranium Sulphate (?)		X
	Mason (1960)	Uranospinite		X
		Uranopilite (?)		X
		Zippeite (?)		X
		Johannite (?)		X
		Curite (?)		X
		Uranophane		X
		Shroeckingerite		X
	Antimony		Tetrahdrite	X
		Stibnite	X	
Arsenic	Mason	Bindheimite (?)		X
		Tennantite	X	
Copper		Arsenopyrite	X	
		Uranospinite		X
		Orpiment, Realgar (?)	X	X
		Tennantite, Tetrahedrite	X	
		Bornite, Chalcopyrite	X	
		Chalcocite	X	X
		Digenite (?)	X	
	McLeod	Covellite	X (?)	X
		Malachite		X
		Azurite, Brochantite		X
Gold		Cuprite	X	
		Native Copper		X
Iron		Native (?)	X	
		Pyrite	X	
		Hematite, Siderite	X	
		Ankerite, Jarosite		X
		Melanterite, Goethite		X
		Limonite, Marcasite		X
Lead		Galena	X	
		Wulfenite		X
		Anglesite		X
		Bindheimite (?)		X
		Dolomite	X	
Magnesium		Rhodocrosite	X	
Manganese		Pyrolusite (?)		X
		Molybdenite	X	
Molybdenum		Ilsemanite		X
		Wulfenite		X
Nickel, Cobalt	McLeod	Siegenite	X	
	AEC	Nickel-Skutterudite (?)	X	
	McLeod	Bravaite (?)	X	

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	Mason	Millerite (?)		X
		Zaratite (?)		X
		Annabergite (?)		X
		Erythrite		X
Mercury		Cinnabar	X	
		Metacinnabar (?)		
Silver		Proustite	X	
Selenium		(Unknown)		
Vanadium		Hewettite		X
Zinc		Sphalerite	X	
		Marmatitic Sphalerite	X	
		Smithsonite		X

II. Elements Indicated by Spectrographic Analysis.

Minerals Unknown:

Codmium  
Columbium (?)  
Gallium  
Germanium  
Tantalum  
Tin  
Titanium  
Yttrium

III. Non-Metallic Epigenetic Minerals:

		Barite, bartyocalcite
		Calcite
		Dolomite
		Aragonite
		Siderite
AEC		Andesine, Labradorite
		Quartz (overgrowth, normal in sediments)
Hamilton		Illite
Hamilton		Alunite
Mason		Allophane
Barrington		Kaolin (Kaolinite)
Barrington		Sericite
		Gypsum
Rare Metals		Carbon

NOTES:

- (1) (?) indicates a tentative identification.
- (2) Identification credited where possible.

Kofford, "The Orphan Mine, "p. 194."

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Continuation Sheet**

Section number 8 Page 39

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While not unique the Orphan Lode deposit has several distinctive characteristics. These include the pipe structure, absence of organic matter, scarcity of secondary oxidized uranium minerals, and presence of large quantities of copper, minor amounts of nickel and cobalt, and low vanadium content. The structure and mineralogy of the Orphan Mine seem to support the hydrothermal theory of origin; yet the pipe exhibits no direct relationship to igneous activity. Thus, it became an excellent site to test the various hypotheses proposed for the source and means of concentration of uranium in sediments of the Colorado Plateau.<sup>60</sup>

Numerous geological studies of the Orphan Lode and other breccia pipes in the Grand Canyon region have been conducted by scholars and government scientists. These studies include publications, professional papers, government reports, and doctoral dissertations. Some of the most significant studies of the Orphan Lode are cited in the footnotes and bibliography of this National Register form.

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<sup>60</sup> Vivien Monisa Gornitz, "Mineralization, Alteration and Mechanism of Emplacement, Orphan Ore Deposit, Grand Canyon, Arizona (Unpublished Ph.D. dissertation, Columbia University, 1969), pp.1-2.

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National Park Service

National Register of Historic Places  
Continuation Sheet

Section number 9 Page 1

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National Park Service

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Continuation Sheet

Section number 9 Page 2

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National Park Service

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Continuation Sheet

Section number 9 Page 3

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National Park Service**

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Continuation Sheet**

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National Park Service

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Continuation Sheet**

Section number 10 Page 1

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That certain mining claim or premises known as the - ORPHAN LODE MINING CLAIM, DESIGNATED BY THE SURVEYOR - GENERAL as Lot No. 2004, embracing a portion of Section 14, in Township 31 north, Range 2 East, Gila and Salt River Meridian, in the Grand Canyon Mining District, in the County of Coconino, and Territory (now State) of Arizona, in the District of Lands subject to sale at Prescott, and bounded, described and platted as follows, with magnetic variations as hereinafter stated:

Beginning at Corner No. 1, a Sandstone 24x14x3 inches, marked 0-1-2004, from which the corner common to Sections 14, 15, 22 and 23, in Township 31 North, Range 2 East, Gila and Salt River Meridian, bears south 17 degrees and 10 minutes west two thousand three hundred and sixty-three and three-tenths feet distant; thence, first course, magnetic variation fourteen degrees and thirty-seven minutes east, south sixty degrees and fifteen minutes east six hundred feet to corner No. 2, a Sandstone 20x10x3 inches, marked 0-2-2004; thence, second course, magnetic variation fourteen degrees and thirty-seven minutes east, north forty-one degrees and three minutes east one thousand five hundred feet to corner No. 3, a Sandstone 18x12x4 inches, marked 0-3-2004; thence, third course, magnetic variation, fifteen degrees and forty minutes east, north sixty degrees and fifteen minutes west three hundred feet to a point from which discovery shaft bears south sixty degrees west seventeen feet distant; six hundred feet to corner No. 4, a X on a Sandstone in place 7x5x2 feet above ground marked 0-4-2004; thence, fourth course, magnetic variation fifteen degrees and forty minutes east, south forty-one degrees and three minutes west one thousand five hundred feet to corner No. 1, the place of beginning; said lot No. 2004 extending one thousand five hundred feet in length along said Orphan Vein or lode and containing twenty acres and twenty-six hundredths of an acre of land, more or less.

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National Park Service

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Continuation Sheet

Section number PHOTOS Page 1

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PHOTOGRAPH LABELS (SEE SKETCH MAPS FOR LOCATION OF PHOTOGRAPHS AND DIRECTION OF CAMERA)

PHOTOGRAPH NO. 1

NAME OF PHOTOGRAPHER - Harlan D. Unrau (Unrau was photographer for all photos submitted with this national register form.)

DATE OF PHOTOGRAPH - May 11-13, 1993 (All photos submitted with this national register form were taken during this three-day period.)

LOCATION OF ORIGINAL NEGATIVE - WESTERN REGIONAL OFFICE, NATIONAL PARK SERVICE, SAN FRANCISCO (Original negatives for all photos submitted with this national register form are located in this office.)

DESCRIPTION OF VIEW - LOOKING NORTHWEST

PHOTOGRAPH NO. 2

DESCRIPTION OF VIEW - LOOKING EAST-NORTHEAST

PHOTOGRAPH NO. 3

DESCRIPTION OF VIEW - LOOKING NORTH-NORTHWEST

PHOTOGRAPH NO. 4

DESCRIPTION OF VIEW - LOOKING EAST-NORTHEAST

PHOTOGRAPH NO. 5

DESCRIPTION OF VIEW - LOOKING SOUTHEAST

PHOTOGRAPH NO. 6

DESCRIPTION OF VIEW - LOOKING SOUTHEAST

PHOTOGRAPH NO. 7

DESCRIPTION OF VIEW - LOOKING SOUTHWEST

PHOTOGRAPH NO. 8

DESCRIPTION OF VIEW - LOOKING NORTHWEST

PHOTOGRAPH NO. 9

DESCRIPTION OF VIEW - LOOKING NORTHEAST

**United States Department of the Interior  
National Park Service**

**National Register of Historic Places  
Continuation Sheet**

Section number PHOTOS Page 2

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PHOTOGRAPH NO. 10

DESCRIPTION OF VIEW - LOOKING SOUTHEAST

PHOTOGRAPH NO. 11

DESCRIPTION OF VIEW - LOOKING NORTHEAST

PHOTOGRAPH NO. 12

DESCRIPTION OF VIEW - LOOKING SOUTHEAST

PHOTOGRAPH NO. 13

DESCRIPTION OF VIEW - LOOKING SOUTH

PHOTOGRAPH NO. 14

DESCRIPTION OF VIEW - LOOKING WEST

PHOTOGRAPH NO. 15

DESCRIPTION OF VIEW - LOOKING NORTHEAST

PHOTOGRAPH NO. 16

DESCRIPTION OF VIEW - LOOKING SOUTHEAST

PHOTOGRAPH NO. 17

DESCRIPTION OF VIEW - LOOKING NORTHEAST

PHOTOGRAPH NO. 18

DESCRIPTION OF VIEW - LOOKING SOUTH

PHOTOGRAPH NO. 19

DESCRIPTION OF VIEW - LOOKING SOUTH

PHOTOGRAPH NO. 20

DESCRIPTION OF VIEW - LOOKING SOUTHWEST

PHOTOGRAPH NO. 21

DESCRIPTION OF VIEW - LOOKING SOUTHEAST

PHOTOGRAPH NO. 22

DESCRIPTION OF VIEW - LOOKING WEST

**United States Department of the Interior  
National Park Service**

# **National Register of Historic Places Continuation Sheet**

Section number PHOTOS Page 3

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PHOTOGRAPH NO. 23

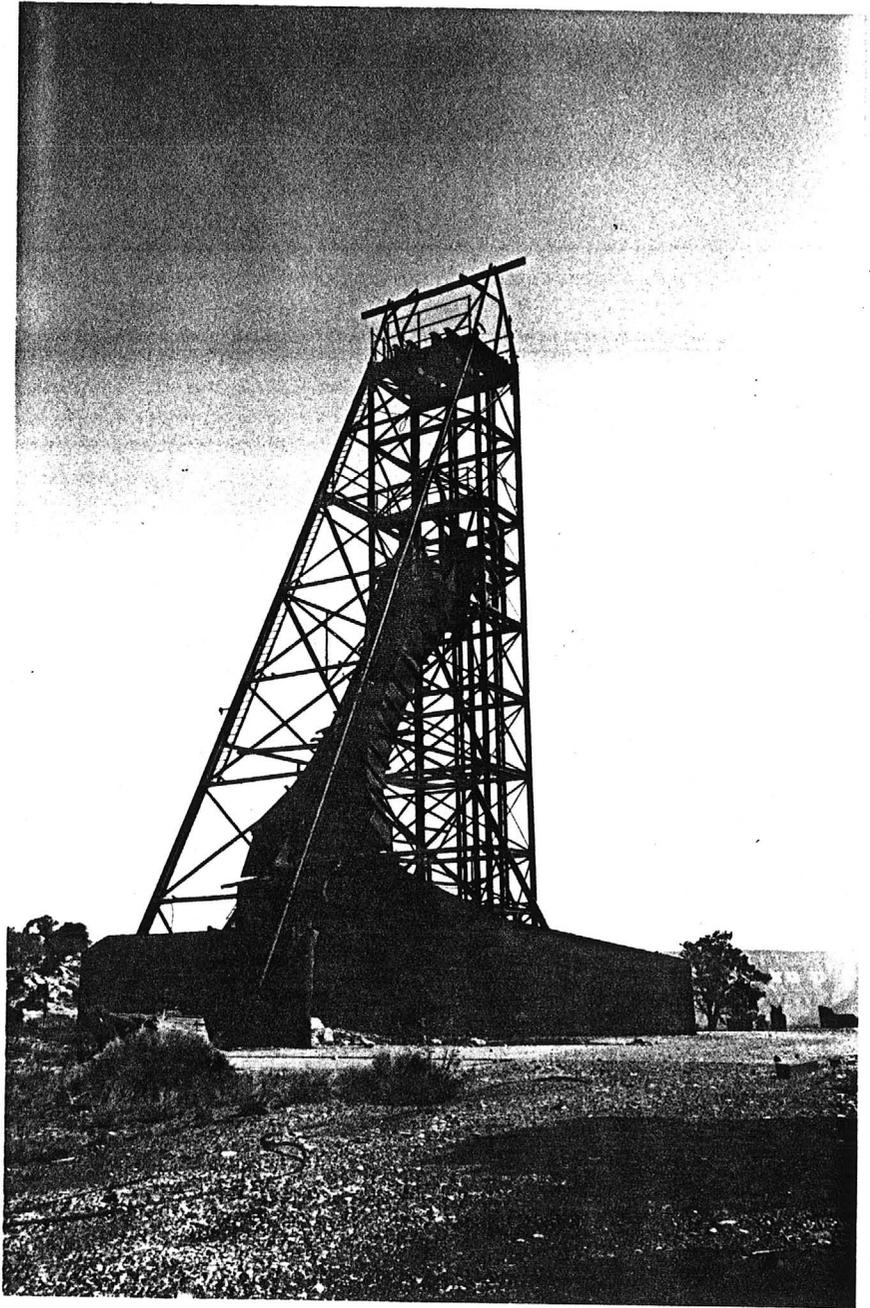
DESCRIPTION OF VIEW - LOOKING SOUTHWEST

PHOTOGRAPH NO. 24

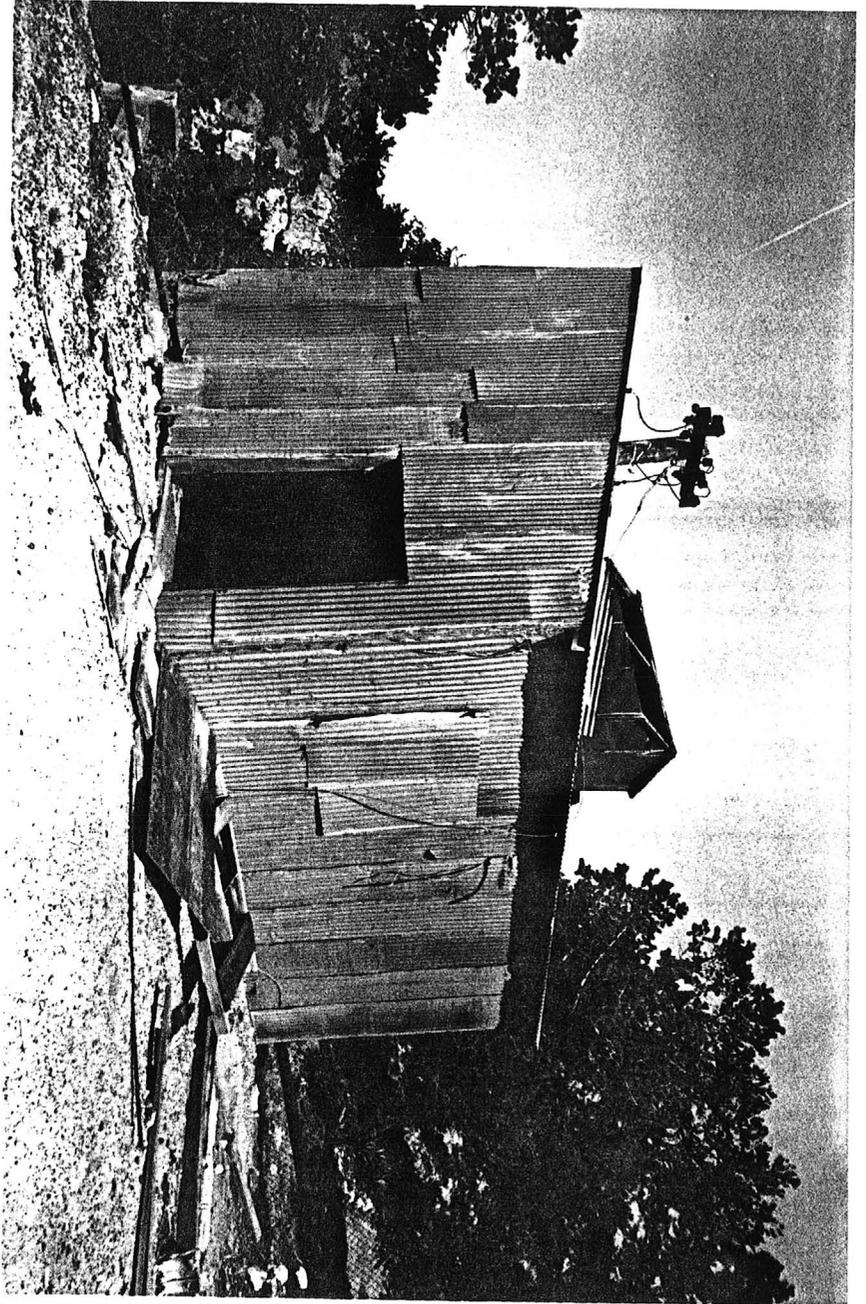
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PHOTOGRAPH NO. 25

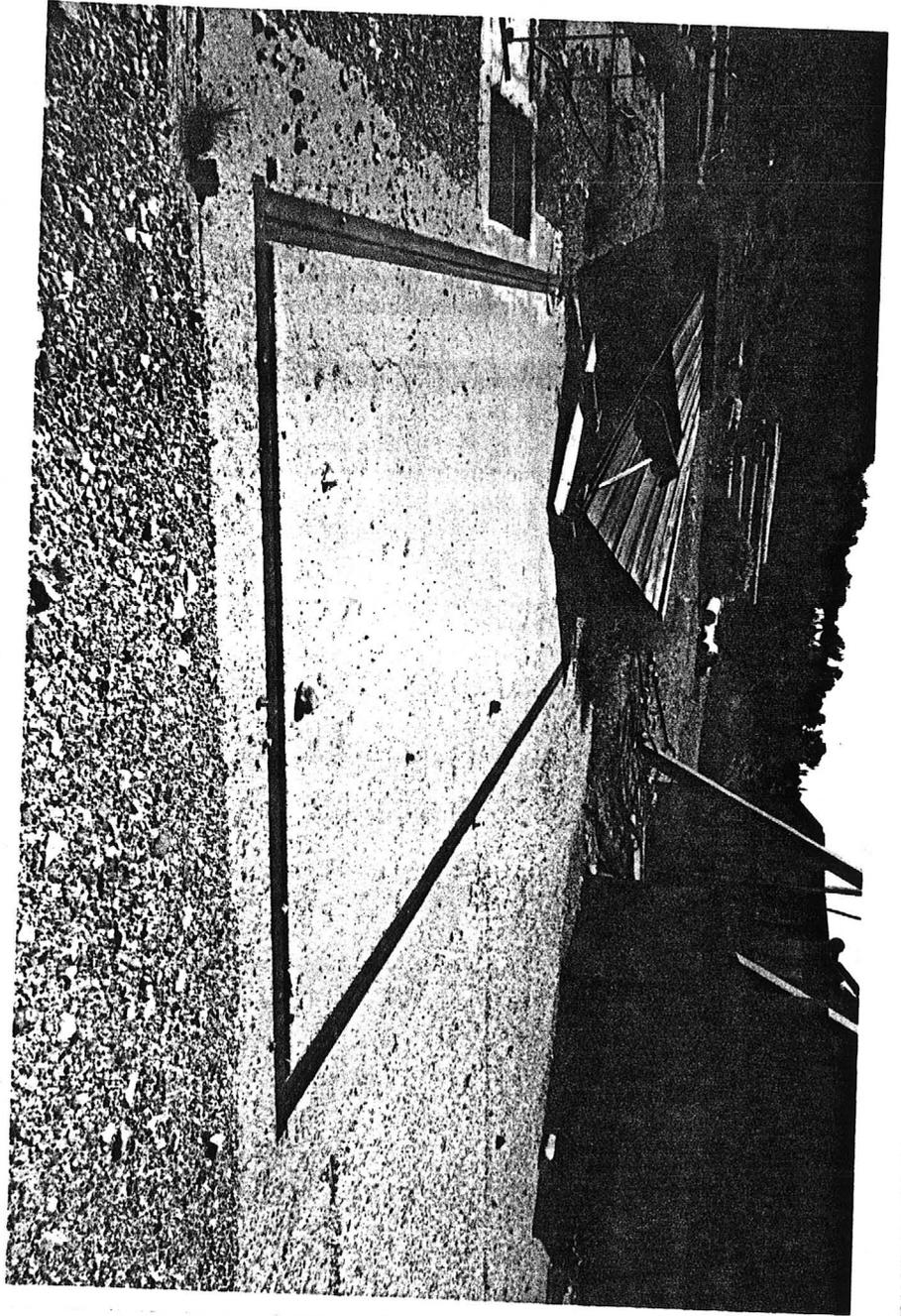
DESCRIPTION OF VIEW - LOOKING SOUTH-SOUTHWEST



HEADFRAME  
ORPHAN LOUIE MINDS CLAIM  
GRAND CANYON NATIONAL PARK  
COCONINO COUNTY, ARIZONA  
PHOTOGRAPH NO. 1



COMPRESSOR HOUSE  
ORPHAN LODGE MINING CLAIM  
GRAND CANYON NATIONAL PARK  
COCHISE COUNTY, ARIZONA  
PHOTOGRAPH NO. 2





IN REPLY REFER TO:

United States Department of the Interior

NATIONAL PARK SERVICE  
DENVER SERVICE CENTER  
12795 W. ALAMEDA PARKWAY  
P.O. BOX 25287  
DENVER, COLORADO 80225-0287

ORF. AN MINE FILE

K



June 23, 1993

Karen J. Wenrich  
MS 939  
US Dept. of the Interior  
Geological Survey  
Box 25046 Federal Center  
Denver, CO 80225-0046

Dear Karen:

Thank you for the inquiry about the status of the National Register of Historic Places work for the Orphan Mine at Grand Canyon National Park. As you know Harlan Unrau assumed responsibility for that determination of eligibility, and has now completed his research and writing for the forms. He made two trips to the mine, the last of which entailed a hike down to the lower level.

The nomination form is nearly ready, according to Harlan, for transmittal to the Western Region offices in San Francisco. That office requested the work and provided the budget to complete it.

If you want a copy of the draft, please contact Thomas D. Mulhern, Chief, Park History and Preservation, Western Region, National Park Service, 600 Harrison Street, Suite 600, San Francisco, California 94107-1372. His telephone number is (415) 744-3961.

If I can be of further assistance, please contact me.

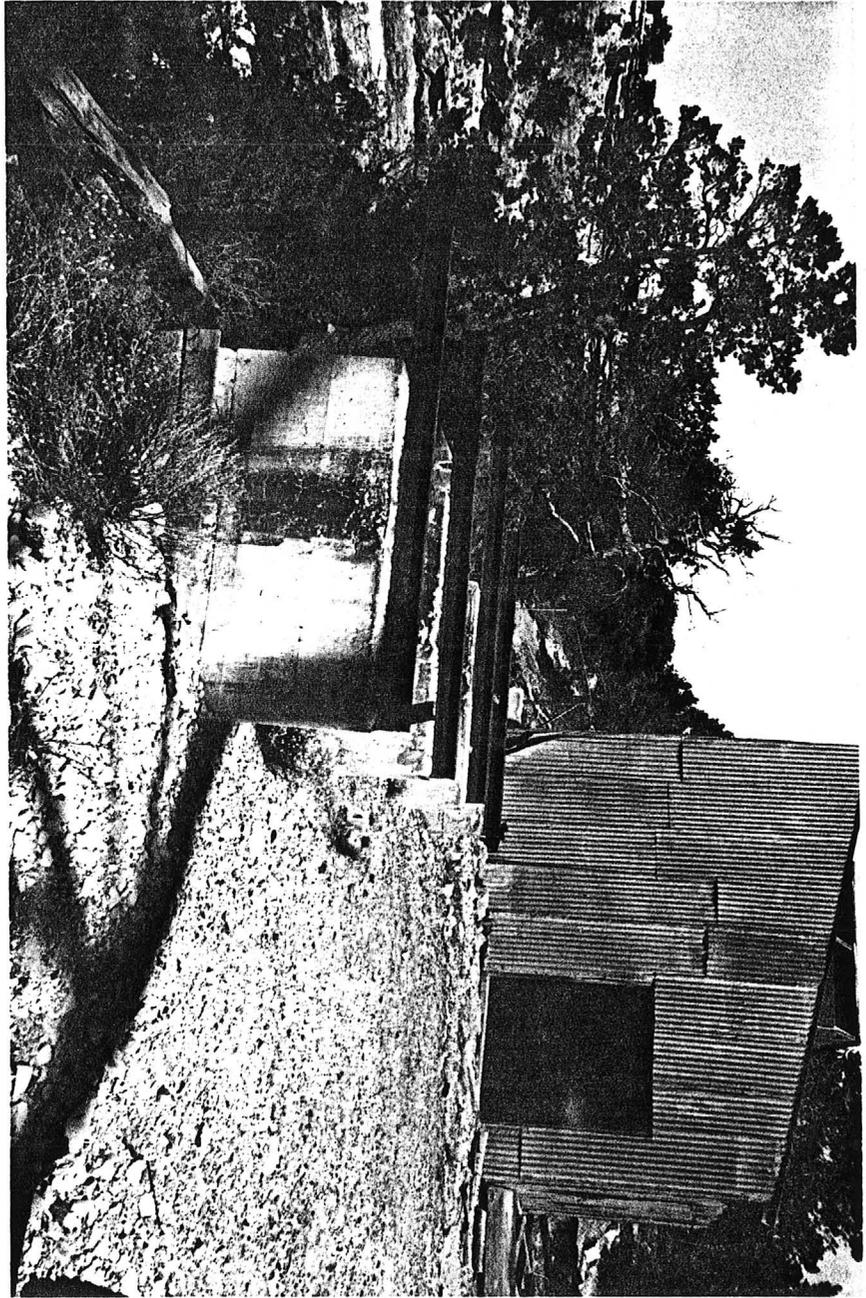
Sincerely,

Jere L. Krakow  
Historian

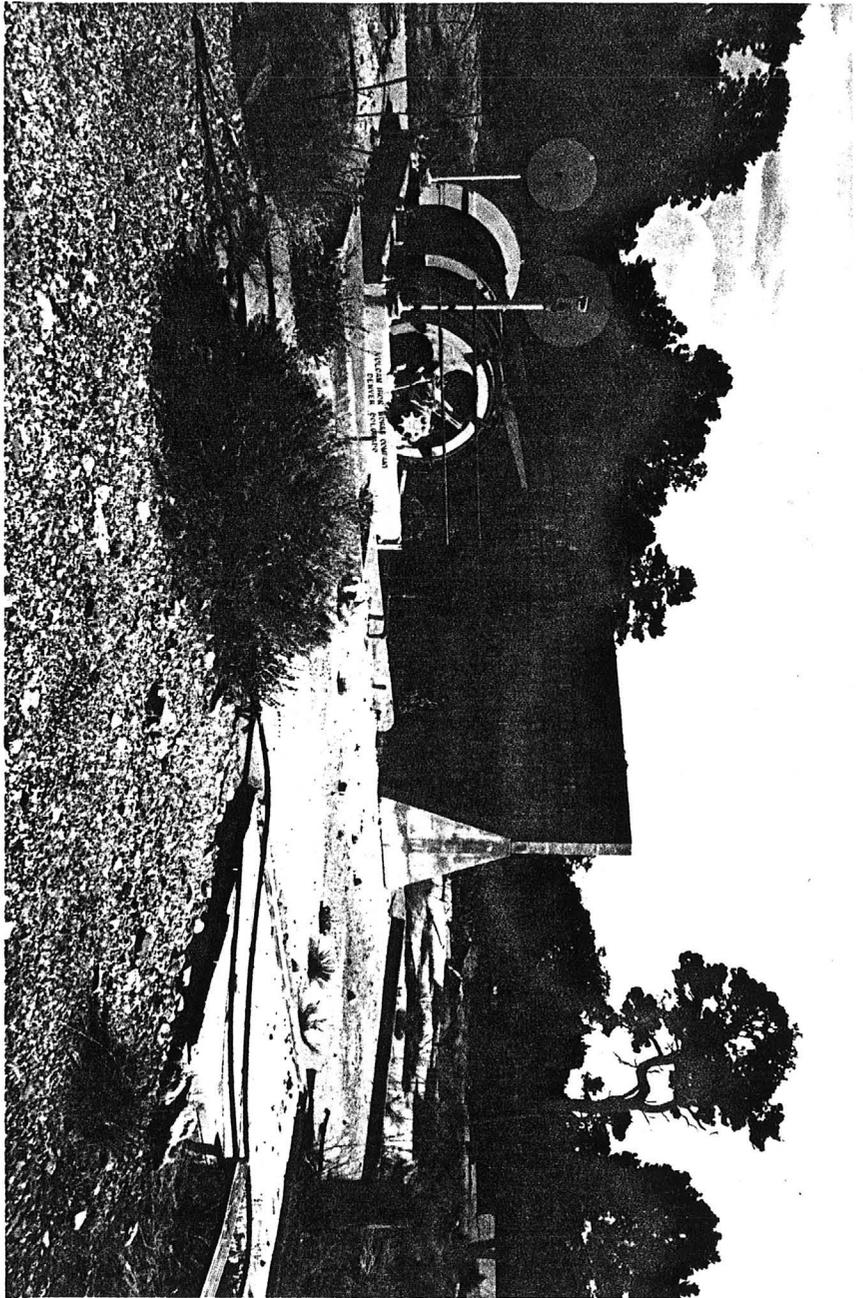
P.S. Did you know the USGS 7.5 sheet shows the name of the mine as the Lost Orphan Mine? Cheers!

*Called and requested copy*

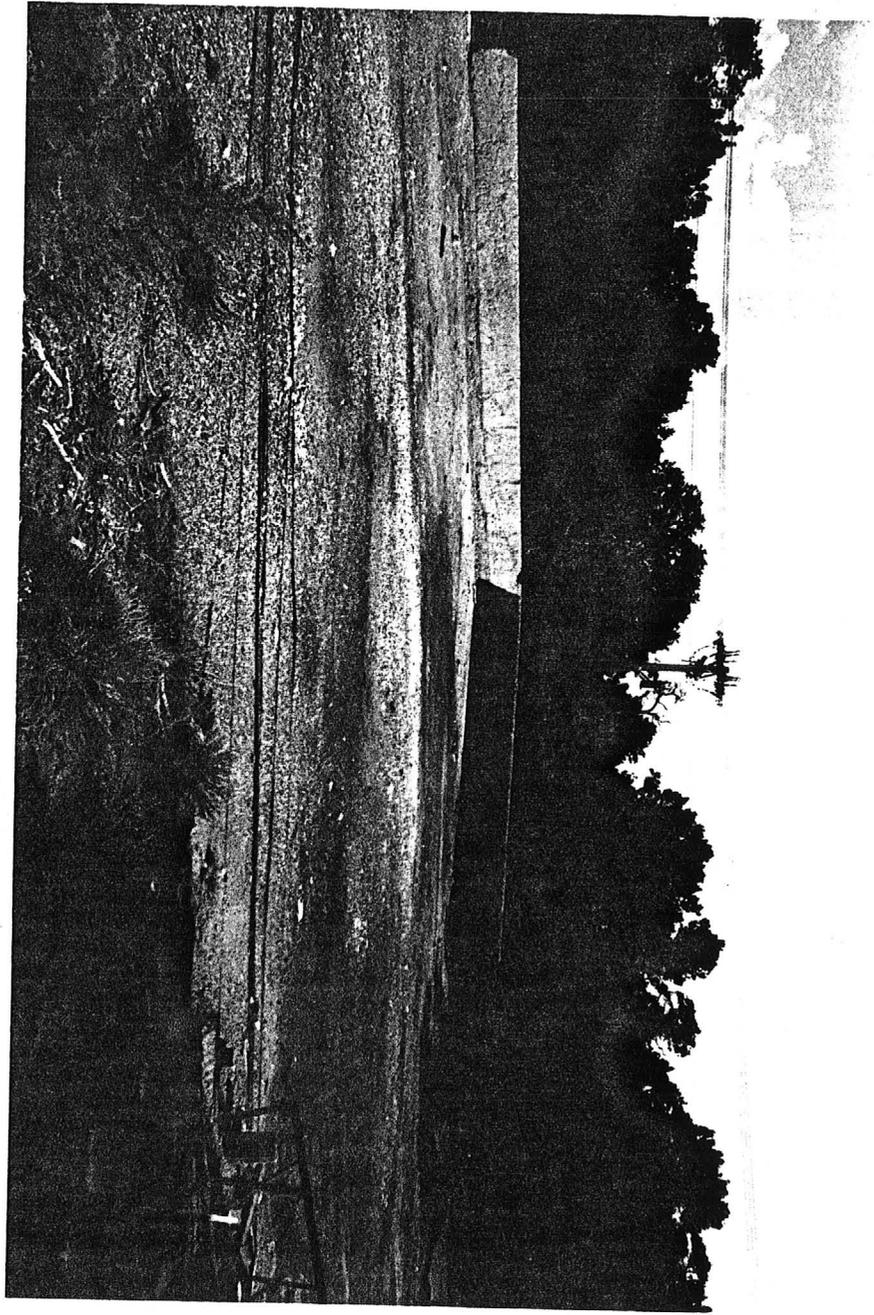
SERIES  
ORPHAN LODGE MINING CLAIM  
GRAND CANYON NATIONAL PARK  
COCONINO COUNTY, ARIZONA  
PHOTOGRAPH NO. 3



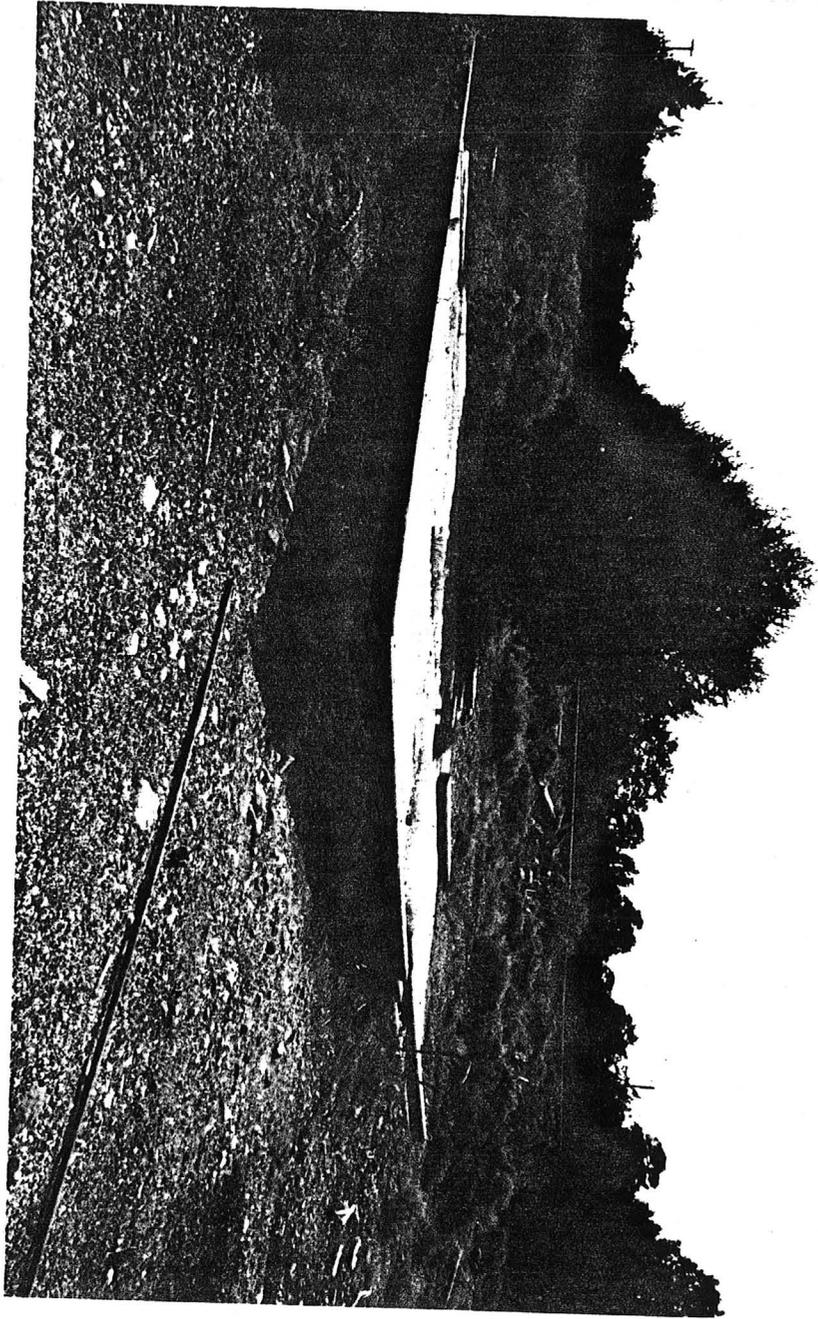
PLATFORM FOOTINGS  
DR PHAU LODGE MINING CLAIM  
GRAND CANYON NATIONAL PARK  
COCONINO COUNTY, ARIZONA  
PHOTOGRAPH NO. 4



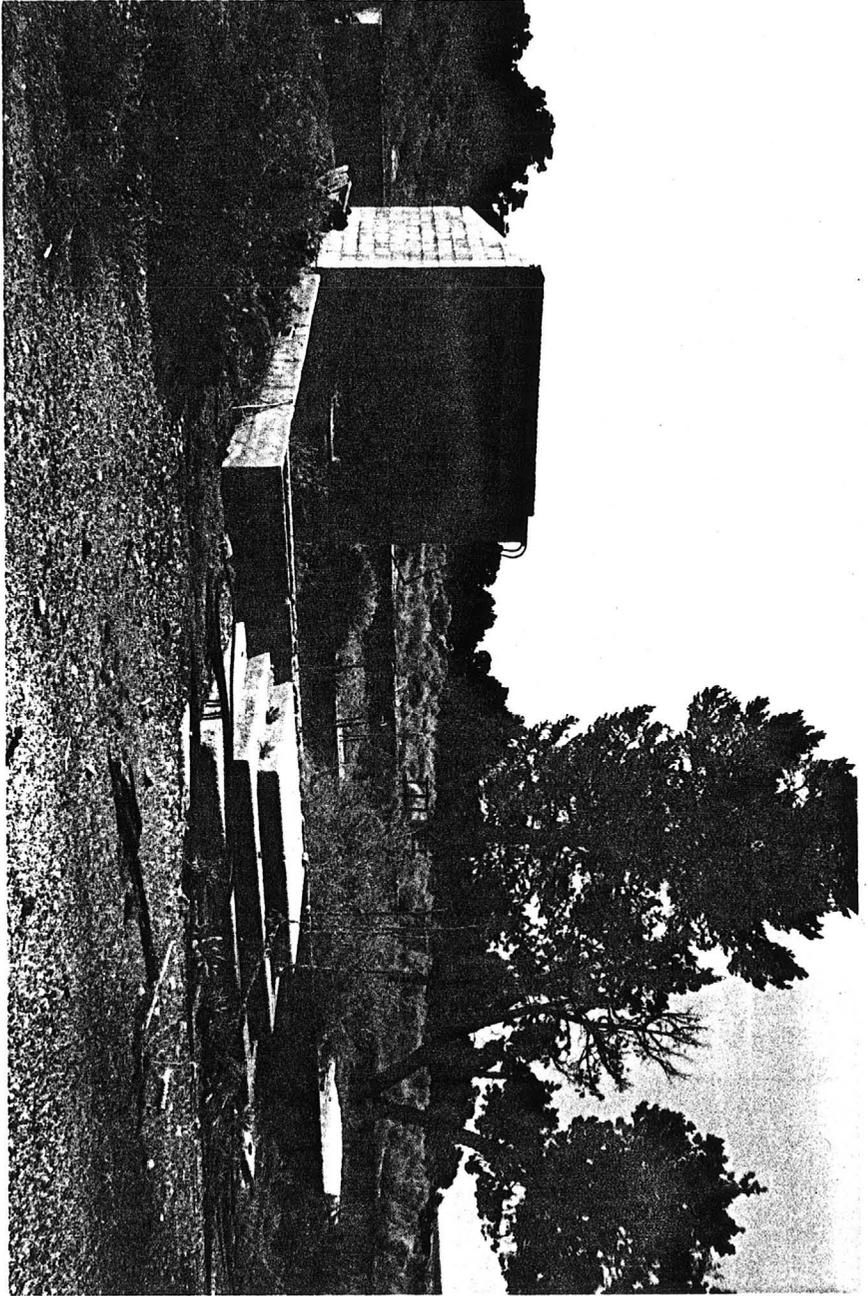
CINDER BLOCK WALL AND MORTARS  
ORPHAN 1013 MINING CLAIM  
GRAND CANYON NATIONAL PARK  
COCONINO COUNTY, ARIZONA  
PHOTOGRAPH NO. 5



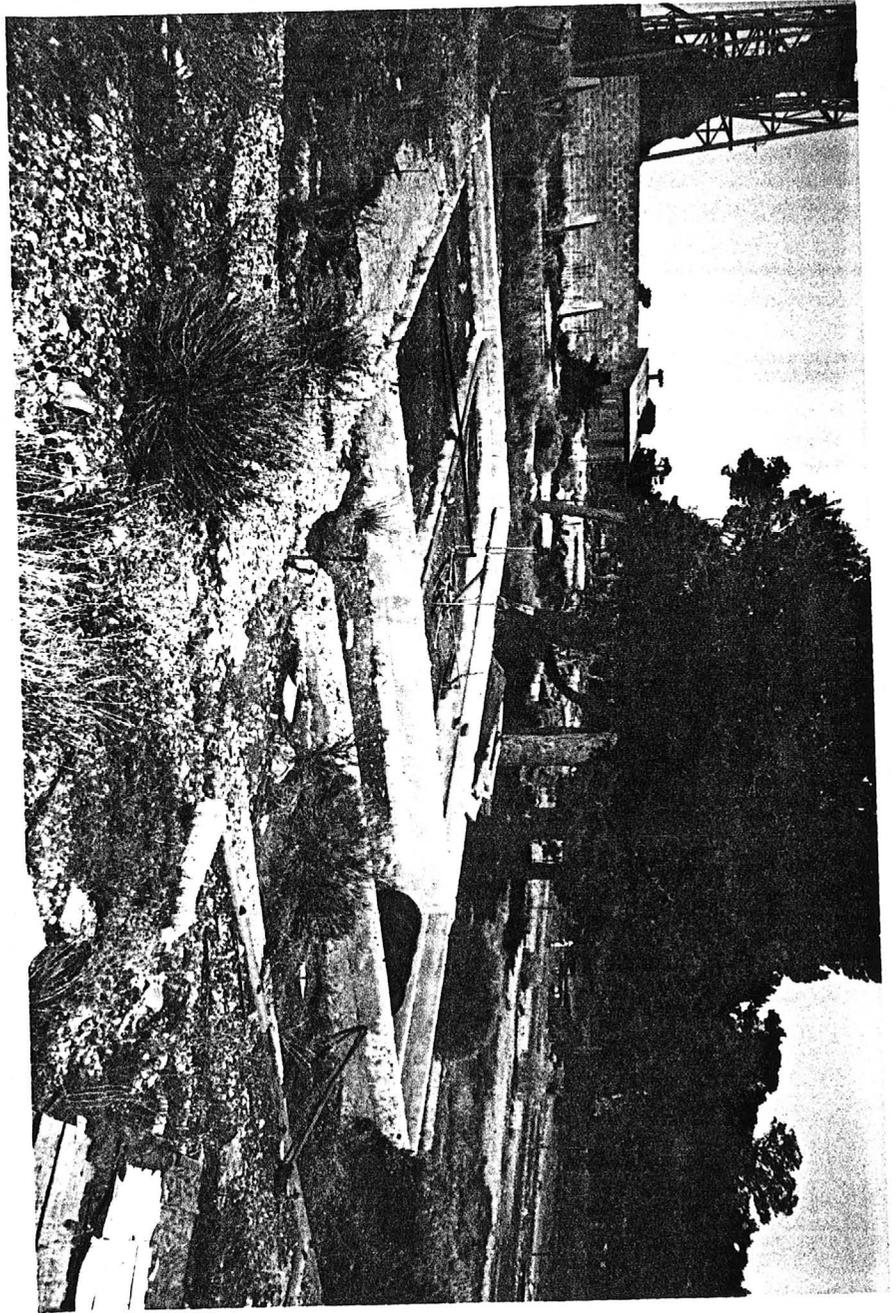
CONCRETE ORE PAD  
DRPHAN LODGE MINING CLAIM  
GRAND CANYON NATIONAL PARK  
COCONINO COUNTY, ARIZONA  
PHOTOGRAPH NO. 6



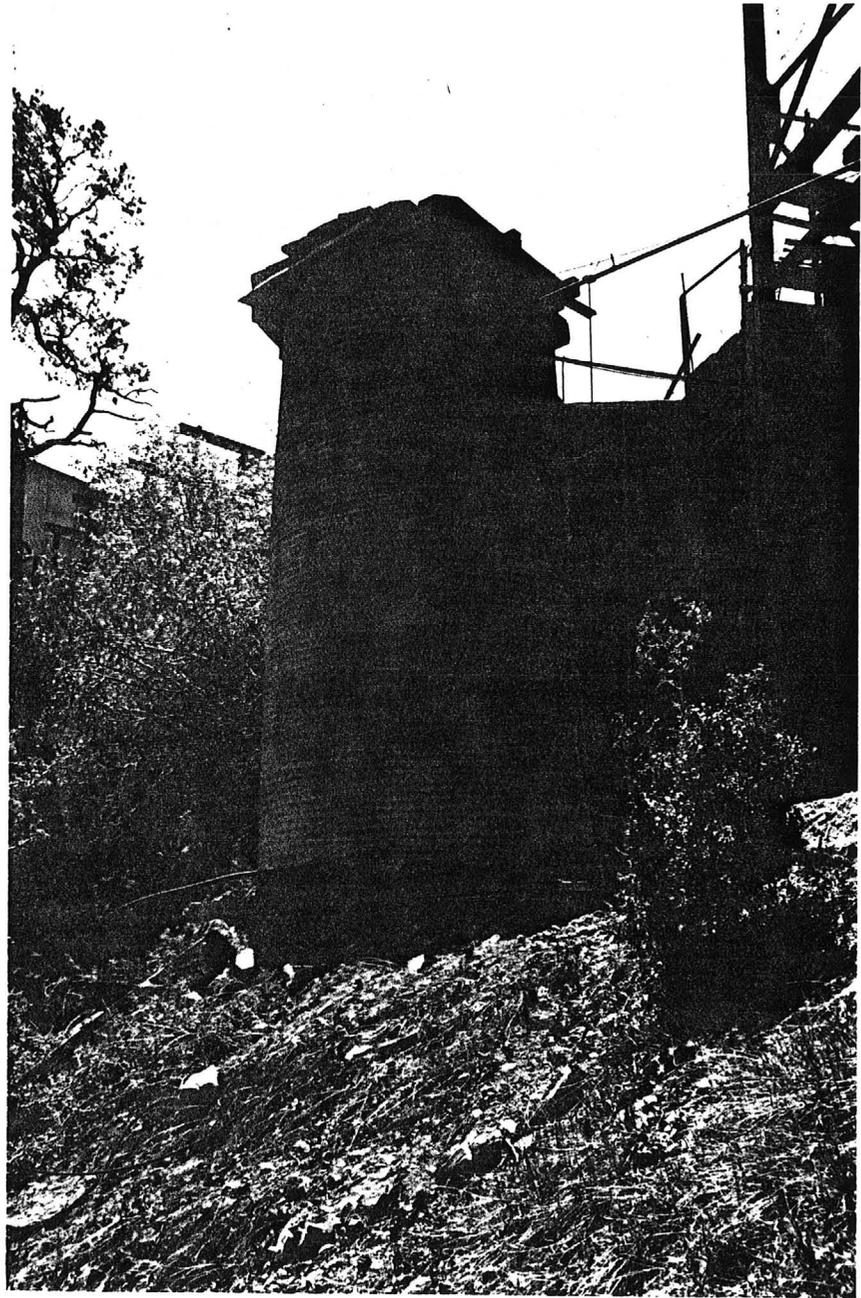
CONCRETE SIAB FOUNDATION  
ORPHAN LODGE MINING CLAIM  
GRAND CANYON NATIONAL PARK  
COCONINO COUNTY, ARIZONA  
PHOTOGRAPH NO. 7



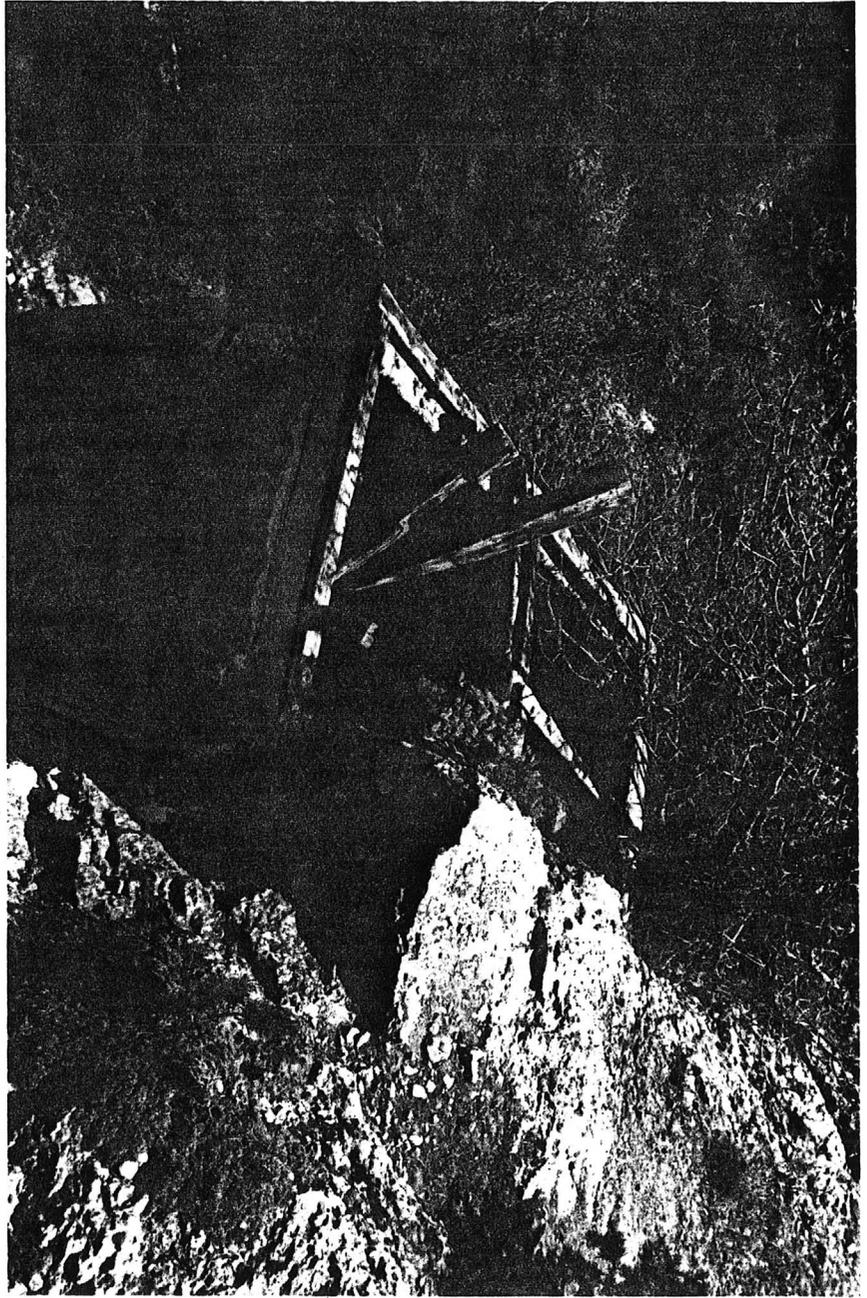
CINDER BLOCK STRUCTURE  
ORPHAN LODGE MINING CLAIM  
GRAND CANYON NATIONAL PARK  
COCONINO COUNTY, ARIZONA  
PHOTOGRAPH NO. 8



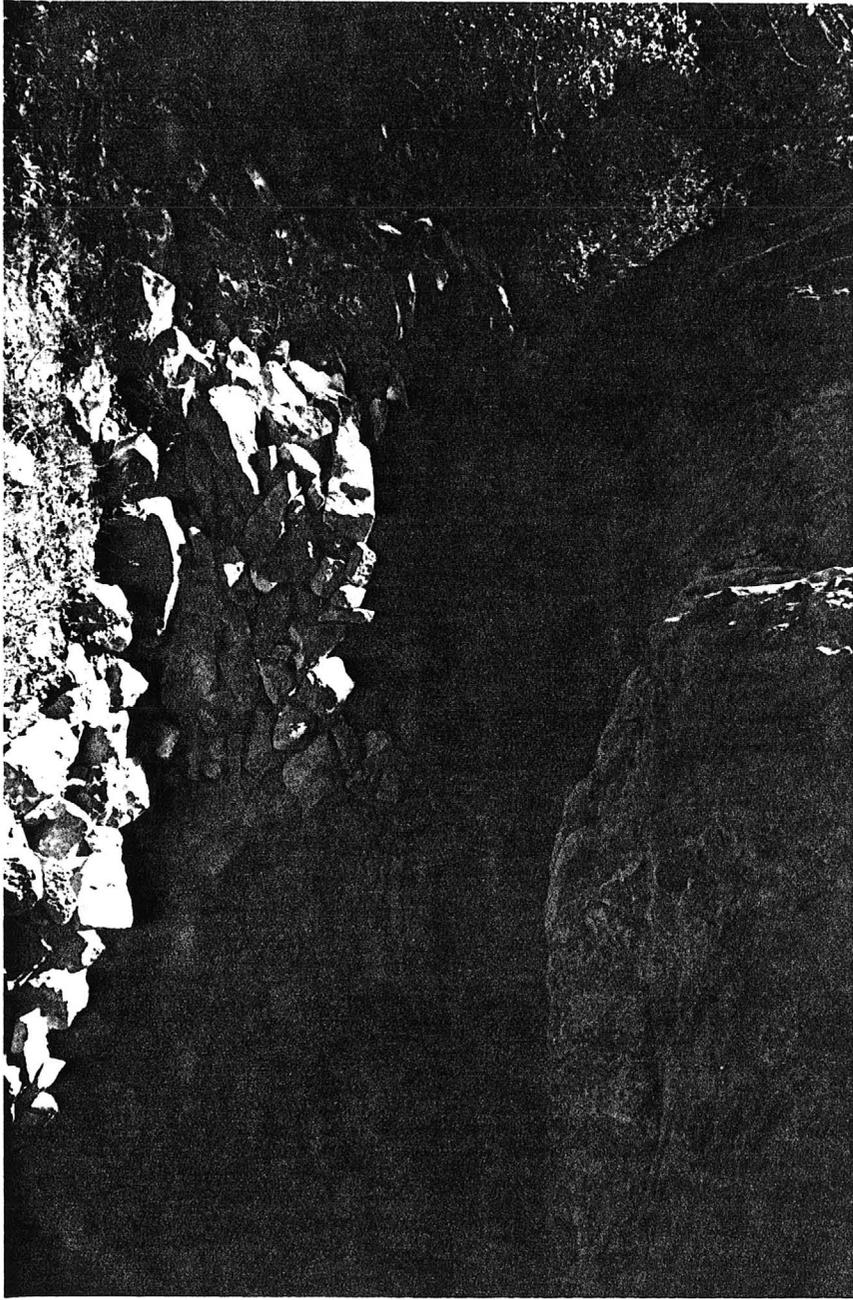
CONCRETE FOOTINGS FOR WALLS  
DRPHAN LODGE MOUNDS CLAIM  
GRAND CANYON NATIONAL PARK  
COCONINO COUNTY, ARIZONA  
PHOTOGRAPH NO. 9



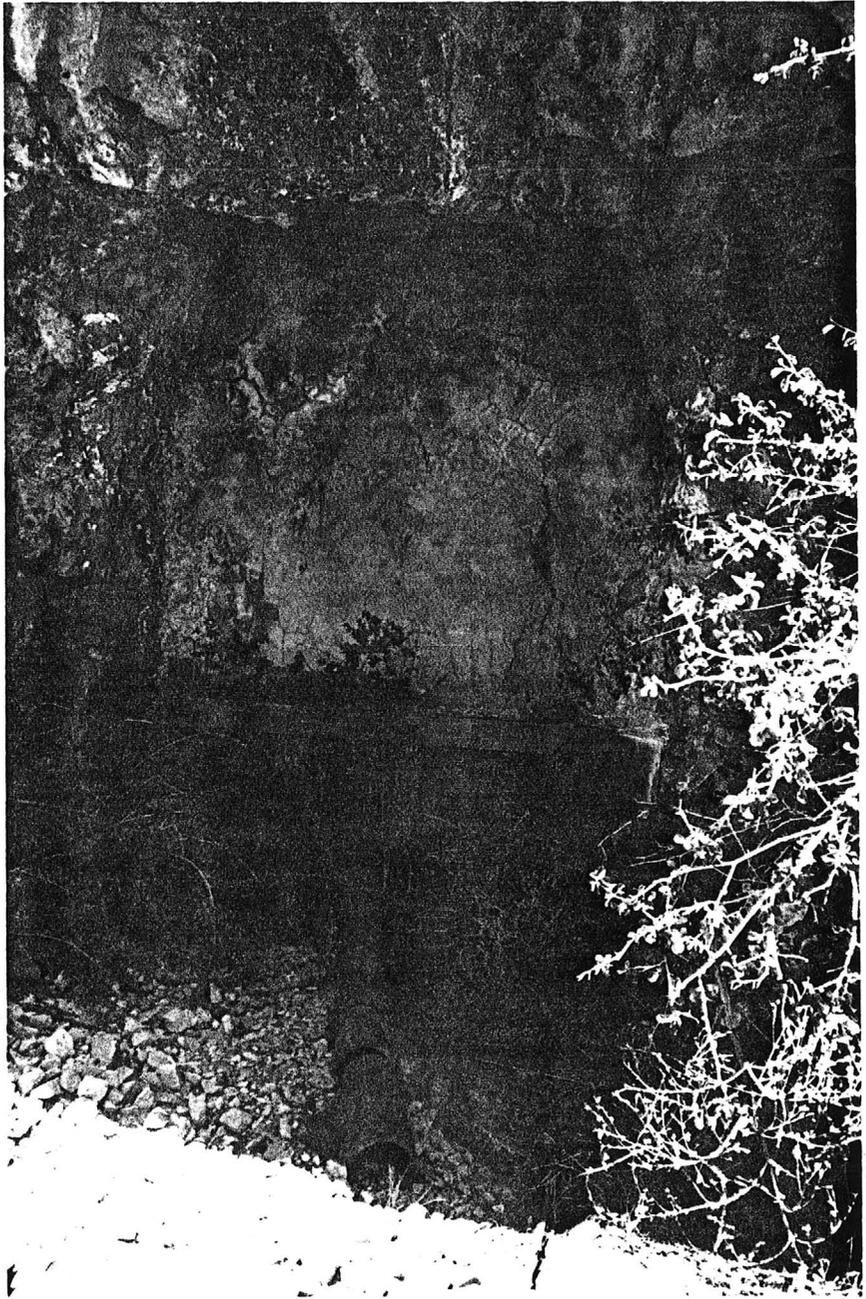
WATER TANK  
ORPHAN LOBE MINING CLAIM  
GRAND CANYON NATIONAL PARK  
COCONINO COUNTY, ARIZONA  
PHOTOGRAPH NO. 10



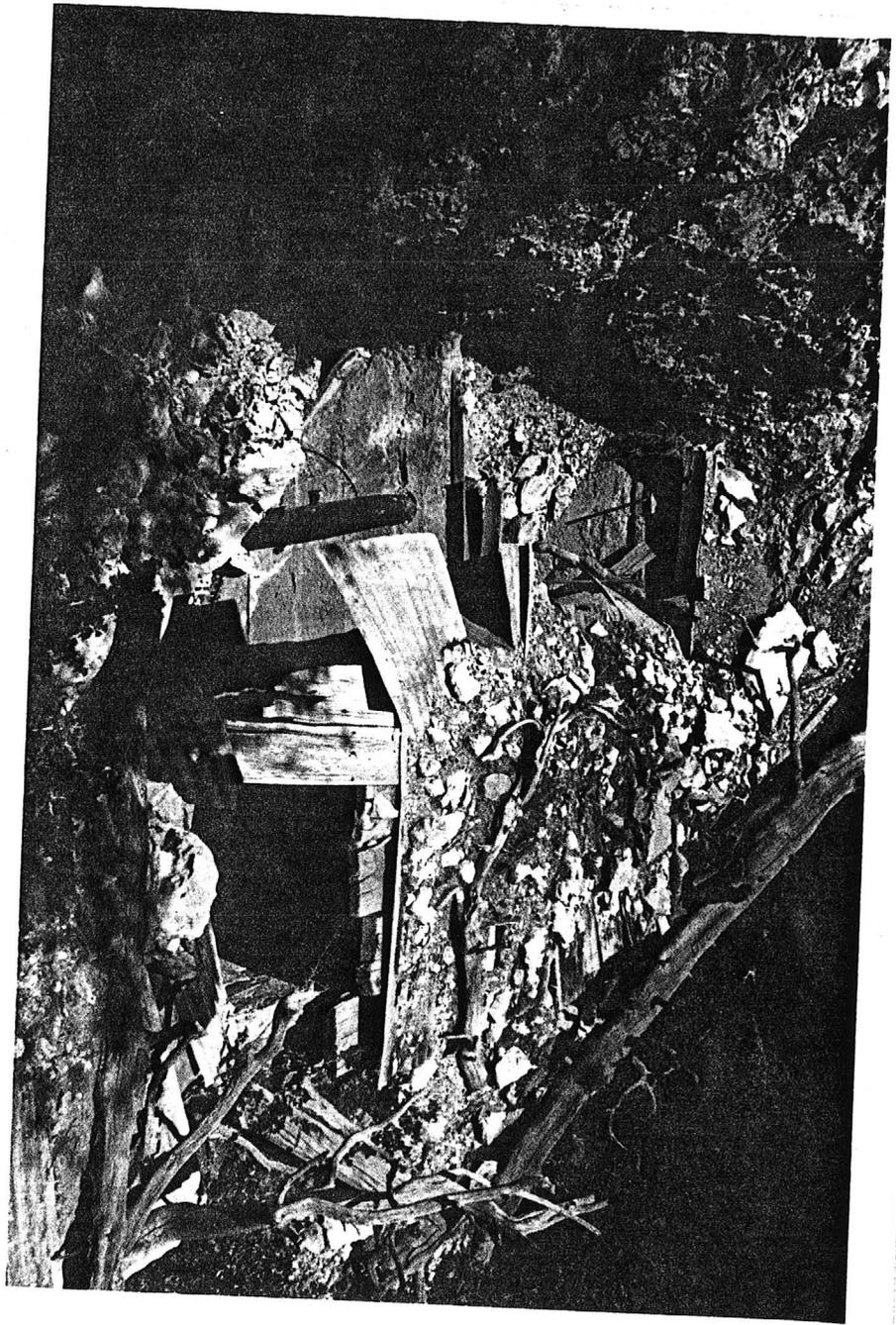
SEPTIC TANK  
ORPHAN LODGE MINING CLAIM  
GRAND CANYON NATIONAL PARK  
COCONINO COUNTY, ARIZONA  
PHOTOGRAPH NO. 11



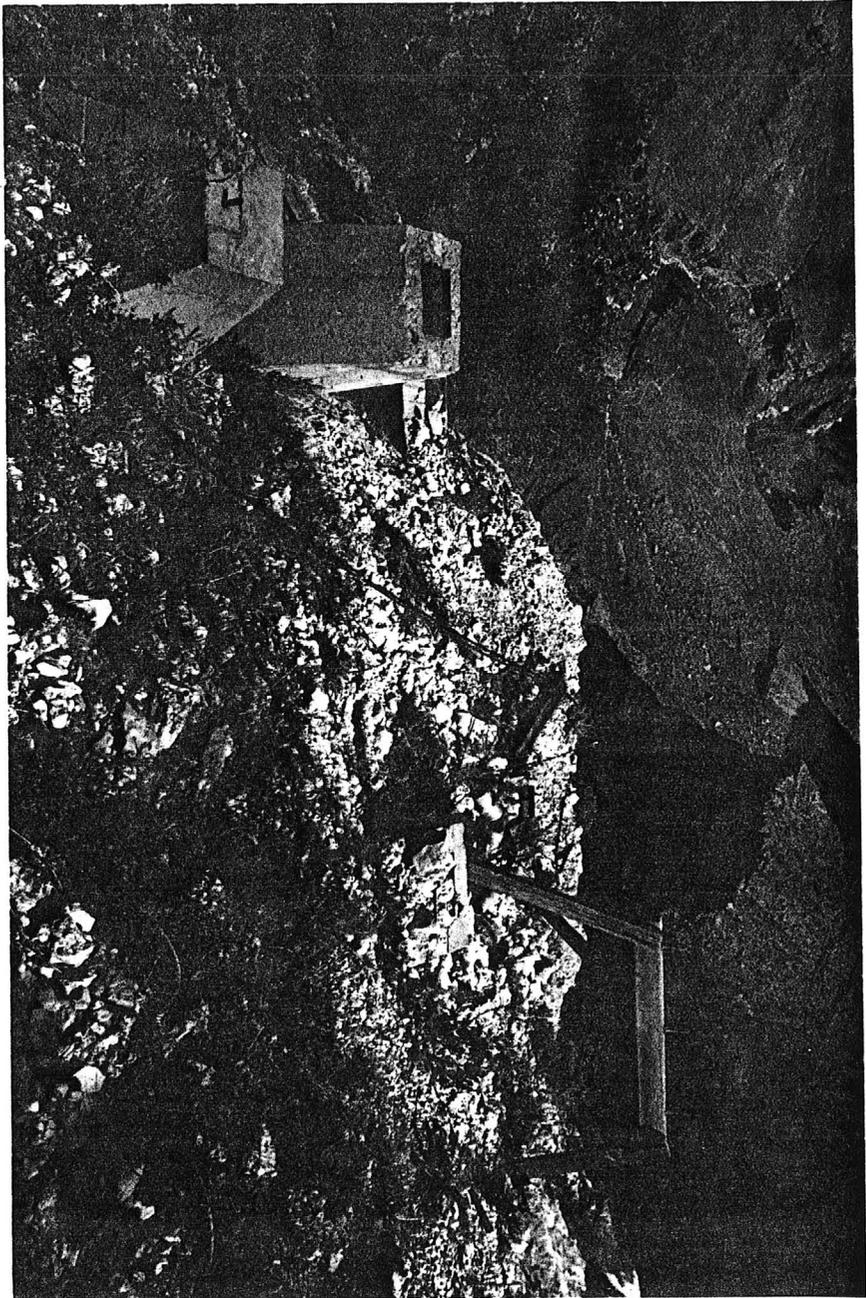
ROCK SHELTER FEATURE  
ORPHAN LODGE MOUNDS CLAIM  
GRAND CANYON NATIONAL PARK  
COCONINO COUNTY, ARIZONA  
PHOTOGRAPH NO. 12



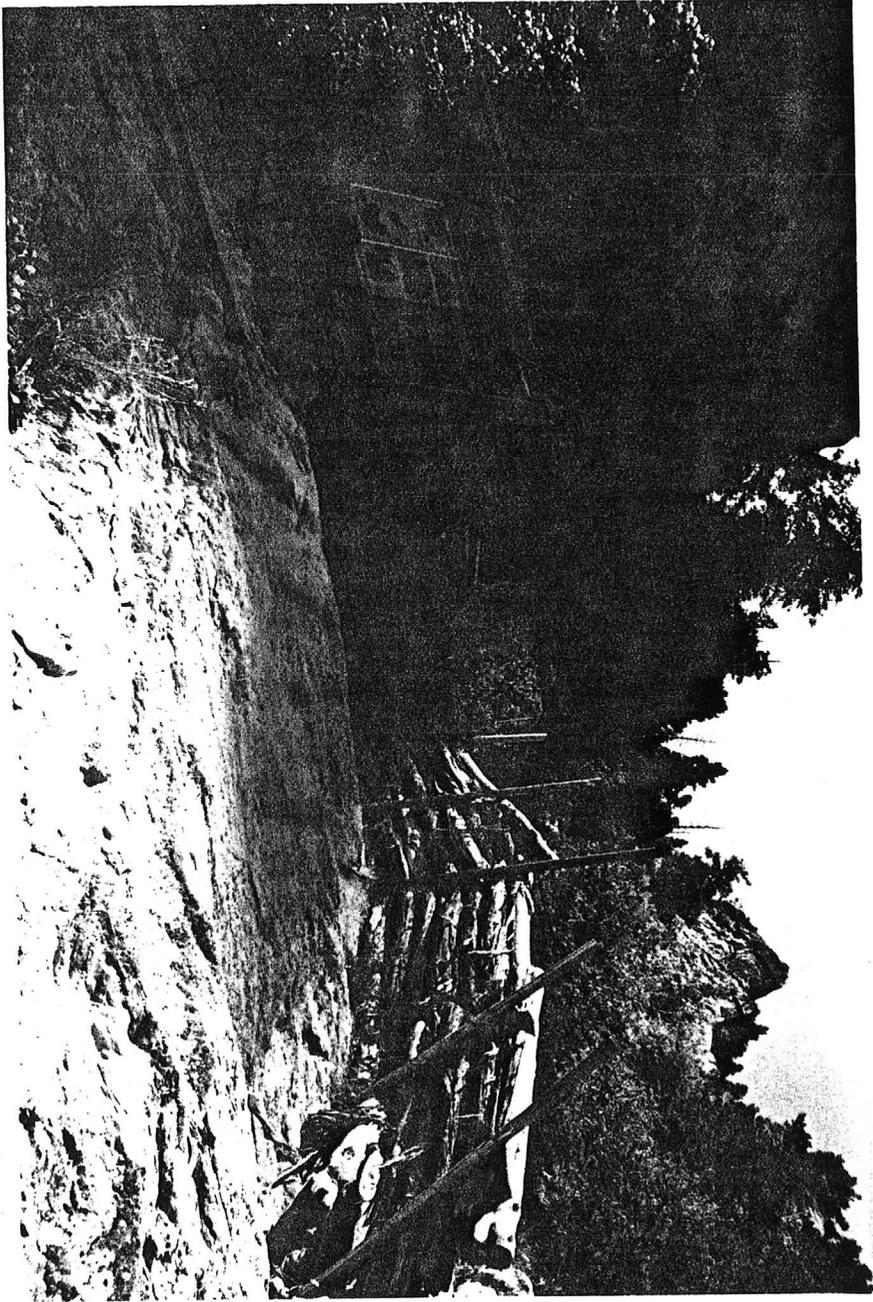
CEMENTED ADIT  
ORPHAN LOBE MINING CLAIM  
GRAND CANYON NATIONAL PARK  
COCONINO COUNTY, ARIZONA  
PHOTOGRAPH NO. 13



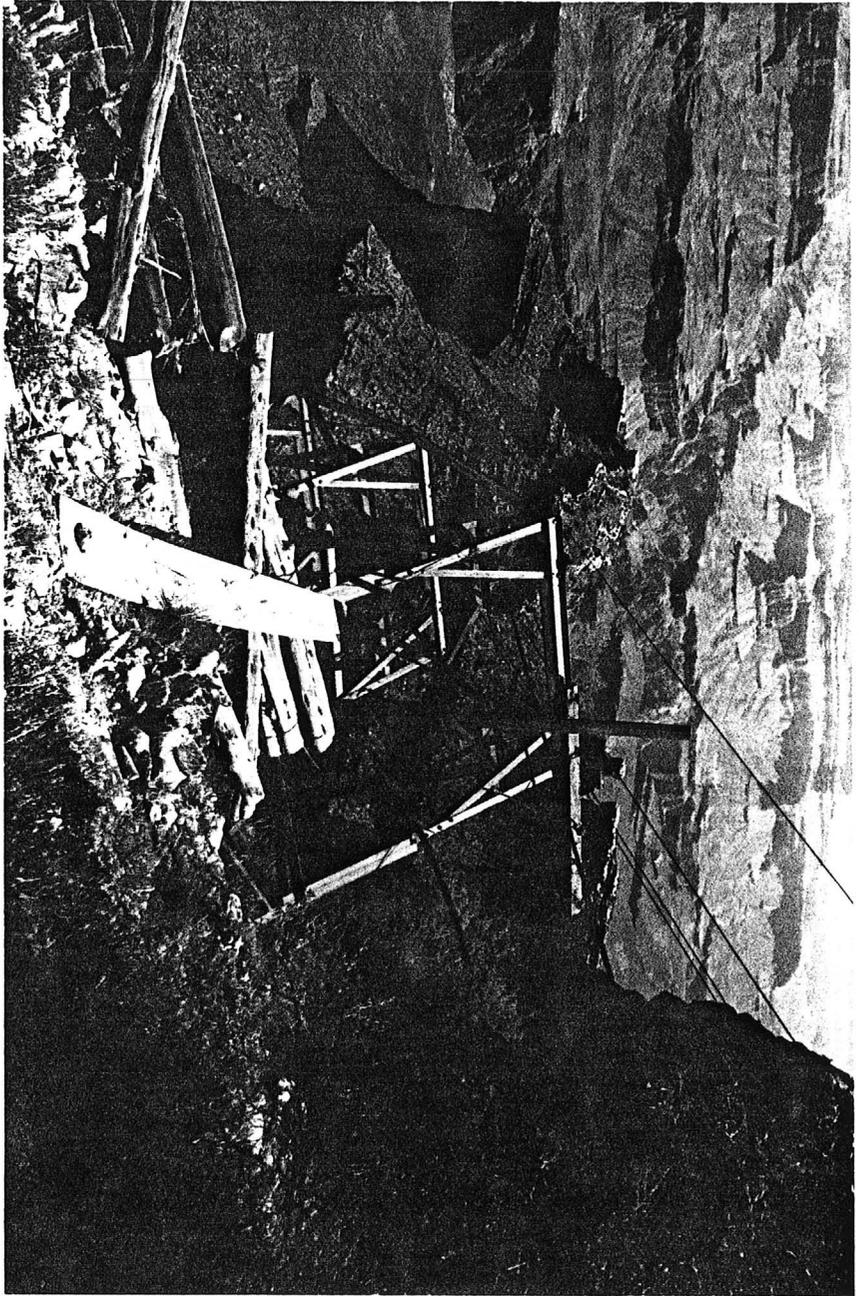
LOWER SEPTIC TANK  
ORPHAN LODGE MINING CLAIM  
GRAND CANYON NATIONAL PARK  
COCONINO COUNTY, ARIZONA  
PHOTOGRAPH NO. 14



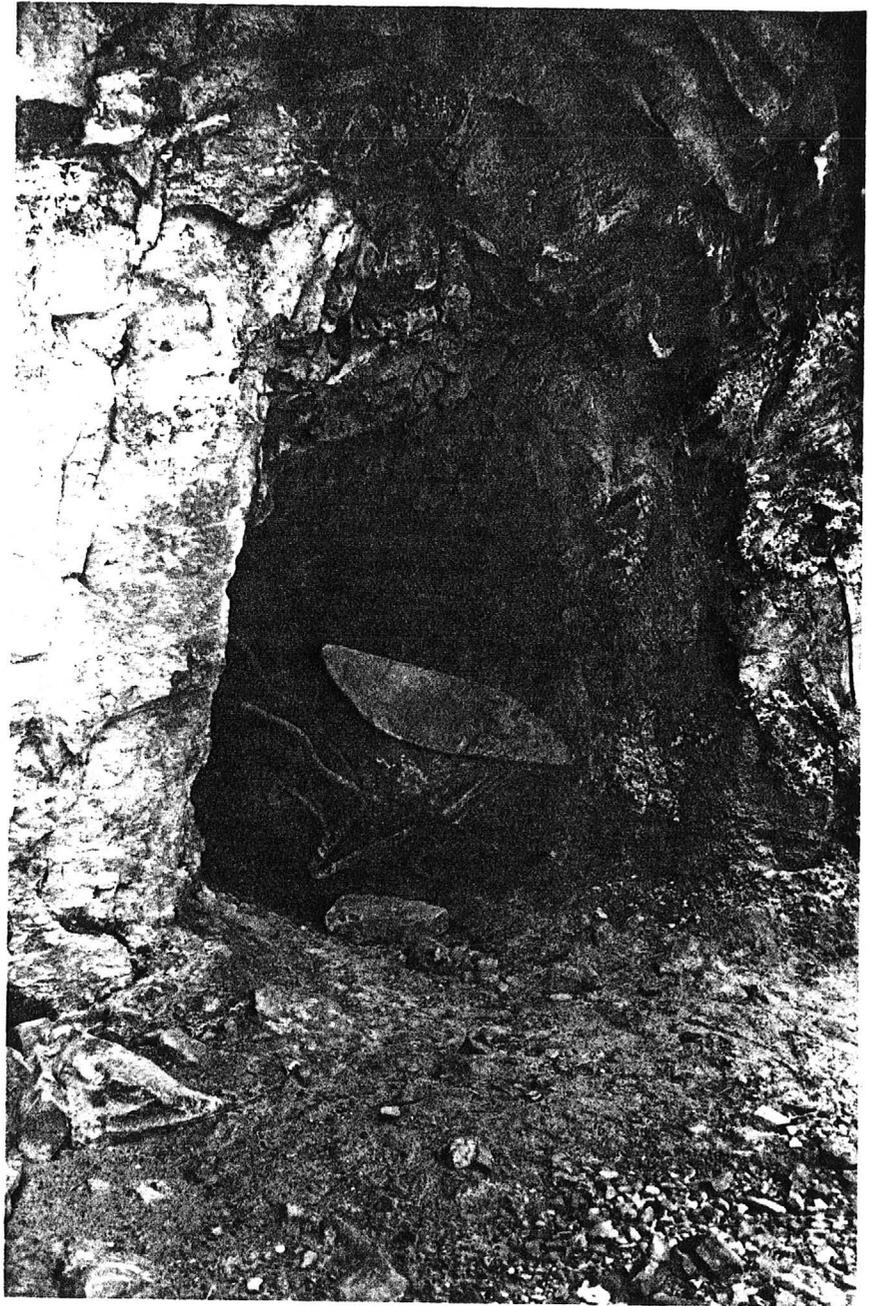
AT FIRST TRIMM FOOTINGS  
ORPHAN LODGE MINING CLAIM  
GRAND CANYON NATIONAL PARK  
COCONINO COUNTY, ARIZONA  
PHOTOGRAPH NO. 15



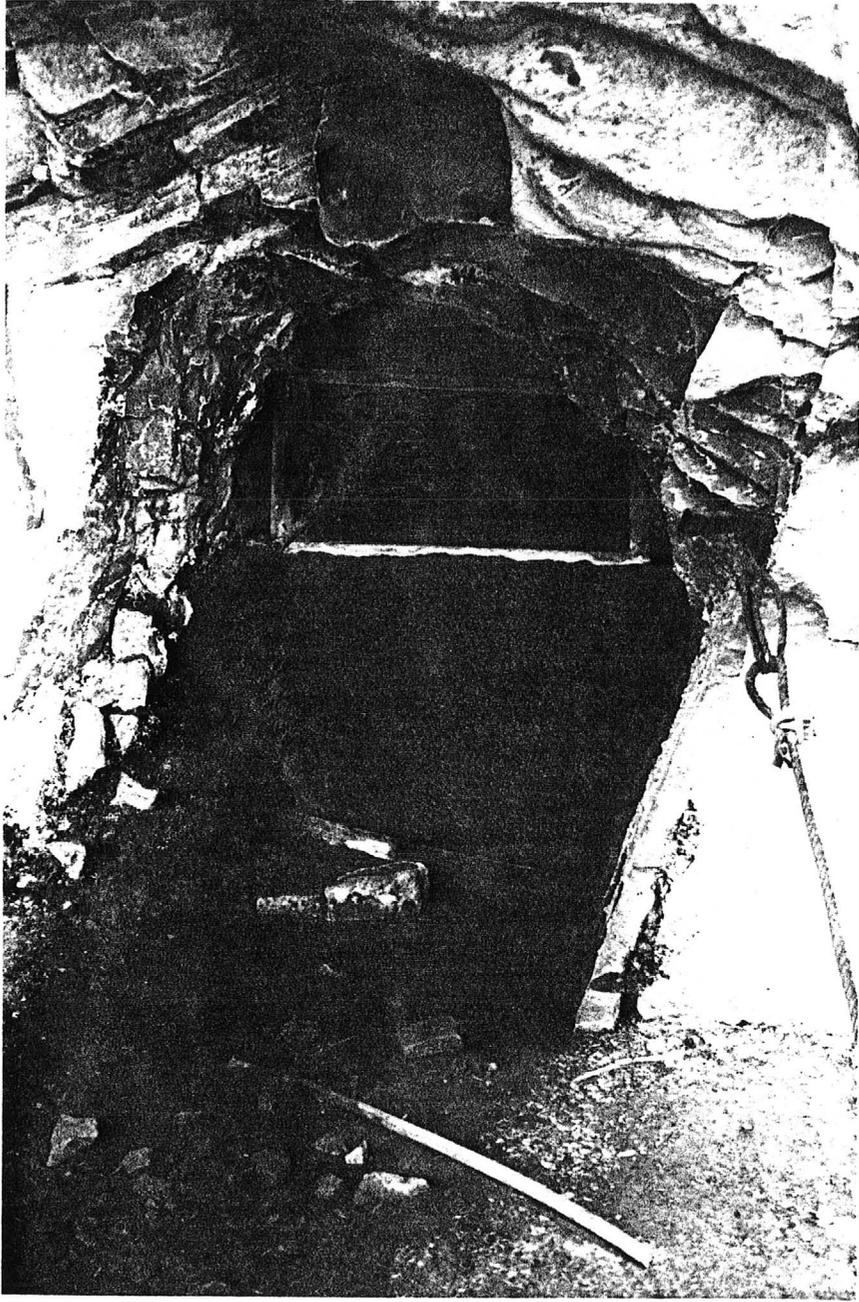
HUIST HOUSE  
DRPHAN LODGE MINING CLAIM  
GRAND CANYON NATIONAL PARK  
COCONINO COUNTY, ARIZONA  
PHOTOGRAPH NO. 16



AERIAL TRAM TOWER  
ORPHAN LODGE MINING CLAIM  
GRAND CANYON NATIONAL PARK  
COCONINO COUNTY, ARIZONA  
PHOTOGRAPH NO. 17



ADIT - LOWER MINE WORKINGS  
ORPHAN LODE MINING CLAIM  
GRAND CANYON NATIONAL PARK  
COCONINO COUNTY, ARIZONA  
PHOTOGRAPH NO. 18

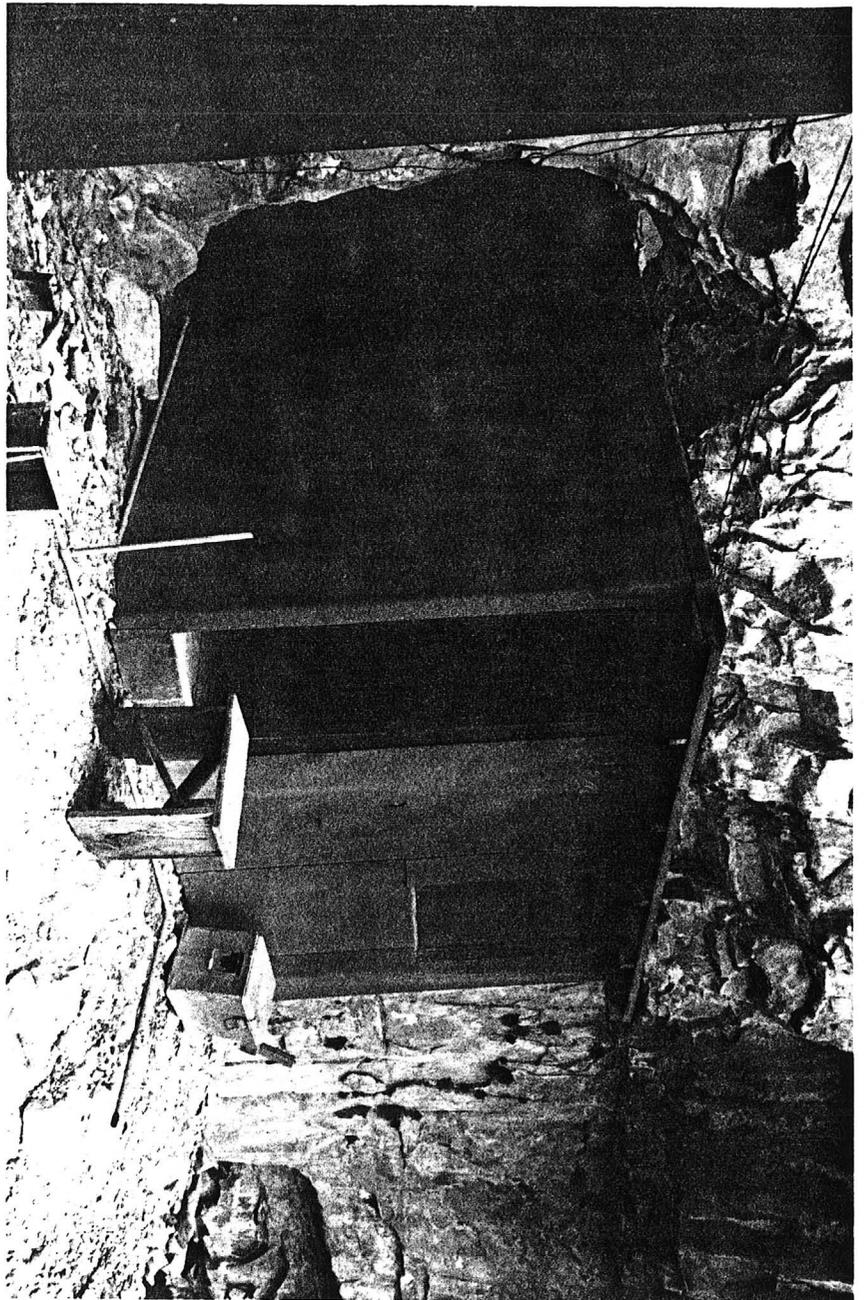


CISTERN ADIT - LOWER MINE WORKINGS  
ORPHAN LOBE MINING CLAIM

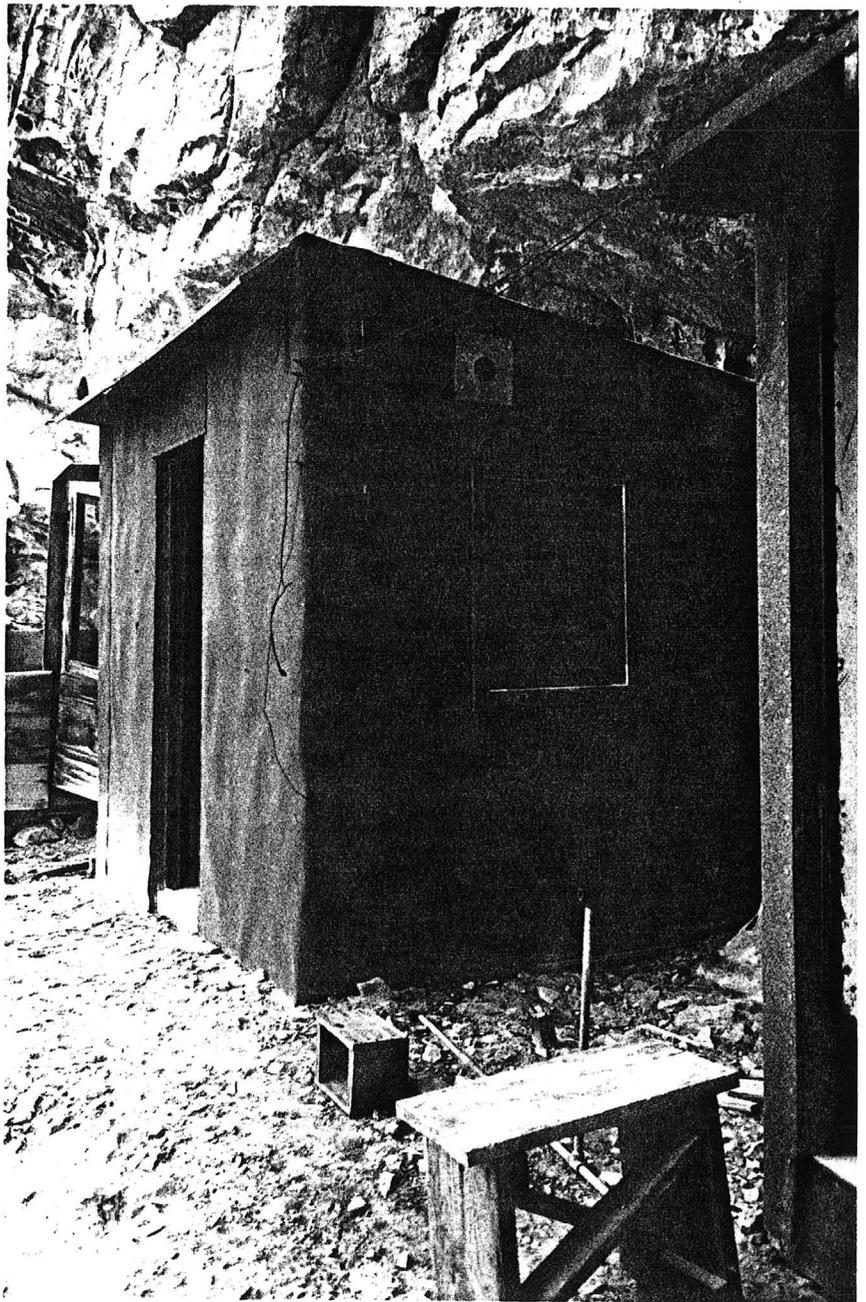
GRAND CANYON NATIONAL PARK

COCONINO COUNTY, ARIZONA

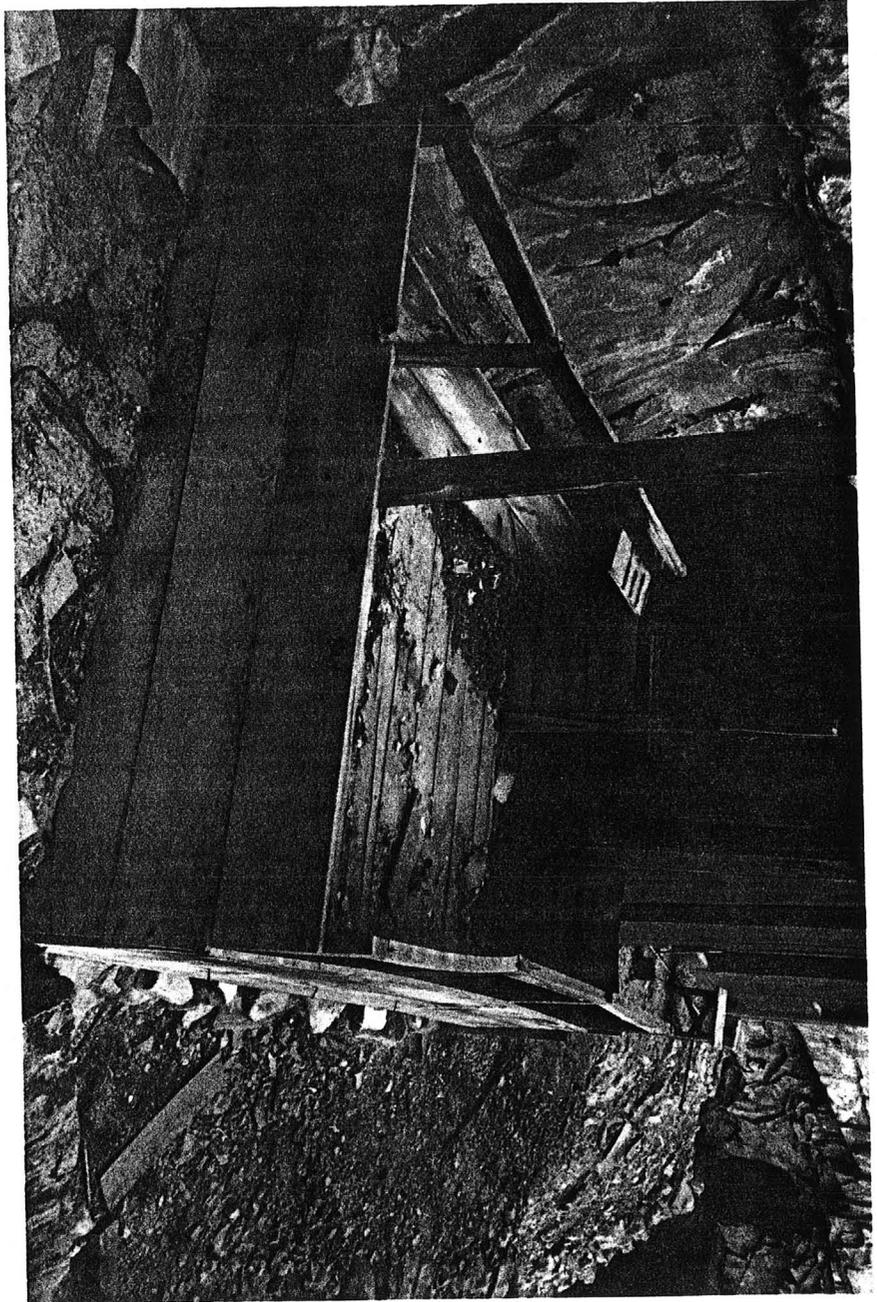
PHOTOGRAPH NO. 19



MESS - LOWER MINE WORKINGS  
ORPHAN LODGE MINE CLAIM  
GRAND CANYON NATIONAL PARK  
COCONINO COUNTY, ARIZONA  
PHOTOGRAPH NO. 20



BUNK HOUSE - LOWER MINE WORKINGS  
ORPHAN LODE MINING CLAIM  
GRAND CANYON NATIONAL PARK  
COCONINO COUNTY, ARIZONA  
PHOTOGRAPH NO. 21



71407 FRANK FOUNDATION - LOUFR NINE WORKINGS  
ORPHAN LODE MINING CLAIM  
GRAND CANYON NATIONAL PARK  
COCONINO COUNTY, ARIZONA  
PHOTOGRAPH NO. 22



LOWER AERIAL TRAM TERMINAL  
DRPHAN LODGE MINING CLAIM  
GRAND CANYON NATIONAL PARK  
COCONINO COUNTY, ARIZONA  
PHOTOGRAPH NO. 23

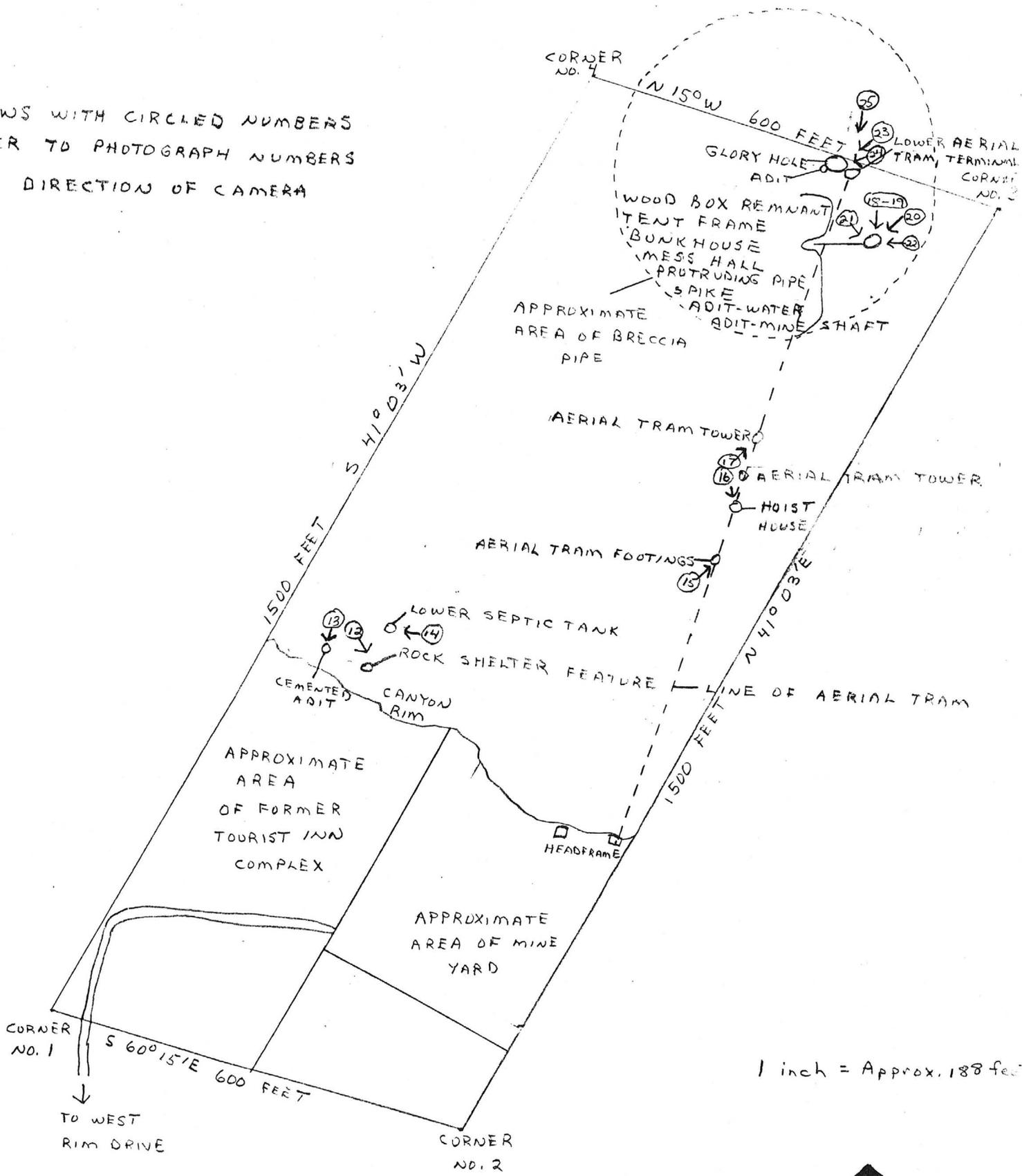


GLORY HOLE  
ORPHAN LODGE MINING CLAIM  
GRAND CANYON NATIONAL PARK  
COCONINO COUNTY, ARIZONA  
PHOTOGRAPH NO. 24

AERIAL TRAM REMNANTS  
ORPHAN LODE MINING CLAIM  
GRAND CANYON NATIONAL PARK  
COCONINO COUNTY, ARIZONA  
PHOTOGRAPH NO. 25

SKETCH MAP  
OF AN LODE MINING CLAIM

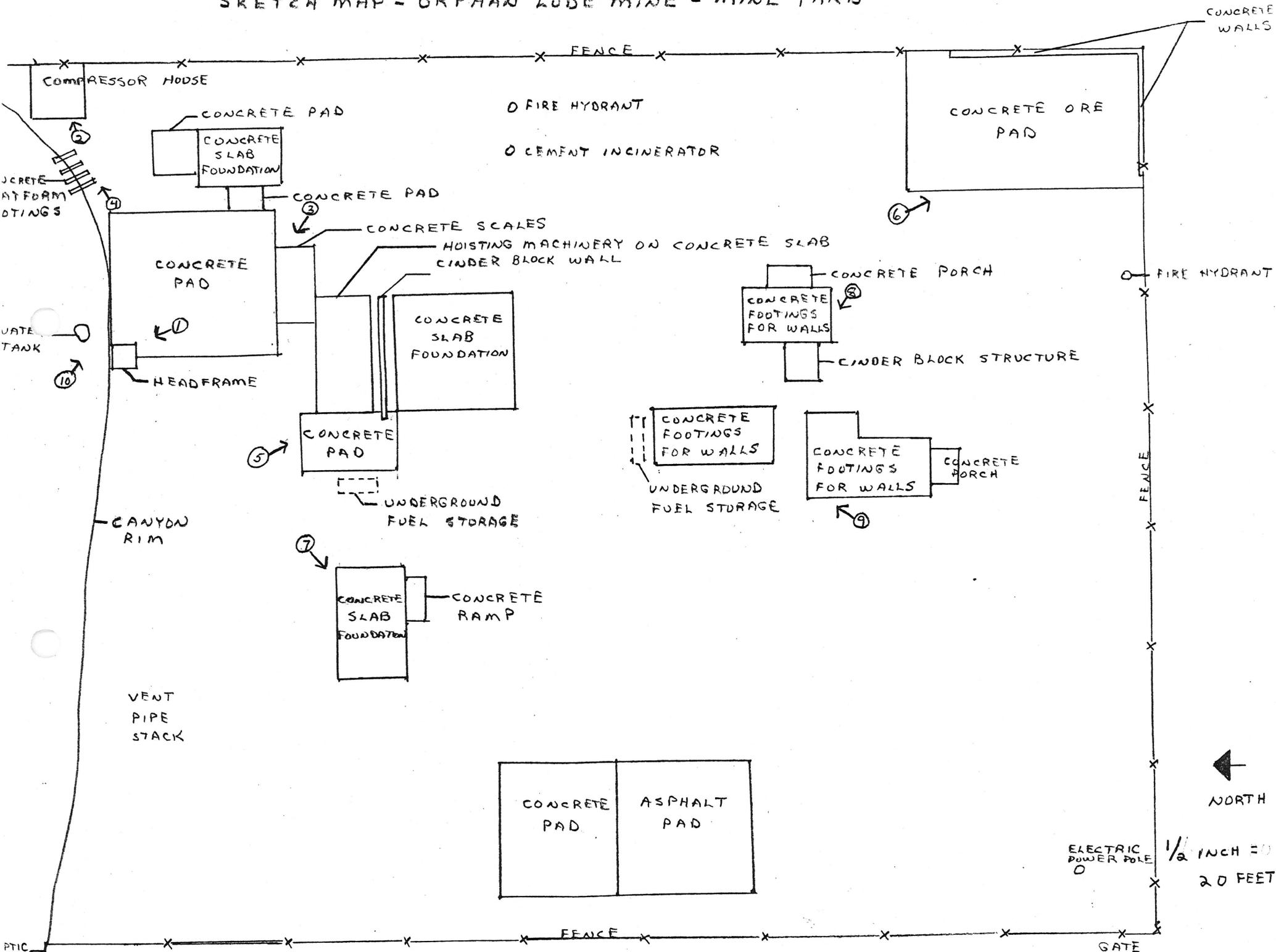
ARROWS WITH CIRCLED NUMBERS  
REFER TO PHOTOGRAPH NUMBERS  
AND DIRECTION OF CAMERA



1 inch = Approx. 188 feet

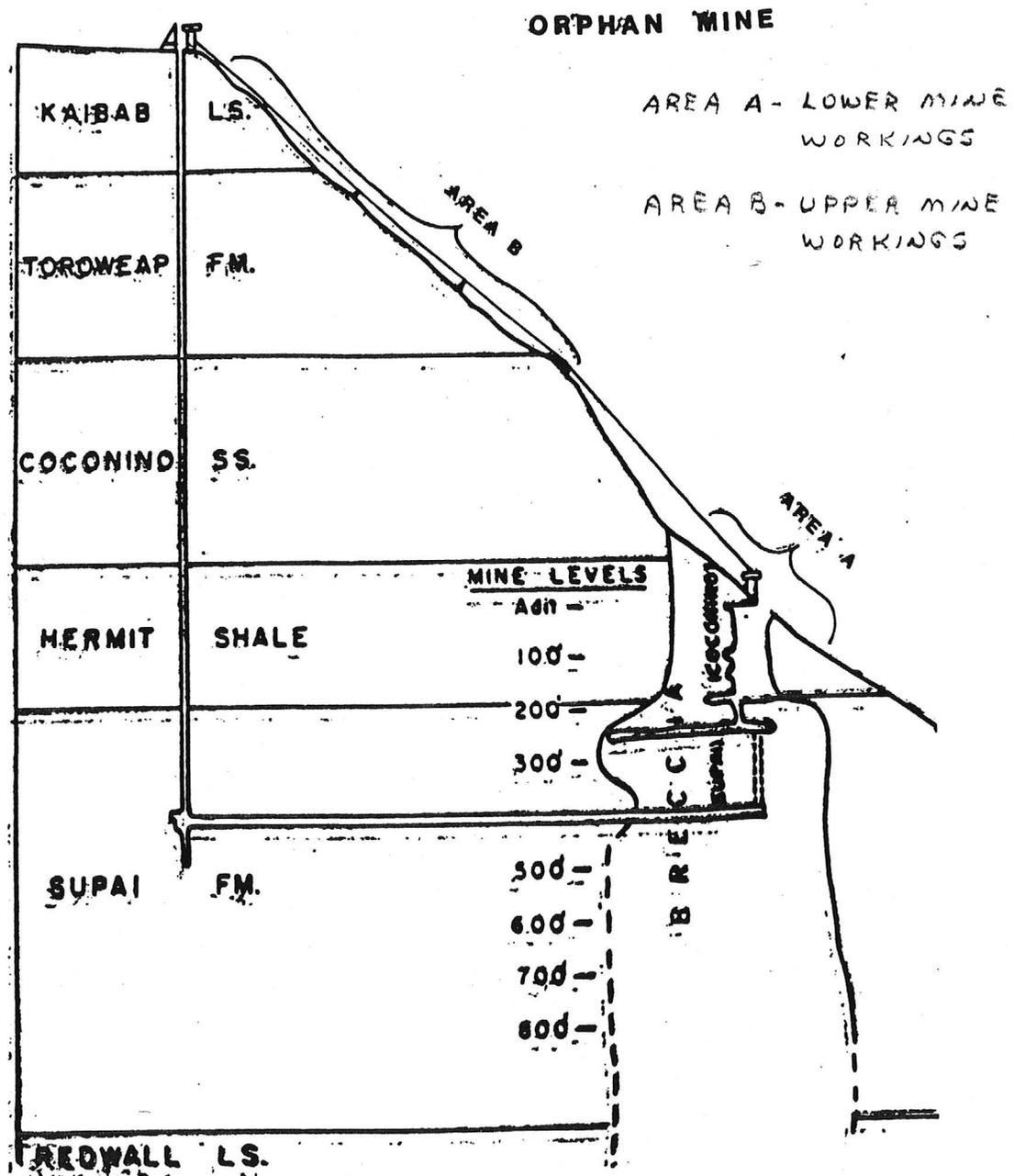


SKETCH MAP - OKPHAN LODE MINE - MINE YARD



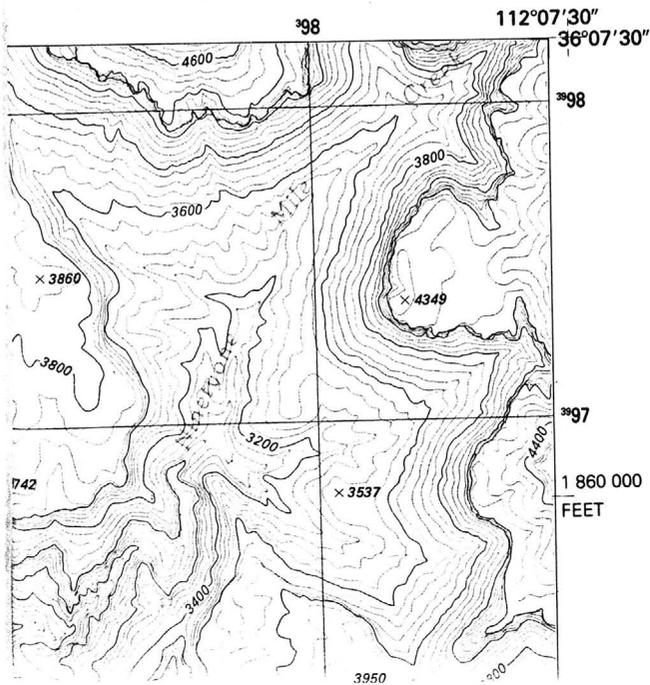
ARROWS WITH CIRCLED NUMBERS REFER TO PHOTOGRAPH NUMBERS AND DIRECTION OF CAMERA

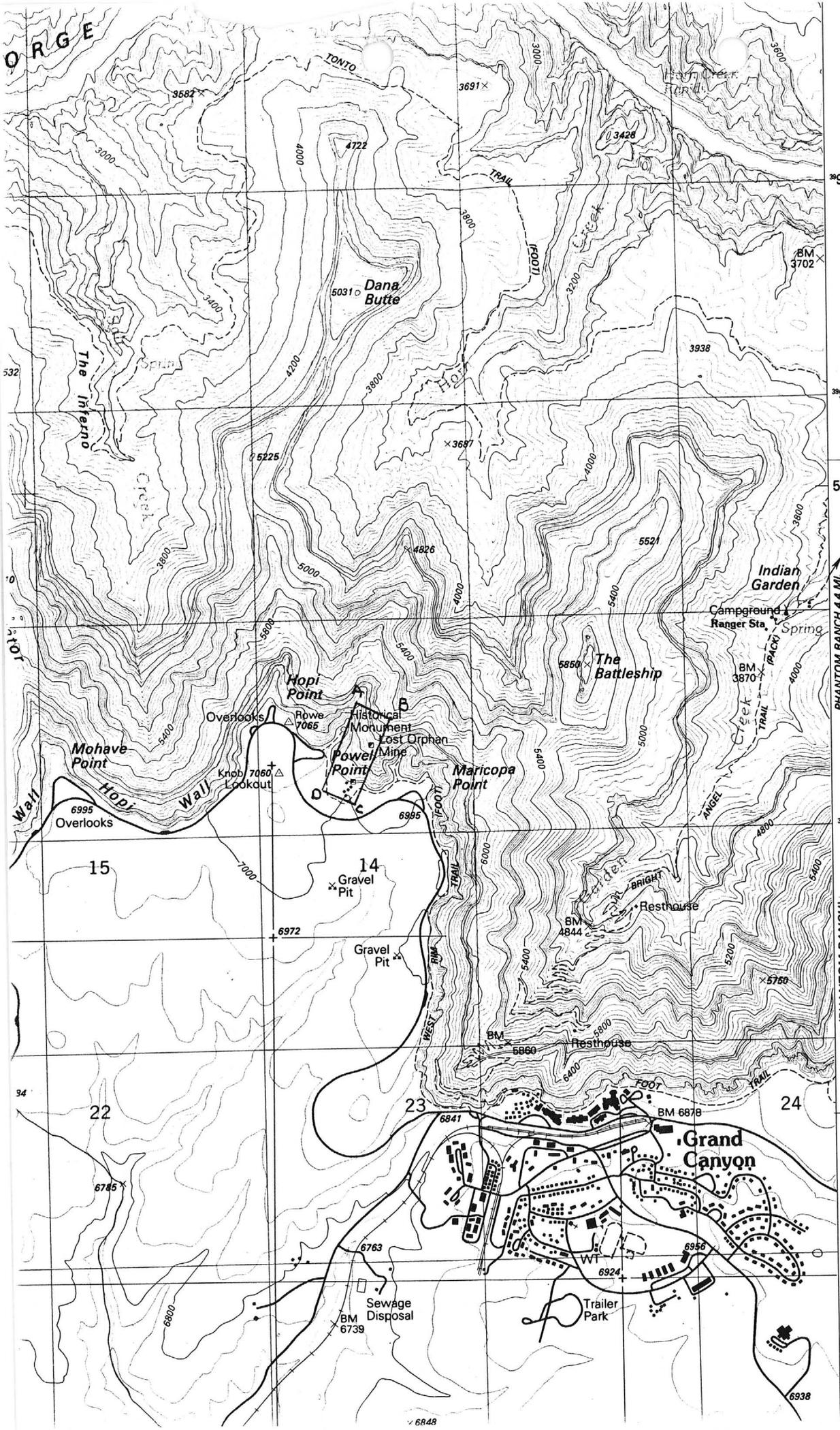
SCHEMATIC SKETCH DRAWING OF ORPHAN LOOSE MINE  
 MADE BY LANDMARK RECLAMATION INC. - 1986



**GRAND CANYON QUADRANGLE**  
**ARIZONA-COCONINO CO.**  
**7.5 MINUTE SERIES (TOPOGRAPHIC)**  
SW/4 BRIGHT ANGEL 15' QUADRANGLE

3556 II NE  
(BRIGHT ANGEL  
POINT)





ORPHAN LODE  
 MINING CLAIM  
 GRAND CANYON  
 NATIONAL PARK  
 COCONINO COUNTY,  
 ARIZONA

UTM  
 (PHANTOM RANCH)  
 3556 II SE  
 A-12/396340/3992600  
 B-12/396490/3992560  
 C-12/396800/3992140  
 D-12/396160/3992180