CP-4 Potential Hazardous Waste Site
504150401

SDMS DOCID # 1148148

TC-3360
FINAL REPORT

PRELIMINARY ASSESSMENT
CAMERON URANIUM MINES
NAVAJO RESERVATION
ARIZONA

by

Tetra Tech, Inc.

Prepared for

U.S. Department of the Interior
Bureau of Indian Affairs
Washington, DC

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APR - . 1988
ASSISTANT AREA DIRECTOR (Res)

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CAMERON URANIUM MINES
EXECUTIVE SUMMARY

The Cameron Uranium Mining District is located north and east of the town of Cameron in Coconino County, Arizona. Cameron is 52 mi north of Flagstaff, Arizona at the intersection of U.S. Highway 89 and the Little Colorado River. In 1952, the first uranium deposit of commercial value in this area was discovered. Most uranium was mined by open pit methods, but a few shafts and adits exist at the bottom of several pits. In 1962, uranium mining ceased and mines were abandoned. No remedial efforts were conducted on the open pits and remaining mine tailings and ore piles. Several potential public health and safety risks associated with these mines, include exposure to ionizing radiation from stockpiled tailings and ores; safety hazards associated with the larger mine pits; ingestion of water and inhalation of dust that may be contaminated with radionuclides; and ingestion of livestock that may have high tissue concentrations of radionuclides as a result of drinking water from the mine impoundments and grazing on vegetation grown near mines.

For the preliminary assessment, the Navajo Nation selected 12 of the 97 abandoned mines in the Cameron Uranium Mining District. They believed these mines presented the most significant threat to public health and the environment. All 12 mines are located on Tribal Trust Land.

Information was collected before and during the preliminary assessment to evaluate potential contaminant migration pathways, the population, and the environment that might be impacted.

Information gathered to date during the preliminary assessment, from historical sources, and local residents indicates that the abandoned uranium mines should be rated as Class III sites. This designation represents sites where hazardous wastes or substances exist in form and quantity, and under such conditions that there is reason to believe a potentially significant

hazard to human health and the environment may exist, and that further definitive investigations should be undertaken.

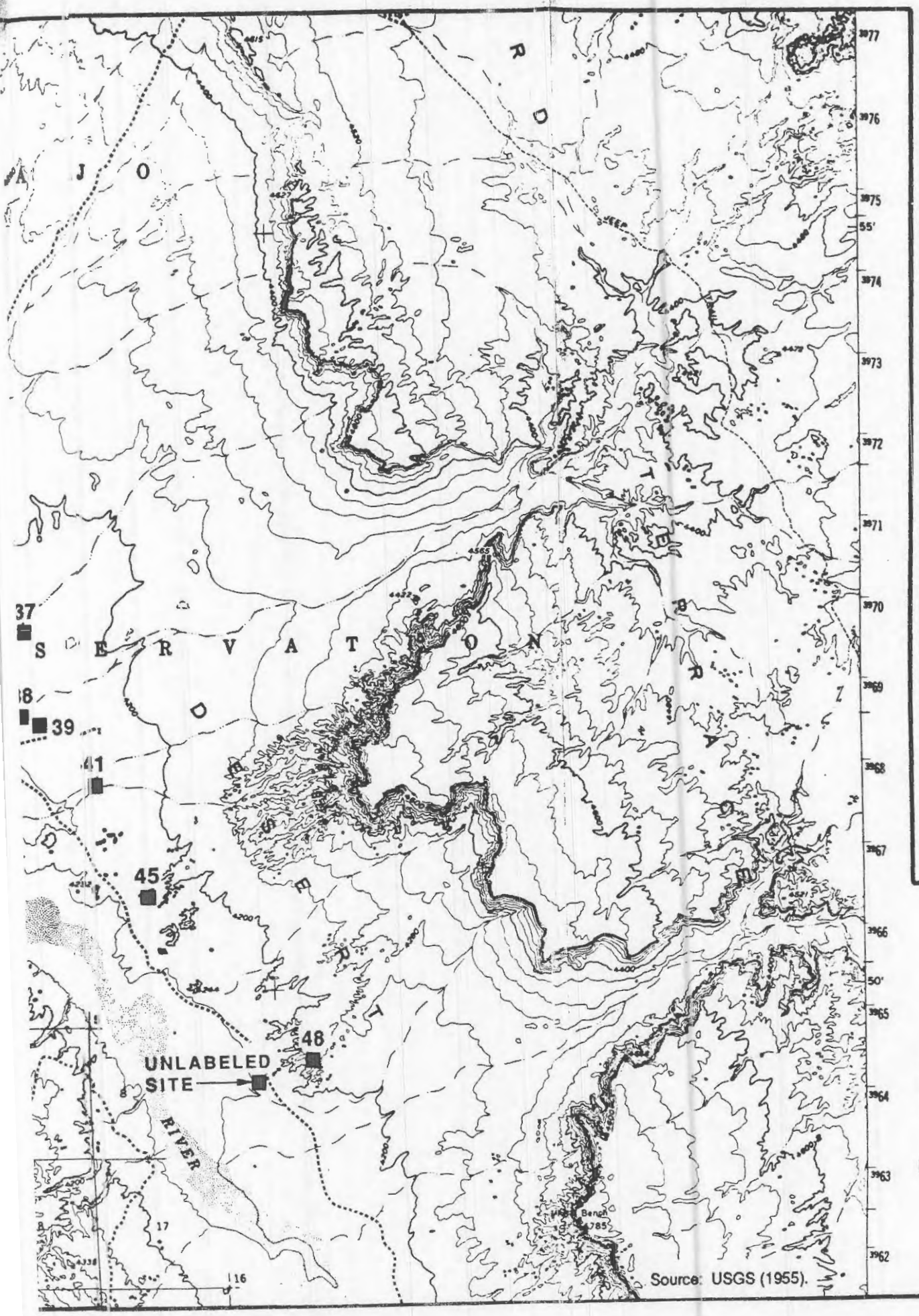
POTENTIAL HAZARDOUS WASTE SITE
PRELIMINARY ASSESSMENT SUMMARY

Site Name: Cameron Uranium Mines
Inspection Date: 22-23 April 1987
U.S. EPA Site Identification No.: None Assigned
Location: North and east of Cameron along Little Colorado River. Sections 13, 14, 15, 22, 23, 24, 25, 26; T29N, R9E; and Sections 17, 18, 19, 20, 29, 30, 31, 32; T29N; R10E
Reservation, State: Navajo Reservation, Arizona

SITE DESCRIPTION AND HISTORY

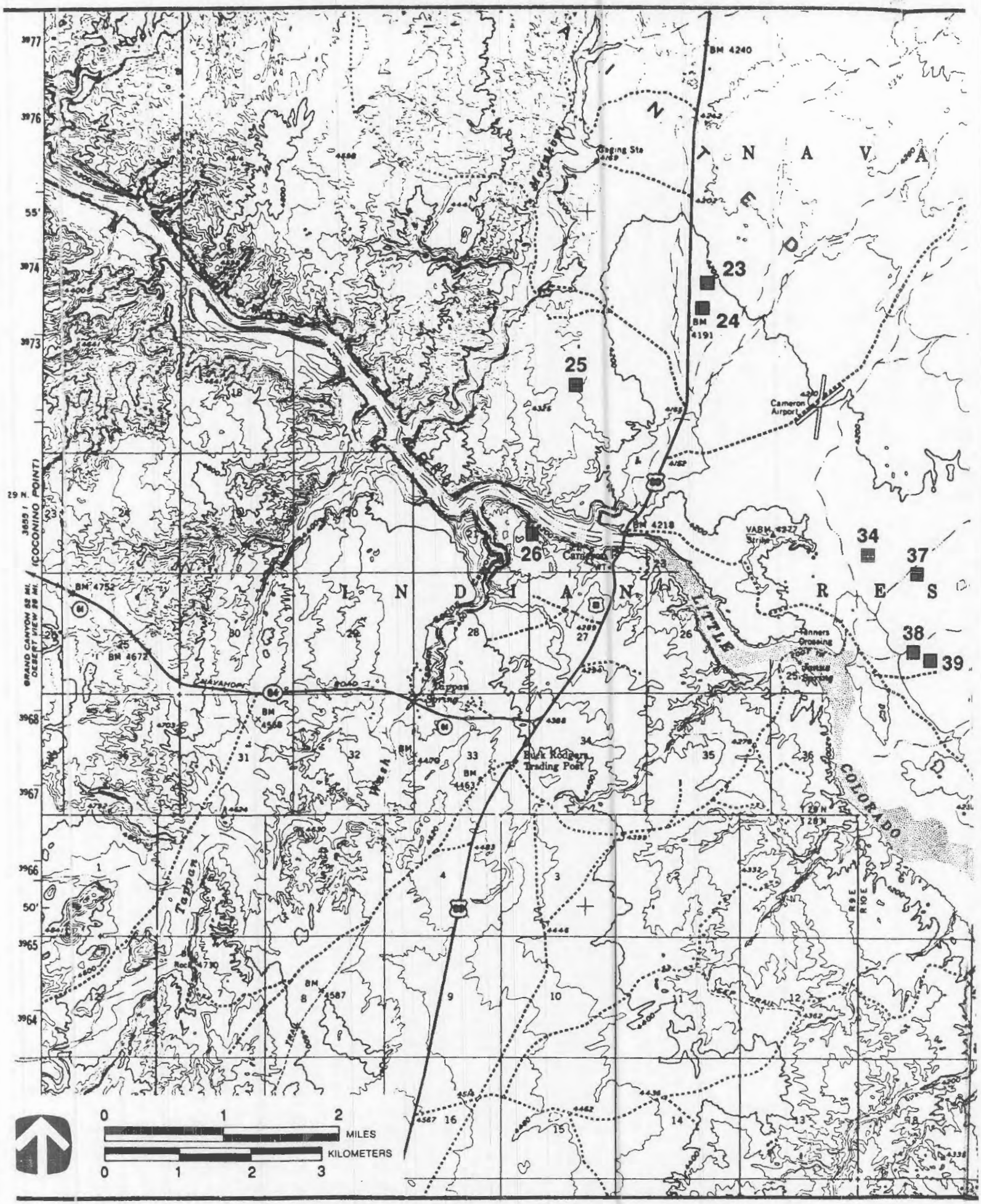
The Cameron Uranium Mining District is located north and east of the town of Cameron in Coconino County, Arizona. The district's orientation is along the southwestern boundary of the Navajo Indian Reservation in the north-central portion of Arizona (see Figure 1). The town of Cameron is located 52 mi north of Flagstaff, Arizona at the intersection of U.S. Highway 89 and the Little Colorado River. The main mining area was located within a curved belt approximately 2 mi wide extending 6 mi north of Cameron along U.S. Highways 89 and 164, and 5 mi wide extending 18 mi southeast along the Little Colorado River.

The first uranium deposit of commercial importance in this area was discovered in 1952. Uranium was mined by open pit methods, but a few shafts and adits exist at the bottom of several pits. The pits ranged in size from shallow trenches to large excavations that were up to 2,400 ft long, 240 ft wide, and 130 ft deep. Approximately 1,211,800 lb of uranium ore was produced from 98 separate locations; 67 of these locations yielded 97 percent of the area's production (Payne 1987). In 1962, uranium mining ceased in the area and the mines were abandoned. No remedial efforts were conducted on the open pits and remaining mine tailings and ore piles. Several potential public health and safety risks associated with these mines include



Source: USGS (1955).

Figure 1. Map of Cameron Uranium Mining District showing locations of 12 abandoned mines surveyed during preliminary assessment.



N A V A
I N D I A N
R E S
23
24
25
26
34
37
38
39
Cameron Airport
Cameron
Tanners Crossing
Tappan Spring
Buck Rodgers Trading Post
LITTLE
COLORADO
Tappan
Wash
NAVAHOPI ROAD
BM 4240
BM 4191
BM 4218
BM 4752
BM 4672
BM 4587
Gaging Sta
VABM 4277
Strike
GRAND CANYON 52 MI.
DESERT VIEW 28 MI.
(COCONINO POINT)
0 1 2 MILES
0 1 2 3 KILOMETERS

exposure to ionizing radiation from stockpiled tailings and ores; safety hazards associated with the larger mine pits (some of which are filled with water); ingestion of water and inhalation of dust that may be contaminated with radionuclides; and ingestion of livestock that may have high tissue concentrations of radionuclides as a result of drinking water from the mine impoundments and grazing on vegetation grown near mines (Arthur and Janke 1986).

PHYSICAL SETTING

The Cameron Uranium Mining District is located in the valley of the Little Colorado River at an elevation of approximately 4,200 ft. The topography of the area between the Little Colorado River and the foot of Ward Terrace is relatively flat (typically less than 1 percent slope). In the Cameron area, sedimentary and volcanic rocks are overlain by glacial outwash and alluvium. Groundwater is present in most of the geologic units, either in regional or perched aquifers. There is vertical movement of water from the upper sedimentary deposits into the lower Coconino and Supia formations through fractures created by the folding and faulting of these formations (Appel and Bills 1981).

Most municipal water supplies are drawn from the deep regional aquifers (e.g., Coconino and Supia). However, some wells along the Little Colorado River obtain water from the upper formations including the alluvium, the volcanic rock, the Shrinarump member of the Chinle formation, and the Moenkopi formation, which are typically less than 100 ft below ground surface. The water quality of these shallow perched aquifers is generally poor. Wells that penetrate the Coconino and Supia aquifers are 154-2,400 ft deep. The direction of groundwater flow in these aquifers is northward (Appel and Bills 1981). There are a few large municipal systems that use pumps to extract water (e.g., Cameron Trading Post), but several small systems use windmills to bring water to the surface.

The Little Colorado River is adjacent to the Cameron Uranium Mining District and is less than 0.25 mi from the nearest mine site. There are several swales that transect the area and terminate at the Little Colorado

River, but these only flow occasionally during the winter months when rainstorms create surface water runoff. The only other surface waters in the area are contained in the mine pits that have filled with surface water runoff and shallow groundwater.

The climate of the Cameron mining district is arid with an average annual precipitation of less than 20.73 in [National Oceanic and Atmospheric Administration (NOAA) 1985] and a mean annual lake evaporation of 59 in (NOAA 1968). The average summer temperature is 63° F and the average winter temperature is 29.5° F (NOAA 1985). The area is sparsely populated, with approximately 33 buildings within a 1-mi radius of the Cameron Uranium Mining District, and 58 within a 3-mi radius [U.S. Geological Survey (USGS) 1955, 1962]. The exact population of these areas is unknown because many of the buildings are vacant (Analla, J., 22 April 1987, personal communication). However, the population is conservatively estimated at 125 for the 1-mi radius and 220 for the 3-mi radius.

SITE VISIT

The Navajo Nation selected 12 of the 97 abandoned mines in the Cameron Uranium Mining District for the preliminary assessment. They believed these mines presented the most significant threat to public health and the environment because they are typically located closest to populated areas, large in size, known recreational areas, or water sources for grazing livestock. All of the mines are located on Tribal Trust Land. A site visit to these 12 high priority mines was conducted 22-23 April 1987 by Tetra Tech. The objective of the site visit was to gather information required to complete U.S. Environmental Protection Agency (EPA) Form No. 2070-12, "Potential Hazardous Waste Site Preliminary Assessment." The completed form for this site is attached as Appendix A.

A briefing was conducted on 22 April 1987 at the Navajo Nation Office building in Tuba City, Arizona. Glynda Steiner and Gregg Wagner (both of Tetra Tech) met with representatives of the Bureau of Indian Affairs (BIA), the Navajo Nation, and the Indian Health Service to discuss the scope of the Preliminary Assessment. Jim Analla and Edmond Store (BIA, Navajo Area

Office), and Levon Benally (Navajo Nation) assisted Tetra Tech personnel in locating the mine sites. Descriptions and site sketches of each mine surveyed are attached as Appendix B.

Information was collected to evaluate the potential contaminant migration pathways, the population, and the environment that might be impacted. An attempt was made to obtain the following information for each of the 12 Cameron uranium mines:

- Radiation measurements
- Proximity to residences
- Proximity to surface waters
- Evidence of recreational use by local residents
- Evidence of use by domestic grazing animals
- Population and land use data.

A Victoreen radiation meter was used to measure radioactivity levels (gamma) near the abandoned mines. Radioactivity levels varied at each mine site, but values typically ranged from 0.05 to 1.0 mR/hr. Radiation measurements are provided in Appendix B for all mines surveyed. Radioactivity levels measured at the mines were below the maximum level (2.0 mR/hr) for immediate site withdrawal as established in the project's site safety plan (Tetra Tech 1987). The radiation meter failed to operate satisfactorily during the afternoon of 23 April 1987 because of high ambient temperature (90-95° F). Therefore, radiation levels at five mine sites could not be obtained.

At each of the mine sites visited, it was evident that the areas were being used by grazing animals (see Photo 3 of Appendix C). There was also evidence at several of the water-filled pits that local residents were using the pits for swimming or other recreational activities.

WASTE CHARACTERISTICS

Uranium deposits in the Cameron area are a result of mineralization of organic material and are most commonly found in the Petrified Forest member of the Chinle formation, and the Moenkopi and Kayenta formations (Christensen 1979). Uranium ore exists as U_3O_8, a partially oxidized form of uraninite, with an average concentration of 0.21 percent occurring in the ore. Other constituents of radioactive deposits include uranium, radium-226, radon gas, lead-210, molybedenum, arsenic, selenium, and sulfates. Because surface mining techniques were used to remove the uranium ore, mine tailings and lower grades of ore were left exposed at the mine sites. Consequently, environmental transport mechanisms (e.g., surface water runoff, wind) have carried these materials away from the confined area of the mine sites.

Several agencies have collected soil, surface water, and groundwater samples from the area. Analyses of these samples have shown elevated concentrations of several of the constituents listed above. Between January 1984 and September 1986, the Navajo Department of Water Resources conducted surface water and groundwater sampling in the Cameron area. Analyses of the surface water samples indicated radionuclide levels, measured as gross alpha particles, that ranged from 24 to 9,400 pico Curies per liter (pCi/L) (Payne 1987). Analyses of the well water samples indicated radionuclide levels, measured as gross alpha concentrations, that ranged from 18 to 28 pCi/L (Payne 1987). As a reference, the U.S. EPA drinking water standards have a maximum contaminant level of 15 pCi/L (Payne 1987). Between October 1979 and September 1984, the USGS conducted radiochemical sampling at the river gaging station on the Little Colorado River located approximately 5 mi downstream from Cameron. Gross alpha suspended particles (measured as uranium) ranged from 1.8 to 3,900 pCi/L. Gross alpha dissolved particles (measured as uranium) ranged from 3.6 to 54 pCi/L (see Appendix E) (USGS 1987; Wilson, R.P., 1 April 1987, personal communication).

SITE STATUS

The uranium mines in the Cameron area have remained virtually unchanged since mining ceased in the 1960s. Mine tailings and ore piles remain exposed along with the abandoned mine pits. The steep, high-walled mine pits, which collect rain, surface water runoff, and shallow groundwater, are used by local grazing animals for water sources and by local residents for recreation areas. Several of the mine sites are also currently being used as uncontrolled domestic waste dumps. Based on these conditions, the uranium mine sites on the Navajo Reservation should be categorized as Class III sites, representing potentially significant hazards to human health and the environment.

The Navajo Environmental Protection Administration is currently conducting an evaluation on 79 of the identified mine sites in the Cameron area. The evaluation includes measurements of the radioactivity levels, amounts of materials present, and size of excavation. Radioactivity measurements were requested for those mines where Tetra Tech's radiation meter was not operating properly and measurements could not be obtained. The Navajo Environmental Protection Administration would not release this data prior to completion of their study.

DATA GAPS

Because the radiation meter malfunctioned, radiation levels at five of the mine sites visited were not obtained. The instrument failure also prevented the Tetra Tech team from obtaining background radiation levels in the Cameron area, therefore, elevations of radioactivity above background levels cannot be estimated from data obtained during this field visit.

Analyses for radionuclides isotopes (e.g., uranium 234, uranium 238, thorium 230 , radium 226, lead 210, and polonium 210) of tissue samples from livestock were not completed during this preliminary assessment, but will likely be conducted at a later date. Tentative plans are to sample two sets (one control group and one group that has been reared near the mine sites)

of grazing animals (one or more species) to determine the radionuclide concentrations of selected organs, bones, and muscle tissue.

RECOMMENDATIONS

Based on this preliminary assessment, it is recommended that the deep, high-wall mines be filled with the waste ore and tailings that are stockpiled around these mines. Additional clean fill material will be necessary to completely fill the mine pits because the original material has experienced reductions in volume from the extraction of uranium deposits, and the settling and erosion of the tailings piles over time. In addition, the clean fill material will act as a cap for residual radioactivity in the tailings, and will minimize further exposure via inhalation and ingestion of radionuclides in the fugitive dust. Livestock exposure to radionuclides through drinking contaminated water will also be reduced because there will no longer be depressions for water to collect. Because water in the mine pits is currently an important source of drinking water for the grazing livestock, alternative sources will have to be provided.

REFERENCES

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U.S. Geological Survey. 1962. Coconino Point, AZ. 15 min quadrangle map, USGS, Denver, CO.

U.S. Geological Survey. 1987. Laboratory analytical data for Little Colorado River water collected 10/79 to 9/84. USGS, Tucson, AZ.

Wilson, R.P. 1 April 1987. Personal Communication (letter to Mr. Gregg Wagner transmitting water quality data for the Little Colorado River). United States Geological Survey, Water Resources Division, Tucson, AZ.

APPENDIX A

POTENTIAL HAZARDOUS WASTE SITE PRELIMINARY ASSESSMENT

EPA

POTENTIAL HAZARDOUS WASTE SITE
PRELIMINARY ASSESSMENT
PART 1 - SITE INFORMATION AND ASSESSMENT

I. IDENTIFICATION	
01 STATE	02 SITE NUMBER
AZ	N/A

II. SITE NAME AND LOCATION

01 SITE NAME (Legal, common, or descriptive name of site)	02 STREET, ROUTE NO., OR SPECIFIC LOCATION IDENTIFIER				
Cameron Abandoned Uranium Mines	North of Cameron along Hwys 89 and 164				
03 CITY	04 STATE	05 ZIP CODE	06 COUNTY	07 COUNTY CODE	08 CONG DIST
Cameron	AZ	86020	Coconino	005	003
09 COORDINATES LATITUDE	LONGITUDE				
35°49' - 35°54'	111°20' - 111°25'				

10 DIRECTIONS TO SITE (Starting from nearest public road)

Approximately 50 mi north on Hwy 89 from Flagstaff, AZ. All mines are accessed from unpaved side roads off Hwy 89 within 1 mi of Cameron.

III. RESPONSIBLE PARTIES

01 OWNER (If known)	02 STREET (Business, mailing, residence)		
Navajo Nation	P.O. Box 308		
03 CITY	04 STATE	05 ZIP CODE	06 TELEPHONE NUMBER
Window Rock	AZ	86515	(602) 871-4941
07 OPERATOR (If known and different from owner)	08 STREET (Business, mailing, residence)		
None - Abandoned Mines			
09 CITY	10 STATE	11 ZIP CODE	12 TELEPHONE NUMBER
			( )

13 TYPE OF OWNERSHIP (Check one)

☐ A. PRIVATE ☐ B. FEDERAL: Bureau of Indian Affairs (Agency name) ☐ C. STATE ☐ D. COUNTY ☐ E. MUNICIPAL

☐ F. OTHER: Navajo Nation (Specify) ☐ G. UNKNOWN

14 OWNER/OPERATOR NOTIFICATION ON FILE (Check all that apply)

☐ A. RCRA 3001 DATE RECEIVED: / / (MONTH DAY YEAR) ☐ B. UNCONTROLLED WASTE SITE (CERCLA 103 c) DATE RECEIVED: / / (MONTH DAY YEAR) ☐ C. NONE

IV. CHARACTERIZATION OF POTENTIAL HAZARD

01 ON SITE INSPECTION

☐ YES DATE 04/22-23/87 (MONTH DAY YEAR)
☐ NO

BY (Check all that apply)

☐ A. EPA ☐ B. EPA CONTRACTOR ☐ C. STATE ☐ D. OTHER CONTRACTOR
☐ E. LOCAL HEALTH OFFICIAL ☐ F. OTHER: BIA and Navajo Nation (Specify)

CONTRACTOR NAME(S): Tetra Tech, Inc.

02 SITE STATUS (Check one)

☐ A. ACTIVE ☒ B. INACTIVE ☐ C. UNKNOWN

03 YEARS OF OPERATION

1950 (BEGINNING YEAR) | 1963 (ENDING YEAR) ☐ UNKNOWN

04 DESCRIPTION OF SUBSTANCES POSSIBLY PRESENT, KNOWN, OR ALLEGED

Uranium Mine Tailings and Ores that emit radiation and produce radionuclides.

05 DESCRIPTION OF POTENTIAL HAZARD TO ENVIRONMENT AND/OR POPULATION

Uranium mine tailings are not contained or stabilized, creating the potential for releases of radionuclides to air, surface water, and groundwater. Potential exposures to local residents and grazing animals through inhalation of dust, and ingestion of contaminated soil and water. Also, several pits are deep and filled with water, posing potential safety hazards.

V. PRIORITY ASSESSMENT

01 PRIORITY FOR INSPECTION (Check one. If high or medium is checked, complete Part 2 - Waste Information and Part 3 - Description of Hazardous Conditions and Incidents)

☐ A. HIGH (Inspection required promptly) ☐ B. MEDIUM (Inspection required) ☒ C. LOW (Inspect as time available basis) ☐ D. NONE (No further action needed, complete current disposition form)

VI. INFORMATION AVAILABLE FROM

01 CONTACT	02 OF (Agency/Organization)		03 TELEPHONE NUMBER
Jim Analla	BIA, Navajo Area Office		(505) 863-9501
04 PERSON RESPONSIBLE FOR ASSESSMENT	05 AGENCY	06 ORGANIZATION	07 TELEPHONE NUMBER	08 DATE
Gregg Wagner		Tetra Tech, Inc.	(206) 822-9596	04 / 23 / 87 (MONTH DAY YEAR)

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POTENTIAL HAZARDOUS WASTE SITE
PRELIMINARY ASSESSMENT
PART 2 - WASTE INFORMATION

I. IDENTIFICATION	
01 STATE	02 SITE NUMBER
AZ	N/A

II. WASTE STATES, QUANTITIES, AND CHARACTERISTICS

01 PHYSICAL STATE (Check all that apply)

- [x] A. SOLID
- [ ] B. POWDER, FINES
- [ ] C. SLUDGE
- [ ] D. OTHER _____ (Specify)
- [ ] E. SLURRY
- [x] F. LIQUID
- [x] G. GAS

02 WASTE QUANTITY AT SITE (Estimate of waste quantities that be appropriate)

TONS: Unknown
CUBIC YARDS: Unknown
NO. OF DRUMS: N/A

03 WASTE CHARACTERISTICS (Check all that apply)

- [ ] A. TOXIC
- [ ] B. CORROSIVE
- [x] C. RADIOACTIVE
- [ ] D. PERSISTENT
- [ ] E. SOLUBLE
- [ ] F. INFECTIOUS
- [ ] G. FLAMMABLE
- [ ] H. IGNITABLE
- [ ] I. HIGHLY VOLATILE
- [ ] J. EXPLOSIVE
- [ ] K. REACTIVE
- [ ] L. INCOMPATIBLE
- [ ] M. NOT APPLICABLE

III. WASTE TYPE

CATEGORY	SUBSTANCE NAME	01 GROSS AMOUNT	02 UNIT OF MEASURE	03 COMMENTS
SLU	SLUDGE			
OLW	OILY WASTE			
SOL	SOLVENTS			
PSD	PESTICIDES			
OCC	OTHER ORGANIC CHEMICALS			
IOC	INORGANIC CHEMICALS			
ACD	ACIDS			
BAS	BASES			
MES	HEAVY METALS			

IV. HAZARDOUS SUBSTANCES (See Appendix for most frequently used CAS Numbers)

01 CATEGORY	02 SUBSTANCE NAME	03 CAS NUMBER	04 STORAGE/DISPOSAL METHOD	05 CONCENTRATION	06 MEASURE OF CONCENTRATION	
****	ENVIRONMENTAL RELEASE AS MEASURED		****			
	Ionizing Radiation		Piles	0.01-2.0	mR/hr	
	(Gamma)					
	Gross Alpha		Mine Impoundment	9400±400	pCi/L	a
	Gross Beta		Mine Impoundment	4100±100	pCi/L	a
	Radium 226		Mine Impoundment	240± 10	pCi/L	a
	Uranium	7440611	Mine Impoundment	1972	pCi/L	a

V. FEEDSTOCKS (See Appendix for CAS Numbers)

CATEGORY	01 FEEDSTOCK NAME	02 CAS NUMBER	CATEGORY	01 FEEDSTOCK NAME	02 CAS NUMBER
FDS			FDS		
FDS			FDS		
FDS			FDS		
FDS			FDS		

VI. SOURCES OF INFORMATION (Cite specific references, e.g., state files, sample analysis, reports)

Bureau of Land Management, 9 May 1985, pers. com.; Payne (1987). U.S. Geological Survey (1955).

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a Jackpot #40(2)

EPA

POTENTIAL HAZARDOUS WASTE SITE PRELIMINARY ASSESSMENT

PART 3 - DESCRIPTION OF HAZARDOUS CONDITIONS AND INCIDENTS

I. IDENTIFICATION	
01 STATE	02 SITE NUMBER
AZ	N/A

II. HAZARDOUS CONDITIONS AND INCIDENTS

01 [X] A. GROUNDWATER CONTAMINATION — 02 [X] OBSERVED (DATE: 1/84-6/86) ☐ POTENTIAL ☐ ALLEGED
03 POPULATION POTENTIALLY AFFECTED: 220 — 04 NARRATIVE DESCRIPTION

Most wells sampled exceeded the Maximum Contaminants Level (MCL) for gross alpha (15 pCi/L). Values ranged from 0.0 +- 9.0 to 1400 +- 100 pCi/L. Six of the 20 groundwater wells sampled near the uranium mines exceeded the MCL of other parameters (including chromium, lead, and sulfate).

01 [X] B. SURFACE WATER CONTAMINATION — 02 [X] OBSERVED (DATE: 1/84-6/86) ☐ POTENTIAL ☐ ALLEGED
03 POPULATION POTENTIALLY AFFECTED: 220 — 04 NARRATIVE DESCRIPTION

Samples collected from water ponded in mine pits and analyzed for radionuclide concentration showed most to be above the recommended MCL (RMCL) (this level is also typically accepted as the ambient water quality limit).

01 [X] C. CONTAMINATION OF AIR — 02 ☐ OBSERVED (DATE:) [X] POTENTIAL ☐ ALLEGED
03 POPULATION POTENTIALLY AFFECTED: 125 — 04 NARRATIVE DESCRIPTION

The potential exists for releases of radionuclides into the air via the transport of fugitive dust particles from the exposed piles.

01 ☐ D. FIRE/EXPLOSIVE CONDITIONS — 02 ☐ OBSERVED (DATE:) ☐ POTENTIAL ☐ ALLEGED
03 POPULATION POTENTIALLY AFFECTED: 0 — 04 NARRATIVE DESCRIPTION

No reported or suspected fire or explosion hazards at the abandoned uranium mines.

01 [X] E. DIRECT CONTACT — 02 ☐ OBSERVED (DATE:) [X] POTENTIAL ☐ ALLEGED
03 POPULATION POTENTIALLY AFFECTED: 125 — 04 NARRATIVE DESCRIPTION

The potential exists for direct contact with materials contaminated with radionuclides via use of these sites as recreation areas. Potential exposure routes include inhalation; ingestion of water, soil, and livestock; and dermal adsorption.

01 [X] F. CONTAMINATION OF SOIL — 02 ☐ OBSERVED (DATE:) [X] POTENTIAL ☐ ALLEGED
03 AREA POTENTIALLY AFFECTED: Unknown (Acres) — 04 NARRATIVE DESCRIPTION

It is likely that soils underlying the tailings piles and impoundments are contaminated because there are no liners or other containment preventing infiltration of water contaminated with radionuclides into the native soils.

01 [X] G. DRINKING WATER CONTAMINATION — 02 [X] OBSERVED (DATE:) ☐ POTENTIAL ☐ ALLEGED
03 POPULATION POTENTIALLY AFFECTED: 220 — 04 NARRATIVE DESCRIPTION

Several springs that are used by local residents for drinking water supplies have gross alpha concentrations that exceed the RMCL of 15 pCi/L.

01 ☐ H. WORKER EXPOSURE/INJURY — 02 ☐ OBSERVED (DATE: 1/84-6/86) ☐ POTENTIAL ☐ ALLEGED
03 WORKERS POTENTIALLY AFFECTED: 0 — 04 NARRATIVE DESCRIPTION

Not applicable. These mines are abandoned and have no current activity.

01 [X] I. POPULATION EXPOSURE/INJURY — 02 ☐ OBSERVED (DATE:) [X] POTENTIAL ☐ ALLEGED
03 POPULATION POTENTIALLY AFFECTED: 220 — 04 NARRATIVE DESCRIPTION

Open mine pits with ponded water and high, steep walls pose safety hazards for residents that use them for recreational purposes (swimming, motorcycle riding, and target practice). Local residents may also be exposed to radionuclides via the consumption of livestock that drink from the mine pits.

EPA

POTENTIAL HAZARDOUS WASTE SITE
PRELIMINARY ASSESSMENT
PART 3 - DESCRIPTION OF HAZARDOUS CONDITIONS AND INCIDENTS

I. IDENTIFICATION	
01 STATE	02 SITE NUMBER
AZ	N/A

II. HAZARDOUS CONDITIONS AND INCIDENTS (Continued)

01 ☐ J. DAMAGE TO FLORA — 02 ☐ OBSERVED (DATE: _____) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

None reported or suspected.

01 ☒ K. DAMAGE TO FAUNA — 02 ☐ OBSERVED (DATE: _____) ☒ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

There is the potential of radionuclides concentrating in the bodies of livestock that drink the water ponded in the abandoned mines, ingest vegetation and soil near the mines, or inhale dust particles contaminated with radionuclides.

01 ☒ L. CONTAMINATION OF FOOD CHAIN — 02 ☐ OBSERVED (DATE: _____) ☒ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

There is the potential for humans to assimilate radionuclides via the consumption of livestock that use the mine impoundments and pits as water sources (see Damage to Fauna, above).

01 ☐ M. UNSTABLE CONTAINMENT OF WASTES — 02 ☐ OBSERVED (DATE: _____) ☒ POTENTIAL ☐ ALLEGED
03 POPULATION POTENTIALLY AFFECTED: 220 — 04 NARRATIVE DESCRIPTION

The tailings piles are not lined or covered to prevent migration of radionuclides via groundwater, surface water runoff, and wind. Several of the mines pits have steep, unstable walls.

01 ☐ N. DAMAGE TO OFFSITE PROPERTY — 02 ☐ OBSERVED (DATE: _____) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

None reported or suspected.

01 ☐ O. CONTAMINATION OF SEWERS, STORM DRAINS, WWTPs — 02 ☐ OBSERVED (DATE: _____) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

There are no sanitary or storm sewers that serve this area.

01 ☒ P. ILLEGAL/UNAUTHORIZED DUMPING — 02 ☒ OBSERVED (DATE: 4/22-23/87) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

Several of the abandoned mines are used for disposal of domestic refuse. There are no approved or licensed refuse disposal areas on the Navajo Indian Reservation.

06 DESCRIPTION OF ANY OTHER KNOWN, POTENTIAL, OR ALLEGED HAZARDS

It has been reported that local residents have used rocks that may have high levels of radioactivity for foundation materials in the construction of new homes. This allegation has not been substantiated by the Navajo Council or the BIA.

III. TOTAL POPULATION POTENTIALLY AFFECTED: 220

IV. COMMENTS

The abondoned uranium mines present potential public health and safety problems from the steep, unstable pit walls; the low quality of ponded water in the pits that are used for recreation and livestock; and the potential for ingestion of dust and groundwater. The mines should be filled to mitigate these potential problems. Temporary measures may include fences and warning signs.

V. SOURCES OF INFORMATION (Cite specific references, e.g., state files, sample analysis, reports)

Begay, T., 12 March 1984, pers. com.; Begay, T., 17 April 1984, pers. com.; Bliss, W., 3 March 1982, pers. com.; Bureau of Land Management, 9 May 1985, pers. com.; Payne (1987); U.S. Geological Survey (1955). Wilson, R., 1 April 1987, pers. com.

APPENDIX B

DIAGRAMS OF ABANDONED MINE SITES

DATE: 4/23/87

MINE SITE #: 23

MINE NAME: CHARLES HUSKON #19

LOCATION: 2 MI NORTH OF CAMERON TRADING POST, BESIDE HWY. #89

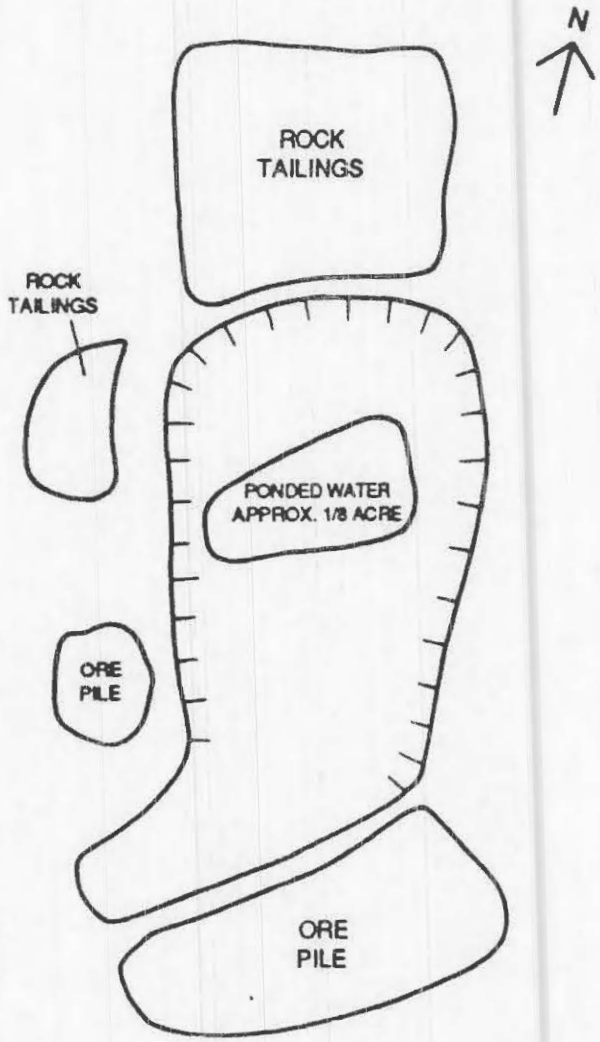
LENGTH: 150 FT WIDTH: 75 FT DEPTH: 20 FT

DISTANCE TO NEAREST HOME: 0.25 MI

POPULATION WITHIN 3 MILES OF SITE: 125

GAMMA RADIATION LEVELS: _____ TO _____

COMMENTS: RADIATION METER MALFUNCTIONING.



DATE: 4/23/87

MINE SITE #: 24

MINE NAME: JACK DANIELS #1-5

LOCATION: 2 MI NORTH OF CAMERON TRADING POST, BESIDE HWY. #89

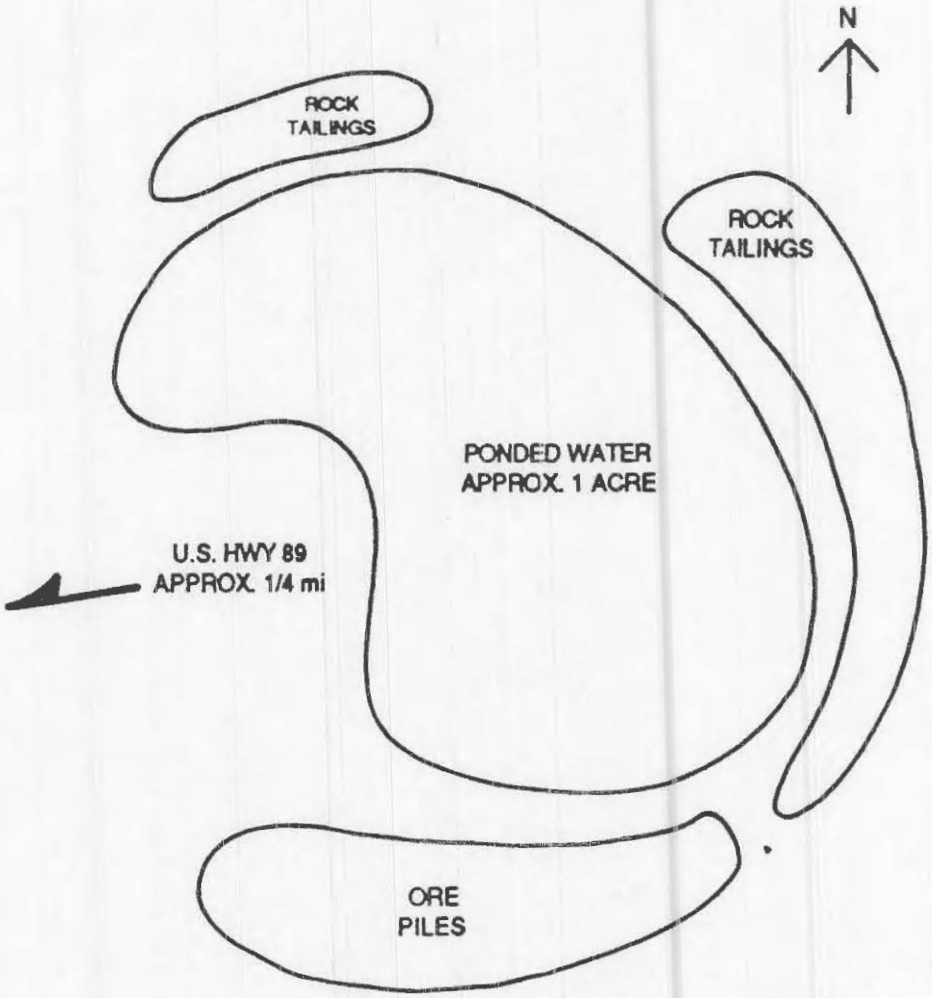
LENGTH: 300 FT WIDTH: 200 FT DEPTH: 15 FT

DISTANCE TO NEAREST HOME: 0.50 MI

POPULATION WITHIN 3 MILES OF SITE: 125

GAMMA RADIATION LEVELS: _____ TO _____

COMMENTS: RADIATION METER MALFUNCTIONING.



DATE: 4/22/87

MINE SITE #: 25

MINE NAME: CHARLES HUSKON #12

LOCATION: 1 MI NORTH OF CAMERON TRADING POST

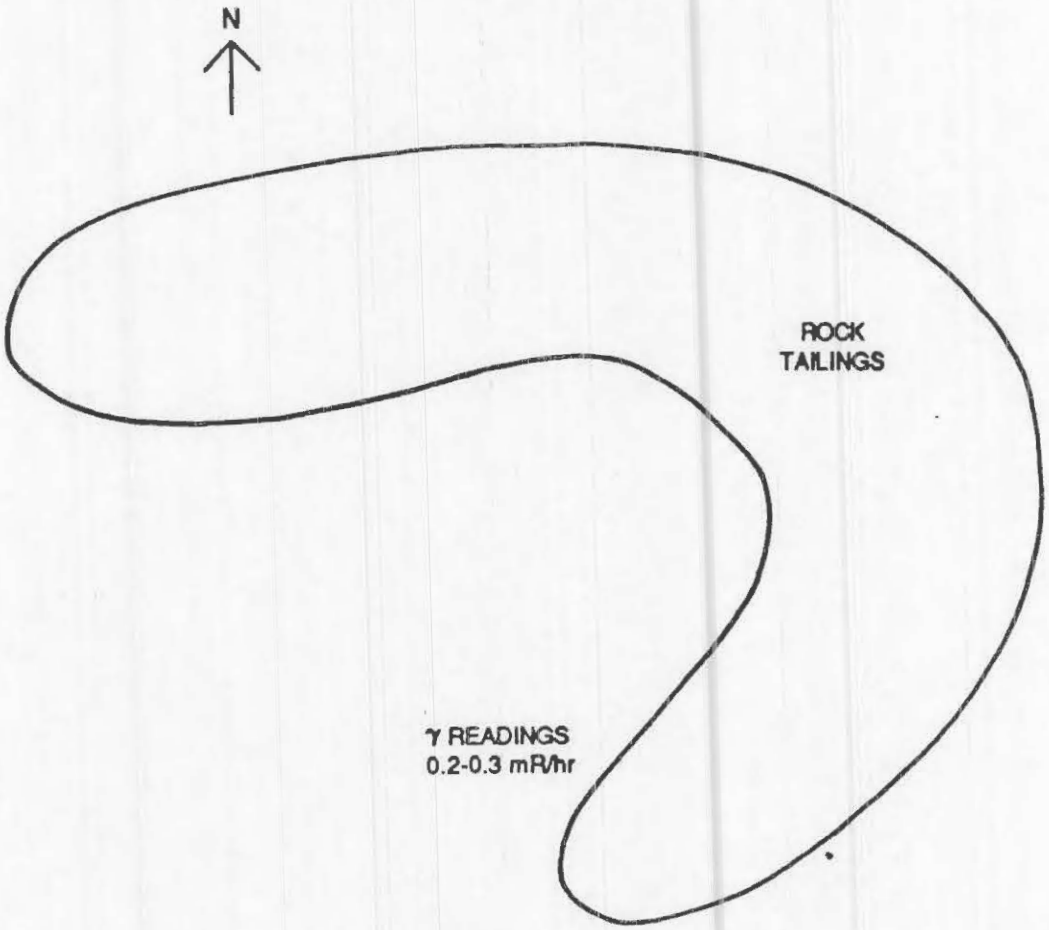
LENGTH: 200 FT WIDTH: 200 FT DEPTH: 10 FT

DISTANCE TO NEAREST HOME: 0.75 MI

POPULATION WITHIN 3 MILES OF SITE: 125

GAMMA RADIATION LEVELS: 0.05 TO 0.3 mR/HR

COMMENTS:



DATE: 4/22/87

MINE SITE #: 26

MINE NAME: A & B #3

LOCATION: 0.5 MI WEST OF CAMERON TRADING POST

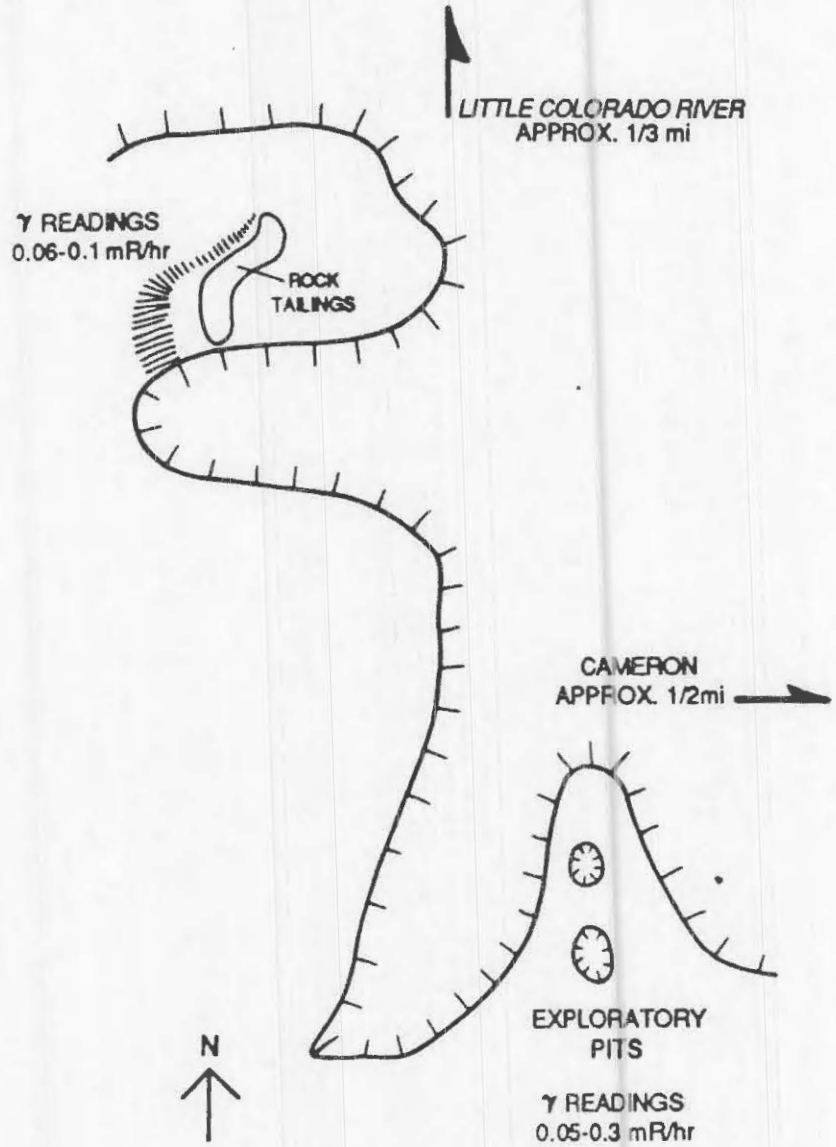
LENGTH: 600 FT WIDTH: 300 FT DEPTH: 50 FT

DISTANCE TO NEAREST HOME: 0.25 MI

POPULATION WITHIN 3 MILES OF SITE: ~125

GAMMA RADIATION LEVELS: 0.05 TO 0.3 mR/HR

COMMENTS: SITE USED EXTENSIVELY AS DOMESTIC GARBAGE DUMP



DATE: 4/23/87

MINE SITE #: 34

MINE NAME: ALYCE TOLENO #1 & 3 (See photo 3, Appendix C)

LOCATION: 2 MI EAST OF CAMERON TRADING POST

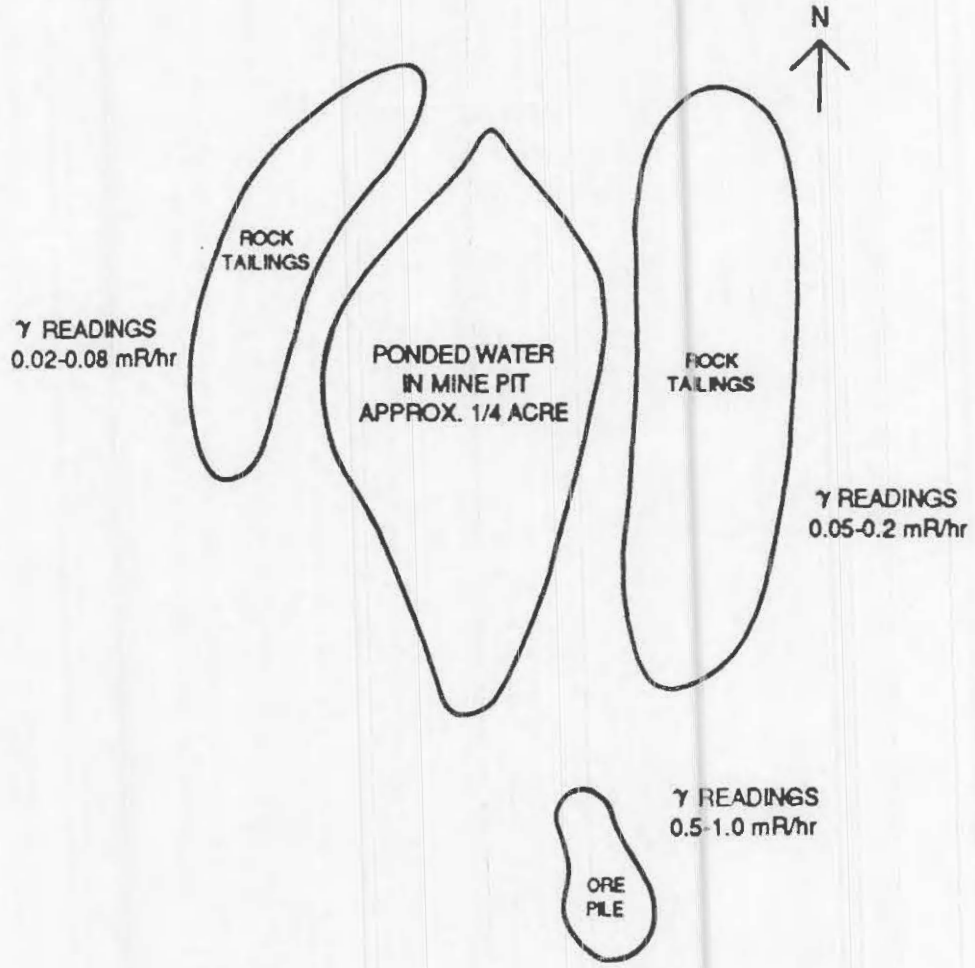
LENGTH: 500 FT WIDTH: 250 FT DEPTH: _____

DISTANCE TO NEAREST HOME: 1 MI

POPULATION WITHIN 3 MILES OF SITE: 125

GAMMA RADIATION LEVELS: 0.05 TO 1.0 mR/HR

COMMENTS: SIX CATTLE OBSERVED DRINKING WATER FROM PIT.
SEVERAL FOOD WRAPPERS AND CANS OBSERVED IN PIT.



DATE: 4/23/87

MINE SITE #: 37

MINE NAME: YAZZIE #312

LOCATION: 2.5 MI EAST OF CAMERON TRADING POST

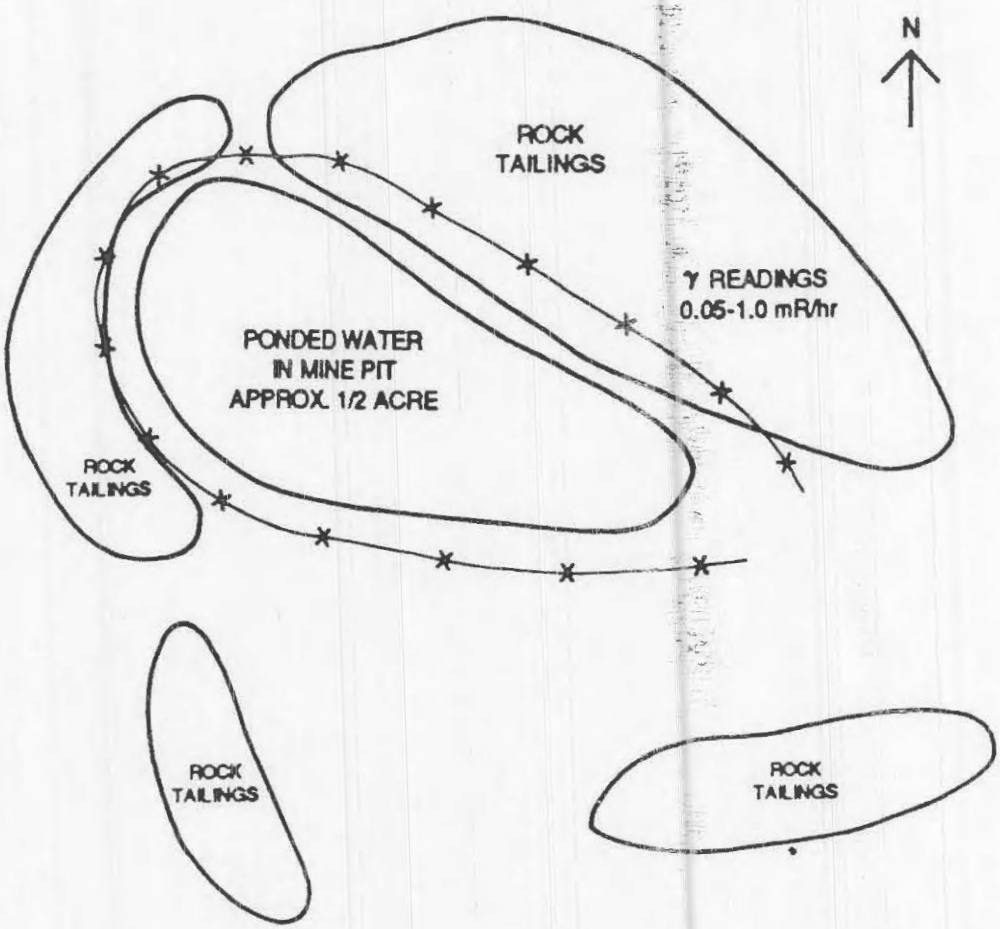
LENGTH: 700 FT WIDTH: 300 FT DEPTH: 30 FT

DISTANCE TO NEAREST HOME: 1 MI

POPULATION WITHIN 3 MILES OF SITE: 125

GAMMA RADIATION LEVELS: 0.05 TO 1.0 mR/HR

COMMENTS: WATER PIT IS FENCED EXCEPT FOR SOUTHEAST END.



DATE: 4/23/87

MINE SITE #: 38

MINE NAME: BOYD TISI #2

LOCATION: 3 MI SOUTHEAST OF CAMERON TRADING POST

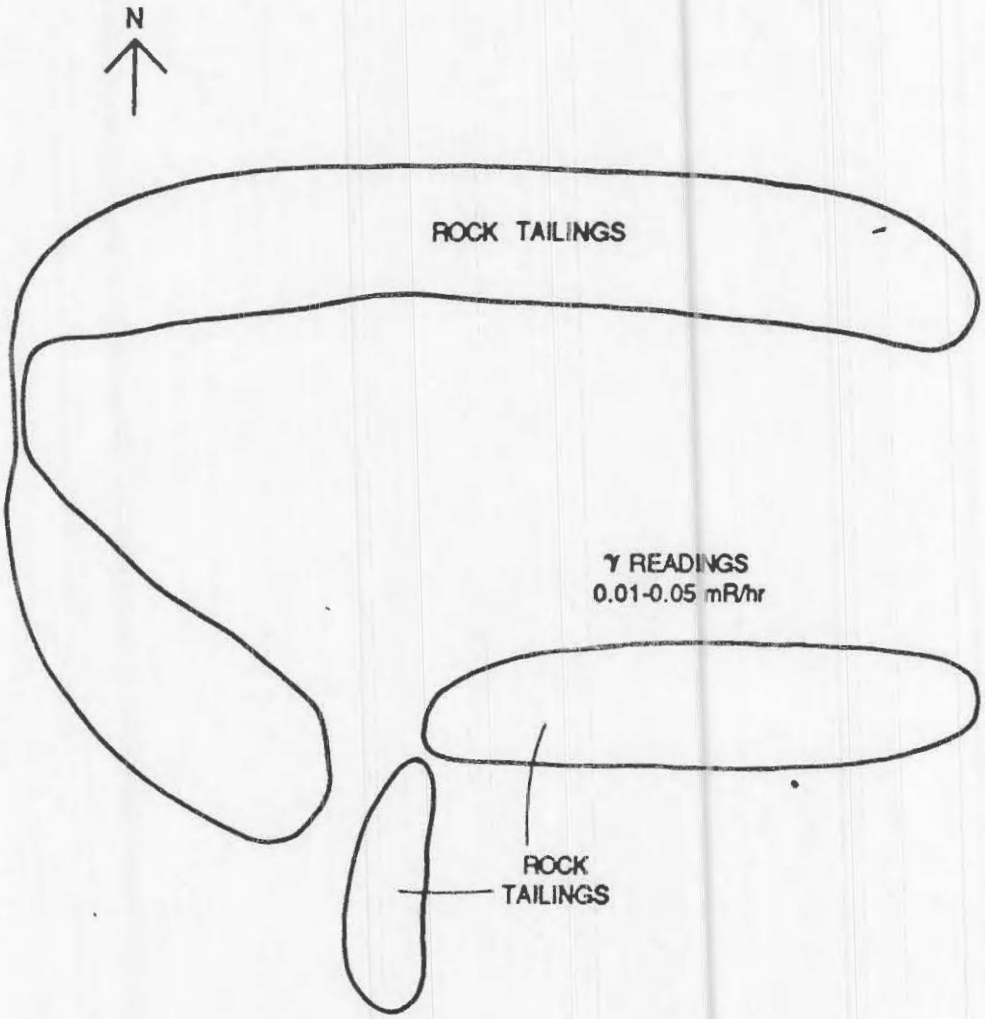
LENGTH: 400 FT WIDTH: 200 FT DEPTH: 20 FT

DISTANCE TO NEAREST HOME: 0.25 MI

POPULATION WITHIN 3 MILES OF SITE: 125

GAMMA RADIATION LEVELS: 0.01 TO 0.05 mR/HR

COMMENTS: MINE PIT HAS BEEN FILLED IN. NO APPARENT ORE PILES PRESENT.



DATE: 4/23/87

MINE SITE #: 39

MINE NAME: JUAN HORSE #3

LOCATION: 3 MI SOUTHEAST OF CAMERON TRADING POST

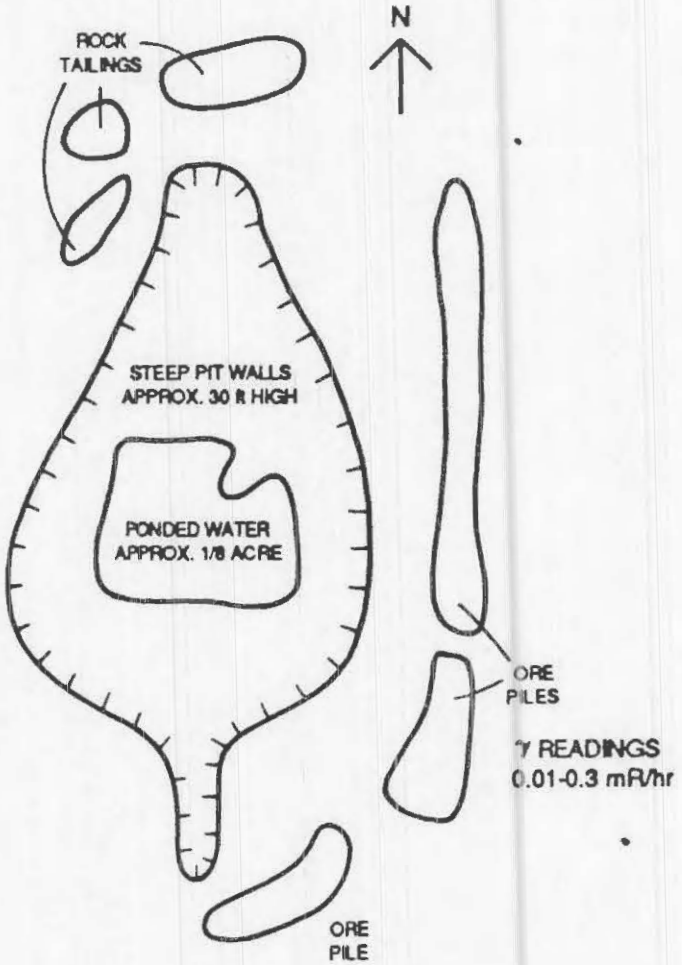
LENGTH: 250 FT WIDTH: 150 FT DEPTH: 40 FT

DISTANCE TO NEAREST HOME: 0.25 MI

POPULATION WITHIN 3 MILES OF SITE: 125

GAMMA RADIATION LEVELS: 0.01 TO 0.3 mR/HR

COMMENTS: VERY STEEP PIT WALLS.



DATE: 4/23/87

MINE SITE #: 41

MINE NAME: JUAN HORSE # 4 (See photo 1, Appendix C)

LOCATION: 3.5 MI SOUTHEAST OF CAMERON TRADING POST

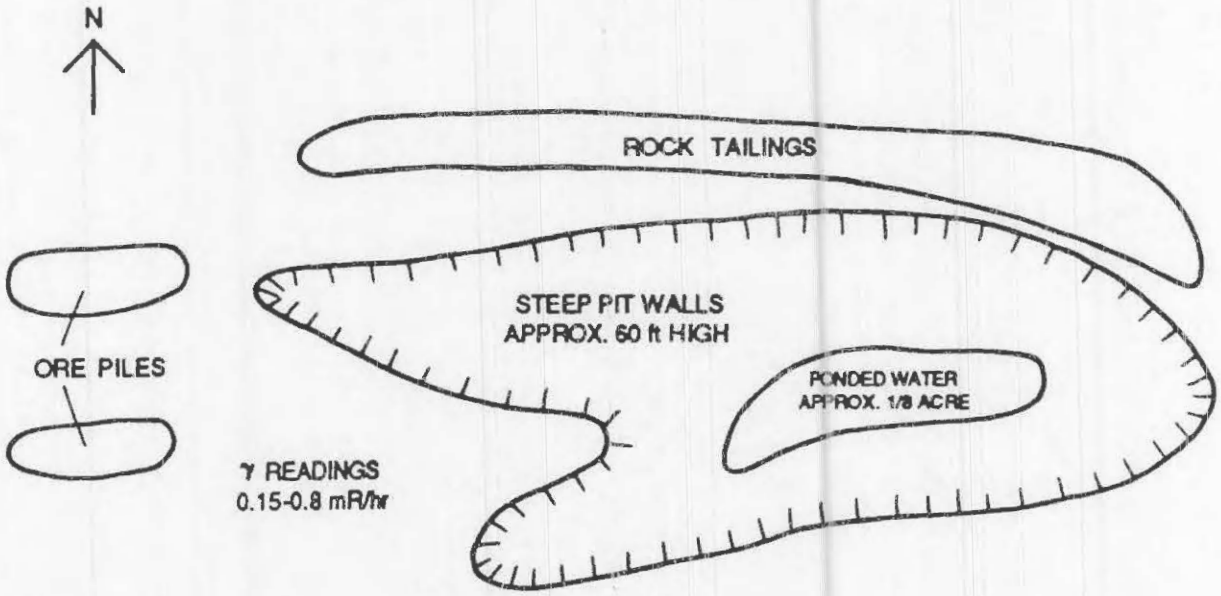
LENGTH: 400 FT WIDTH: 80 FT DEPTH: 60 FT

DISTANCE TO NEAREST HOME: 0.5 MI

POPULATION WITHIN 3 MILES OF SITE: 50

GAMMA RADIATION LEVELS: 0.15 TO 0.80 mR/HR

COMMENTS: VERY STEEP PIT WALLS.



DATE: 4/23/87

MINE SITE #: 45

MINE NAME: MANUEL DENETSONE #2

LOCATION: 4 MI SOUTHEAST OF CAMERON TRADING POST

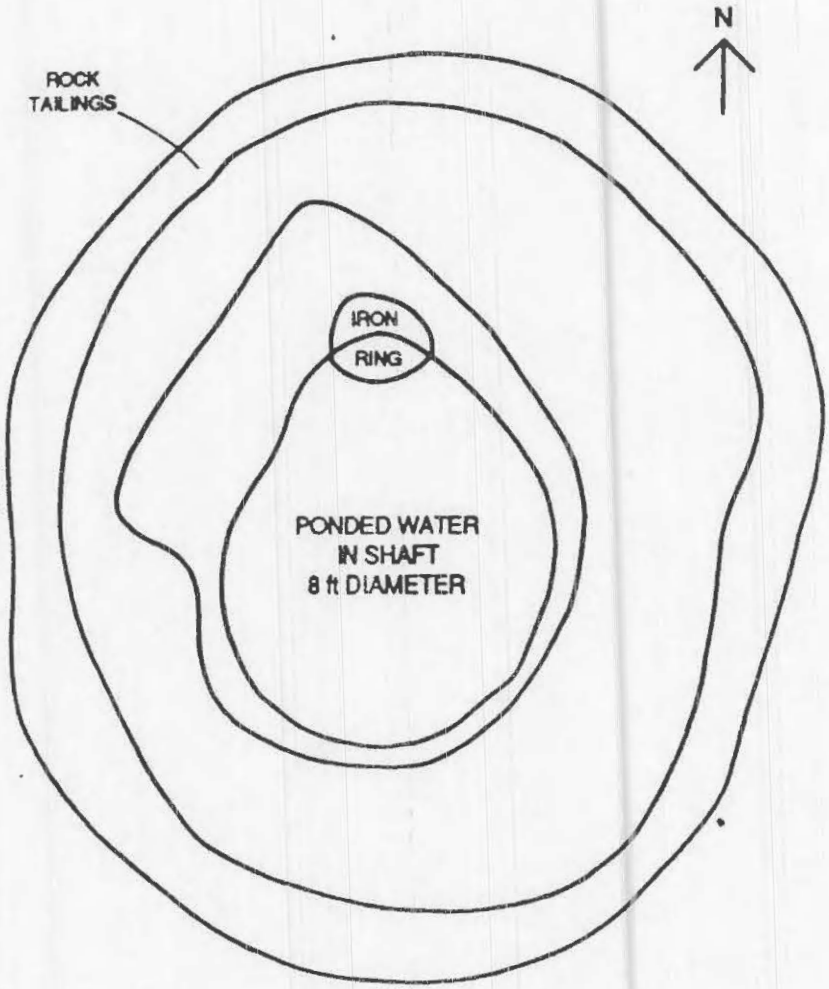
LENGTH: 10 FT WIDTH: 10 FT DEPTH: 30 FT

DISTANCE TO NEAREST HOME: 0.5 MI

POPULATION WITHIN 3 MILES OF SITE: 50

GAMMA RADIATION LEVELS: _____ TO _____

COMMENTS: RADIATION METER MALFUNCTIONING.



DATE: 4/23/87

MINE SITE #: 48

MINE NAME: JACK HUSKON #3 (See photo 2, Appendix C)

LOCATION: 6 MI SOUTHEAST OF CAMERON TRADING POST

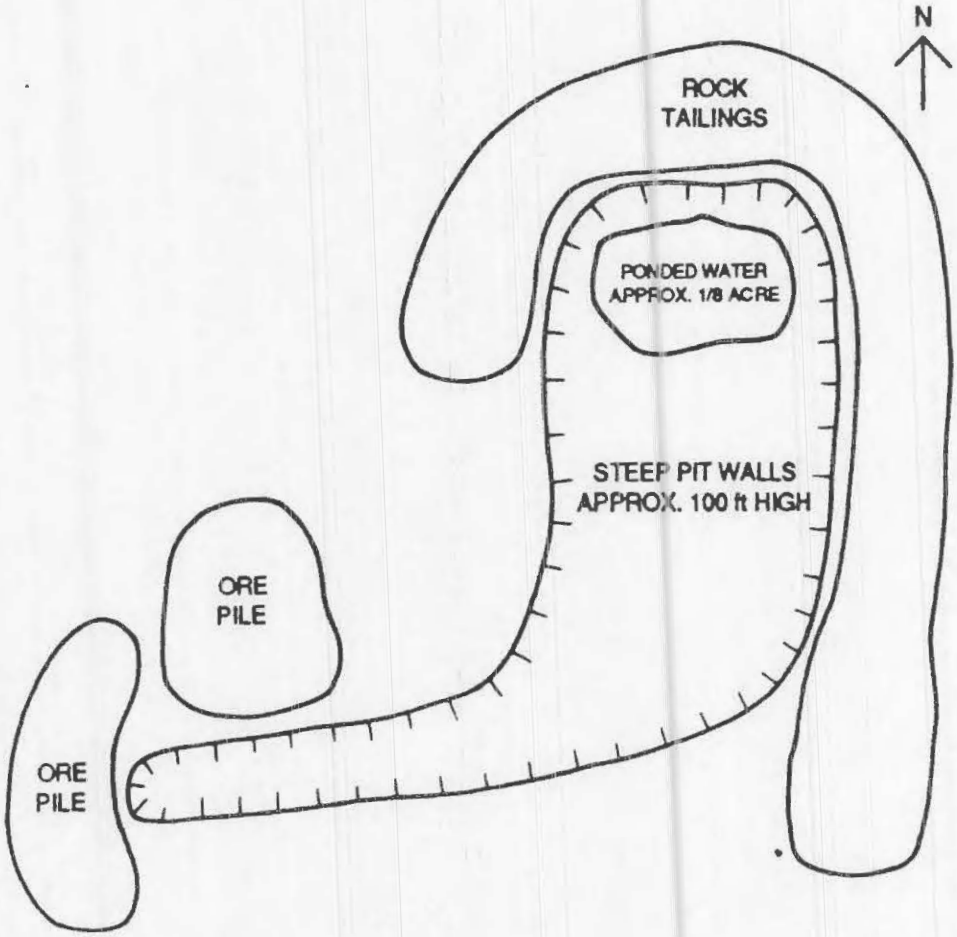
LENGTH: 800 FT WIDTH: 200 FT DEPTH: 100 FT

DISTANCE TO NEAREST HOME: 1 MI

POPULATION WITHIN 3 MILES OF SITE: 50

GAMMA RADIATION LEVELS: _____ TO _____

COMMENTS: RADIATION METER MALFUNCTIONING.



DATE: 4/23/87

MINE SITE #: (not identified on map)

MINE NAME: (not named)

LOCATION: 6 MI SOUTHEAST OF CAMERON TRADING POST, 0.5 MI WEST OF MINE #48

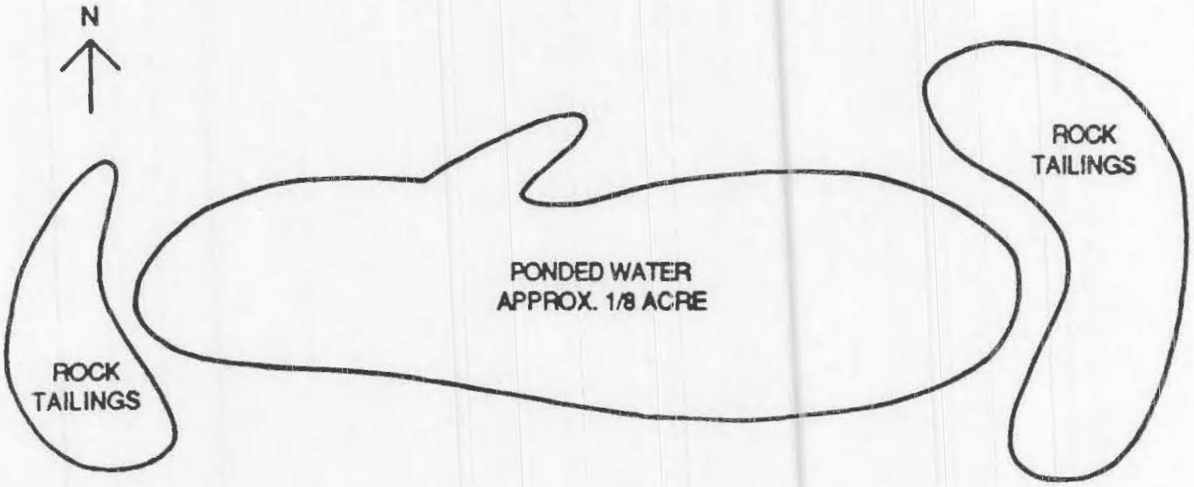
LENGTH: 80 FT WIDTH: 40 FT DEPTH: 5 FT

DISTANCE TO NEAREST HOME: 1 MI

POPULATION WITHIN 3 MILES OF SITE: 50

GAMMA RADIATION LEVELS: _____ TO _____

COMMENTS: MINE NOT LOCATED ON SITE MAP. RADIATION METER MALFUNCTIONING.



APPENDIX C

PHOTOGRAPHIC LOG OF PRELIMINARY ASSESSMENT

APPENDIX C

PHOTOGRAPHIC LOG OF PRELIMINARY ASSESSMENT

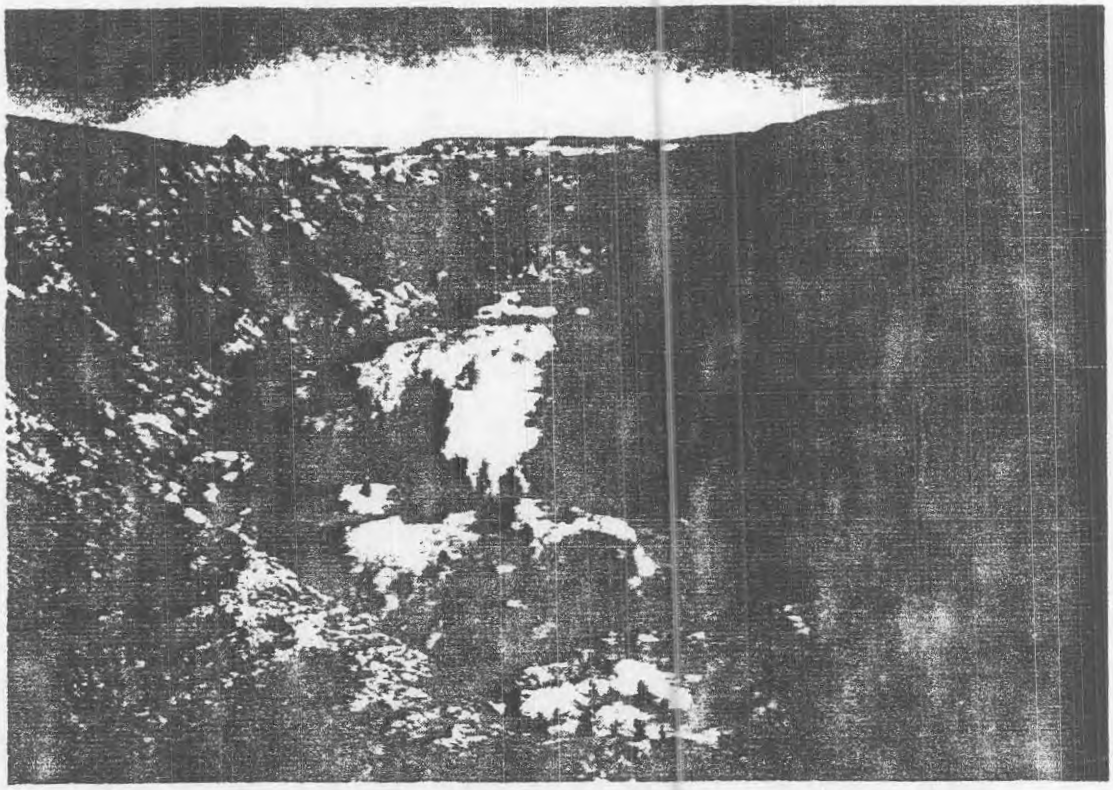


Photo 1. Mine site #41, Juan Horse #4. Photo view east showing steep, high-walled mine pit approximately 300 ft long, 80 ft wide, and 60 ft deep.

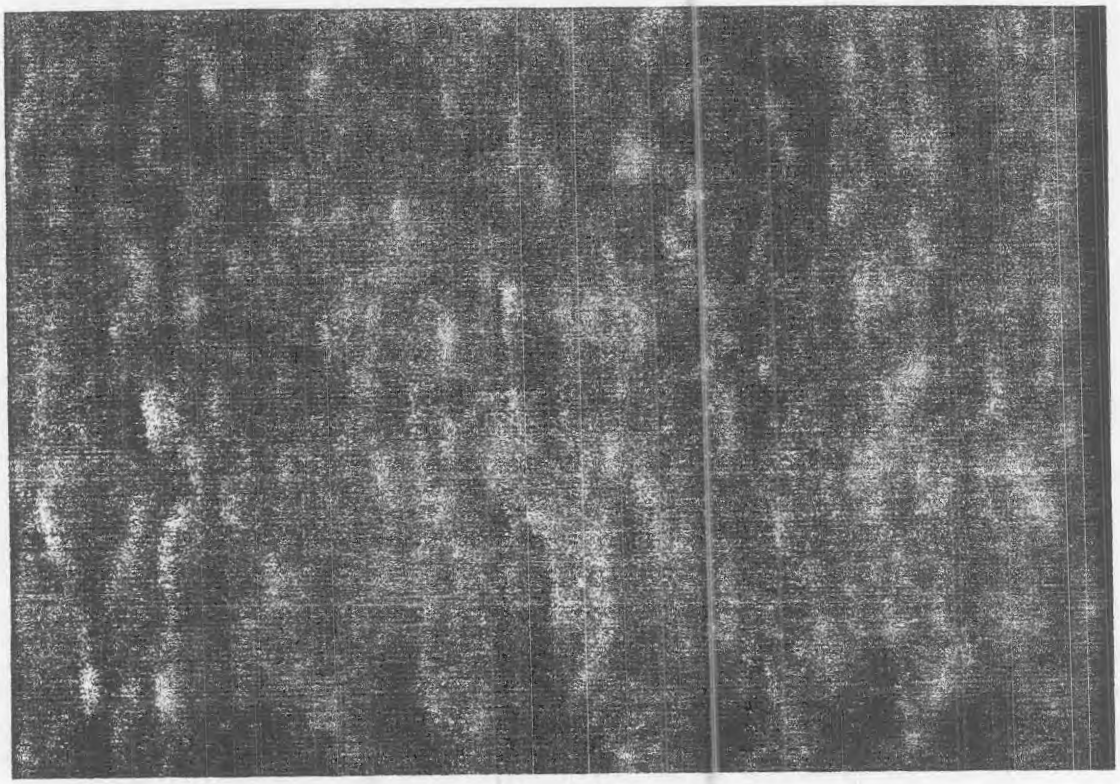


Photo 2. Mine site #48, Jack Huskon #3. Photo view north showing steep, high-walled pit approximately 800 ft long, 200 ft wide, and 100 ft deep.

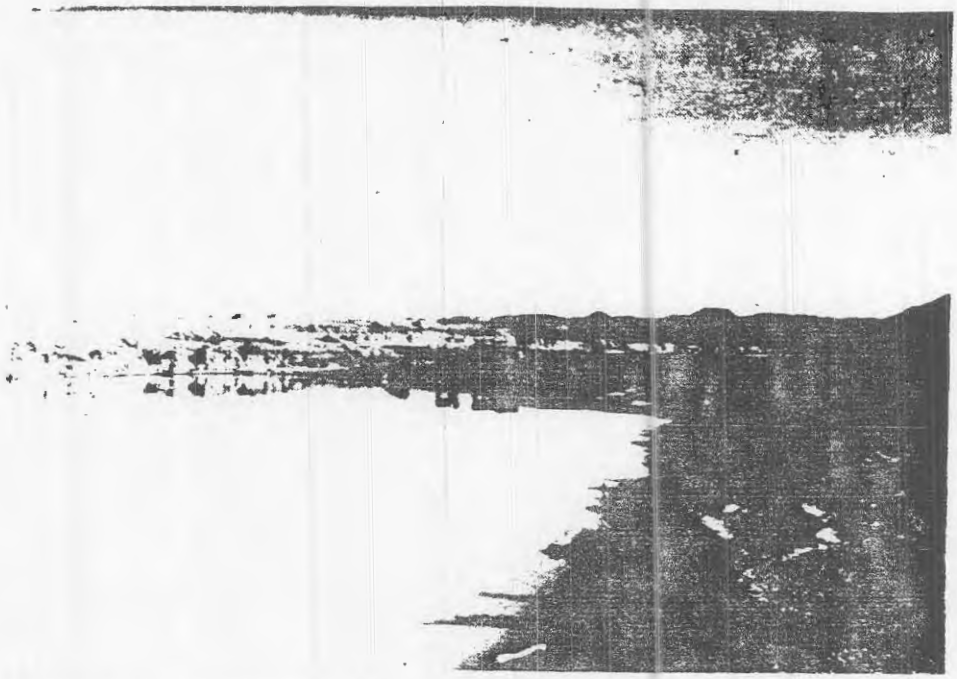


Photo 3. Mine site #34, Alyce Tolino #1 and #3. Photo of cattle drinking at north end of water-filled mine pit.

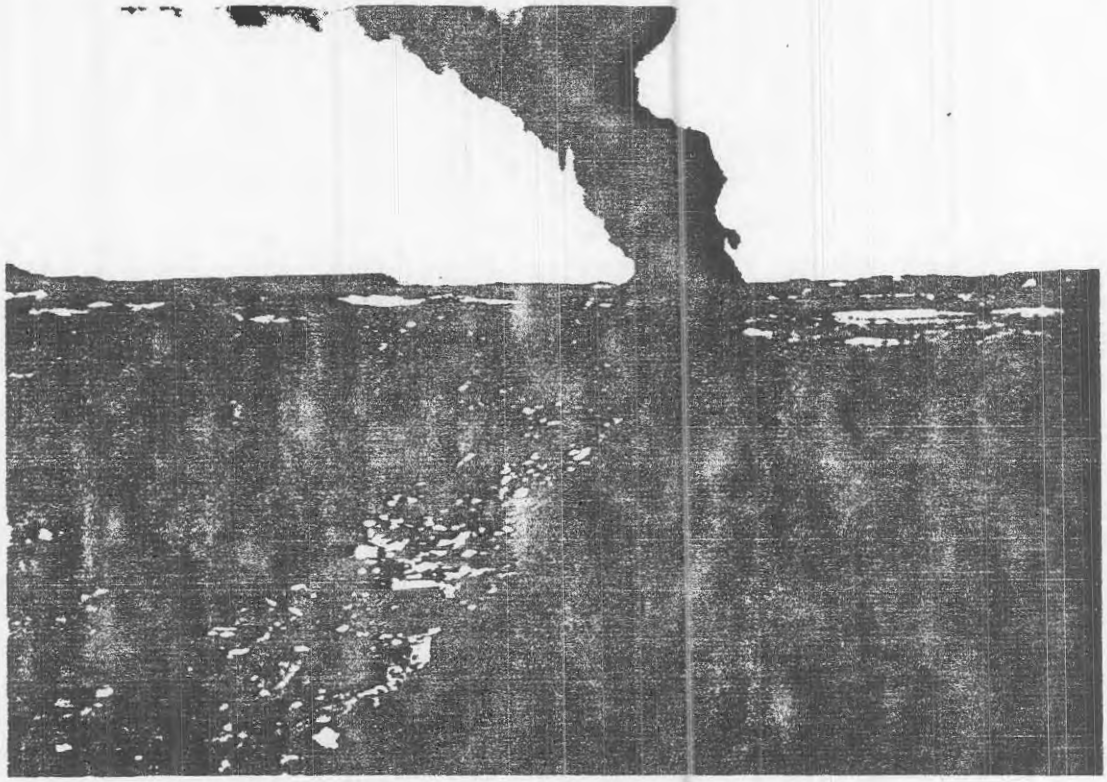


Photo 4. Mine site #35, Evans Huskon #2. Photo view showing garbage-filled mine pit and burning tires.

APPENDIX D

CONTACT REPORTS

INFO TO:

CONTACT REPORT

DATE: 3/23/87
1430 HRS

PROPOSAL #

CONTRACT # TC-3360

CONTACT BY: G. WAGNER

CONTACT DATE/TIME: 3/23/87 - 1430

PERSON(S) CONTACTED: GEORGE ABE

ORGANIZATION: BIA - LAND OPERATIONS

PHONE NO: 602-283-4531 X-254

SUBJECT OF CONTACT: STATUS OF INVESTIGATIONS IN CAMERON N.M. AREA.

CONTACT TYPE:

✓ PHONE

_ Tt FACILITY (

_ OTHER (

RESULT OF CONTACT: G. ABE IS AWARE THAT SEVERAL INVESTIGATIONS HAVE BEEN CONDUCTED BY VARIOUS AGENCIES. HE WILL DETERMINE STATUS/SOURCES AND CALL BACK.

G. ABE IS CONCERNED THAT THE UNCONTROLLED TAILINGS PILES ARE POSING AN IMMINENT THREAT TO SURROUNDING POPULATION + ENVIRONMENT. HE ASKED TO BE INFORMED OF OUR SCHEDULE FOR ON-SITE WORK.

NEXT ACTION

TETRA TECH INC

INFO TO:

CONTACT REPORT

DATE: 3/27/87

PROPOSAL #

CONTRACT # TC-3362

CONTACT BY: G. WAGNER

PERSON(S) CONTACTED: JIM ANALLA

ORGANIZATION: BIA - ENV. QUALITY

PHONE NO: 505-863-9501

SUBJECT OF CONTACT:

RADIOLOGICAL STUDIES IN CAMERON AREA

CONTACT DATE/TIME: 3/27/87 1315

CONTACT TYPE:

✓ PHONE

_ Tt FACILITY (

_ OTHER (

RESULT OF CONTACT:

JIM SAID THERE ARE ~12 DIFFERENT STUDIES/REPORT DEALING WITH CAMERON MINE SITES.
HE GAVE ME ANOTHER EPA CONTACT - DAVE DUNCAN - THE REGIONAL RADIATION REP. 415-974-8378
HE MIGHT HAVE ACCESS TO PA REPORTS FOR CAMERON AREA.

NEXT ACTION CALL DUNCAN

TETRA TECH INC

INFO TO:

CONTACT REPORT

DATE: 8/3/87

PROPOSAL #

CONTRACT # 3366

CONTACT BY: S. Steiner

CONTACT DATE/TIME: 8/3/87

PERSON(S) CONTACTED: Don Bills

ORGANIZATION: U.S.G.S

PHONE NO: 602 527-7139

CONTACT TYPE:

X PHONE

_ Tt FACILITY (

_ OTHER (

SUBJECT OF CONTACT:

Hydrologic Sz near Cameron Mines

RESULT OF CONTACT:

Alluvium material of the Chinle formation along the Little Colorado River is upper aquifer - not extensive beyond River.

Regional aquifer is in the Coconino Sandstone, but there is hydraulic communication from upper and lower formations.

Two references

- Hydrology of the Navajo and Hopi Indian Reservations, 1969, Cooley et al prof paper 521-.

- Maps showing groundwater conditions near San Francisco Peaks Open file 81-914, 1979 Cynthia Appel and Don Bills

NEXT ACTION

8/3 Ordered doc 1 from U.S.G.S. Don will send me doc 2.

Book and Open File Section
U.S.G.S
Box 25425 DFC
Denver CO 80225

TETRA TECH INC

303-236-7476

INFO TO:

CONTACT REPORT

DATE: 3/23/87

PROPOSAL #

CONTRACT # TC-3360

CONTACT BY: G. WAGNER

CONTACT DATE/TIME: 3/23/87 1545 M

PERSON(S) CONTACTED: MICHAEL BROWN

ORGANIZATION: NM ENV IMPROVEMENT DIVISION

PHONE NO: 505-827-2959

SUBJECT OF CONTACT: INFORMATION GATHERING FOR RADIATION STUDIES IN CAMERON, NM AREA.

CONTACT TYPE:

✓ PHONE

_ Tt FACILITY (

_ OTHER (

RESULT OF CONTACT: NM EID HAS BEEN GATHERING INFO BY MONITORING RADIONUCLIDE CONSTITUENTS IN WINDBLOWN MAT'LS, RADON GAS, AND WATER RUNOFF SINCE 1978. SEVERAL REPORTS GENERATED ON SUBJECT OF RADIONUCLIDE UPTAKE BY GRAZING ANIMALS → MAN. ONE SPECIFIC REPORT DEALS WITH UPTAKE BY SHEEP → MAN. RESULTS SHOW NO SIGNIFICANT LEVELS IN EITHER SPECIE. M. BROWN WILL SEND TC ALL REPORTS HE CAN LOCATE. HE'S ALSO WILLING TO PROVIDE ANY INFO WE MAY NEED IN THE FUTURE.

BRUCE GALLAHER HAS BEEN DOING RADIONUCLIDE STUDIES ON GROUNDWATER IN THE CAMERON AREA.
PHONE # - 505-827-2899

NM EID HAS BEEN CONDUCTING TRANSPORT STUDIES SINCE UNITED NUCLEAR DAM BREAK IN 1979.

NEXT ACTION CONTACT B. GALLAHER

TETRA TECH INC

INFO TO:

CONTACT REPORT

DATE: 3/25/87

PROPOSAL #

CONTRACT # TC-3360

CONTACT BY: G. WAGNER

CONTACT DATE/TIME: 3/25/87 0900

PERSON(S) CONTACTED: STEVE CINNAMON

ORGANIZATION: NAT'L PARK SERVICE - WUPATKI NAT'L MONUMENT

PHONE NO: 602-527-7040

CONTACT TYPE:

✓ PHONE

_ Tt FACILITY (

_ OTHER (

SUBJECT OF CONTACT:

RADIOLOGICAL STUDIES DONE IN CAMERON, AZ AREA.

RESULT OF CONTACT:

HE HAS DONE SEDIMENT AND SURFACE WATER SAMPLING IN THE AREA FROM BLACK FALLS TO CAMERON.

HE WILL SEND US DATA WITH RESULTS OF ALPHA + BETA RADIATION ANALYSES - ALONG WITH MAPS OF THE REGION DETAILING MINE SITES.

NEXT ACTION

TETRA TECH INC

CONTACT REPORT

DATE: 3/26/87

PROPOSAL #

CONTRACT # TC-356

CONTACT BY: G. WAGNER

CONTACT DATE/TIME: 3/26/87 0955

PERSON(S) CONTACTED: DR. DARYL ENGLISH

ORGANIZATION: N. ARIZONA UNIVERSITY

PHONE NO: 602-523-4105

CONTACT TYPE:

✓ PHONE

_ Tt FACILITY (

_ OTHER (

SUBJECT OF CONTACT:

RADIOLOGICAL STUDIES ON HUMAN CHROMOSOMES

RESULT OF CONTACT:

STUDIES HE'S CONDUCTING DEAL WITH BACKGROUND RADIATION LEVELS IN TUBA CITY VS FLAGSTAFF AREAS. BLOOD LEVELS IN POPULATIONS OF BOTH AREAS ARE TO BE COMPARED WITH OCCURRENCES OF CHROMOSOME ABERRATIONS. STUDY IS INCOMPLETE - WON'T BE DONE FOR ~ 1 YEAR. STUDY RESULTS WILL BE SUSPECT IN HIS MIND DUE TO HIGH TURNOVER RATE OF UNDERGRAD TECHS → VARIABILITY IN TECHNIQUES.

ADDRESS: N. ARIZONA UNIVERSITY
BOX 5640
FLAGSTAFF, AZ 86011

NEXT ACTION

TETRA TECH INC

INFO TC

CONTACT REPORT

DATE: 3/24/87

PROPOSAL #

CONTRACT # TC-3360

CONTACT BY: G. WAGNER

CONTACT DATE/TIME: 3/24/87 1500

PERSON(S) CONTACTED: BRUCE GALLAHER

ORGANIZATION: NM EID - GROUNDWATER DIV.

PHONE NO: 505-827-2899

SUBJECT OF CONTACT: GROUNDWATER STUDIES IN AREAS OF RADIOACTIVE MINE TAILINGS

CONTACT TYPE:

✓ PHONE

_ Tt FACILITY (

_ OTHER (

RESULT OF CONTACT:

HAS CONDUCTED LEACHING TESTS AND COLLECTED SURFACE WATER SAMPLES ON DEWATERING EFFLUENTS FROM MINE TAILINGS.

GROUNDWATER DIVISION DID NOT CONDUCT DRILLING TESTS NEAR MINE TAILINGS.

INFORMED ME THAT EPA AND THEIR SUBCONTRACTOR - PETCO CONDUCTED DRILLING STUDIES IN NEW MEXICO AND WYOMING.

NEXT ACTION CONTACT EPA REGION IX CONCERNING DRILLING STUDIES.

TETRA TECH INC

CONTACT REPORT

DATE: 3/26/87

PROPOSAL #

CONTRACT # TC-3360

CONTACT BY: G. WAGNER

CONTACT DATE/TIME: 3/26/87 090

PERSON(S) CONTACTED: BILL GARRETT

ORGANIZATION: USGS-TUCSON

PHONE NO: 602-629-6225

SUBJECT OF CONTACT: RADIOCHEMICAL DATA COLLECTED BY USGS FOR AZ ENV. HEALTH SERVICES

CONTACT TYPE:

✓ PHONE

_ Tt FACILITY (

_ OTHER (

RESULT OF CONTACT: B. GARRETT SAID USGS HAD RADIOCHEMICAL DATA FROM THE LITTLE COLORADO RIVER AT THE CAMERON GAGING STATION. DATA INCLUDES, AMONG OTHER PARAMETERS, TOTAL SUSPENDED SOLIDS, AND RADIOACTIVITY (GROSS ALPHA, BETA ETC).
IN ORDER TO GET A COPY OF THE DATA - I MUST SUBMIT ~~AN~~ A LETTER OF REQUEST.

NEXT ACTION DRAFT LETTER TO USGS —

TETRA TECH INC

CONTACT REPORT

DATE: 3/24/87

PROPOSAL #

CONTRACT # TC-3360

CONTACT BY G. WAGNER

CONTACT DATE/TIME: 3/24/87 0815

PERSON(S) CONTACTED: DR. PAUL HAHN

ORGANIZATION: EPA LAS VEGAS LAB

PHONE NO: 702-798-2100

CONTACT TYPE:

✓ PHONE

_ Tt FACILITY (

_ OTHER (

SUBJECT OF CONTACT: ANY INFORMATION REGARDING ANALYSES OF ANIMAL TISSUE FROM GRAZING ANIMALS NEAR RADIOACTIVE SITES.

RESULT OF CONTACT:

DR HAHN STATED EPA LAS VEGAS LAB MERELY RAN ANALYSES ON ANIMAL TISSUES. PROJECT WAS BEING CONDUCTED BY NM ED - MIKE BROWN.

- M. BROWN HAS BEEN CONTACTED PREVIOUSLY - INFO IS EN ROUTE.

NEXT ACTION

TETRA TECH INC

CONTACT REPORT

DATE: 3/25/87

PROPOSAL #

CONTRACT # TC-336

CONTACT BY: G. WAGNER

CONTACT DATE/TIME: 3/25/87 0930A

PERSON(S) CONTACTED: CHARLES HEATON

DOE

ORGANIZATION: UMTRA - DIVISION OF RESOURCES

PHONE NO: 602-871-6594

SUBJECT OF CONTACT: RADIOLOGICAL STUDIES IN CAMERON, AZ AREA.

CONTACT TYPE:

✓ PHONE

_ Tt FACILITY (

_ OTHER (

RESULT OF CONTACT:

C. HEATON IS A GEOLOGIST - HE'S DONE EXTENSIVE GEOLOGICAL STUDIES IN CAMERON AREA.

HE'LL SEND US INFO ON GEOLOGY OF THE MINE SITES.

NEXT ACTION

TETRA TECH INC

CONTACT REPORT

DATE: 3/24/87

PROPOSAL #

CONTRACT # TC-3360

CONTACT BY: G. WAGNER

CONTACT DATE/TIME: 3/24/87 1515 AZ

PERSON(S) CONTACTED: LOUISE LINKIN

ORGANIZATION: NAVAJO NATION - ENVIRONMENTAL PROTECTION.

PHONE NO: 602-871-~~6534~~ 1639

CONTACT TYPE:

✓ PHONE

_ Tt FACILITY (

_ OTHER (

SUBJECT OF CONTACT:
RADIATION STUDIES AT MINES IN NEW MEXICO AREA

RESULT OF CONTACT: MS LINKIN STATED THAT ENV. PROTECTION FOR NAVAJO NATION HAS CONDUCTED NUMEROUS RADIOLOGICAL STUDIES, BUT SHE WOULD ONLY RELEASE THE INFORMATION AFTER RECIEVING A LETTER OF REQUEST.

NEXT ACTION FORMULATE LETTER OF REQUEST -
LOUISE A. LINKIN
NAVAJO NATION ENVIRONMENTAL PROTECTION
DIVISION OF RESOURCES
WINDOW ROCK, AZ 86515

TETRA TECH INC

CONTACT REPORT

DATE: 3/26/87

PROPOSAL #

CONTRACT # TC-3362

CONTACT BY: G. WAGNER

CONTACT DATE/TIME: 3/26/87 1110

PERSON(S) CONTACTED: NICK MORGAN

ORGANIZATION: EPA - REGION IX

PHONE NO: 415-974-8603

CONTACT TYPE:

✓ PHONE

_ Tt FACILITY (

_ OTHER (

SUBJECT OF CONTACT:

PRELIMINARY ASSESSMENTS DONE IN THE CAMERON, AZ AREA

RESULT OF CONTACT:

N. MORGAN HAS REVIEWED PA'S IN THE AREA — PAUL LA COURREYE (LA CORE-YÄ) HAS CONDUCTED THE PA'S OR HAS THEM IN HIS CUSTODY. CONTACT HIM 3/27 OR 3/30.

NEXT ACTION CONTACT P. LA COURREYE 3/27

TETRA TECH INC

CONTACT REPORT

DATE: 5/3/87

PROPOSAL #

CONTRACT # 3360

CONTACT BY: S. Steiner

CONTACT DATE/TIME:

PERSON(S) CONTACTED: Michele Moustakes

CONTACT TYPE:

ORGANIZATION: EPA Reg 9

X PHONE

PHONE NO: (415) 974-0775

_ Tt FACILITY (

SUBJECT OF CONTACT:

_ OTHER (

Navajo Public Water Supplies

RESULT OF CONTACT:

Only public system near Cameron is Cameron System (5 wells) 3T-551, 3T-552, 3T-528B, 3T-538C, unnamed

Reports bacterological info monthly, metals every 3 years, and radionuclides every 4 yr as required under current federal regulation. New regs will require additional monitoring of ~60 parameters.

1979-1980	gross α	< 3 pci/l
1985	gross α	< 2 pci/l
new well	gross α	7 pci/l

NEXT ACTION

Call Tina Lujan IHS Tuba City about well depths and other supply wells (private) (602) 283-6211 ext 252

Don Payne Navajo Nation Water Management (602) 729-2637

TETRA TECH INC

MCL for gross alpha is 15 pCi/l. If above
that analyze for radon and uranium
Regulated gross alpha = X_g - U - radon

Michele will be replaced by Marvin ~~Yo~~ Young

CONTACT REPORT

DATE: 3/26/87

PROPOSAL #

CONTRACT # TC-3360

CONTACT BY: G. WAGNER

CONTACT DATE/TIME: 3/26/87 0945

PERSON(S) CONTACTED: DON PAYNE

ORGANIZATION: INDIAN HEALTH SERVICES

PHONE NO: 602-729-2637

CONTACT TYPE:

✓ PHONE

_ Tt FACILITY (

_ OTHER (

SUBJECT OF CONTACT:
WATER QUALITY DATA FROM CAMERON, AZ AREA

RESULT OF CONTACT: I.H.S. CONDUCTED H_2O QUALITY SAMPLING, INCLUDING RADIOLOGICAL STUDIES, IN THE CAMERON AREA. HE COULDN'T RECALL RESULTS, BUT WILL SEND Tt A COPY OF THE REPORT.

NEXT ACTION

TETRA TECH INC

INFO TO:

CONTACT REPORT

DATE: 3/25/87

PROPOSAL #

CONTRACT # TC-3360

CONTACT BY G. WAGNER

CONTACT DATE/TIME: 3/25/87 1445

PERSON(S) CONTACTED: EDWIN SWANSON

ORGANIZATION: AZ STATE ENV. HEALTH SERVICES

PHONE NO: 602-257-2362

CONTACT TYPE:

✓ PHONE

_ Tt FACILITY (

_ OTHER (

SUBJECT OF CONTACT:
RADIOLOGICAL INFO FROM CAMERON, AZ.

RESULT OF CONTACT:

E. SWANSON SAID HIS ORGANIZATION CONDUCTED SURFACE WATER AND SEDIMENT SAMPLING STUDIES FOR USGS AND BIA. HIS WORK LOAD IS TOO GREAT TO RETRIEVE THE DATA. USGS INFO IS AVAILABLE THROUGH THE WATSTOR PROGRAM - ASK FOR THE CAMERON GAGING STATION ON THE LITTLE COLORADO RIVER.

EHS ALSO PRODUCED A REPORT FOR THE BIA COVERING SEDIMENT LOADING STUDIES ON THE PUERCO RIVER THAT E. SWANSON SAID WERE "VERY INCRIMINATING".

NEXT ACTION - CONTACT LOCAL USGS FOR COPY OF WATSTOR PRINTOUT OF LITTLE CO. R. AT CAMERON GAGING STATION.

- CONTACT BIA FOR COPY OF AZ EHS REPORT.

TETRA TECH INC

APPENDIX E

MISCELLANEOUS ENVIRONMENTAL DATA

GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
FILE COPY
SUBDIVISION
LIBRARY
U.S. DEPARTMENT OF INTERIOR

APPEL AND BILLS—GROUND-WATER CONDITIONS IN THE SAN FRANCISCO PEAKS AREA, ARIZONA

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MAPS SHOWING GROUND-WATER CONDITIONS IN THE SAN FRANCISCO PEAKS AREA, COCONINO COUNTY, ARIZONA–1979

BY CYNTHIA L. APPEL AND DONALD J. BILLS

U.S. GEOLOGICAL SURVEY
WATER-RESOURCES INVESTIGATIONS
OPEN-FILE REPORT 81-914

TUCSON, ARIZONA
JULY 1981

PREPARED IN COOPERATION WITH THE
ARIZONA DEPARTMENT OF WATER RESOURCES

UNITED STATES GOVERNMENT

Memorandum

TO : THE RECORD DATE: November 10, 1981

FROM : Donald J. Bills, Hydrologic Technician, USGS, WRD, Flagstaff, Az.
THROUGH: George W. Hill, Subdistrict Chief

SUBJECT: REPORTS: USGS WRI Open-File Report No. 81-914, "Maps showing ground-water conditions in the San Francisco Peaks area, Coconino County, Az.-1979", by Cynthia L. Appel and Donald J. Bills.

Correction to Geohydrology section of the text: 3rd paragraph, 13th line, 150 ft should be 225 ft (the correct value is shown on the map). The corrected sentence reads, "The depth to water in the glacial outwash ranges from 0 to 225 ft below the land surface, ..."

Donald J. Bills
Donald J. Bills
gwh

Copy: R. D. MacNish, District Chief, Tucson, Az.
Reports Section, WRD, Tucson, Az.
Cynthia L. Appel, WRD, Salt Lake City, Utah

Buy U.S. Savings Bonds Regularly on the Payroll Savings Plan

INTRODUCTION

The San Francisco Peaks area includes about 2,300 mi^2, of which about 500 mi^2 is in the Navajo Indian Reservation, in north-central Arizona. Ground-water development has been slight except for the public-supply wells for Flagstaff and domestic wells in Fort Valley, Pitman Valley, and the area west of Elden Mountain. The public water supply for Flagstaff is primarily from Upper Lake Mary but is supplemented by ground water from wells near Woody Mountain and Lower Lake Mary and from wells and springs in the Inner Basin. In 1978 about 2,000 acre-ft of ground water was withdrawn for public, industrial, domestic, and stock supplies in the San Francisco Peaks area.

The hydrologic data on which these maps are based are available, for the most part, in computer-printout form and may be consulted at the Arizona Department of Water Resources, 99 East Virginia, Phoenix, and at U.S. Geological Survey offices in: Federal Building, 301 West Congress Street, Tucson; Valley Center, Suite 1880, Phoenix; and 2255 North Gemini Drive, Building 3, Flagstaff. Material from which copies can be made at private expense is available at the Tucson, Phoenix, and Flagstaff offices of the U.S. Geological Survey. Only the springs for which discharge data are available are shown on the maps, and only selected wells are shown in areas of high well density.

GEOHYDROLOGY

The San Francisco Peaks area is underlain by a bedded sequence of sedimentary rocks, which generally is overlain by volcanic rocks in the southern part of the area. In places the sedimentary and volcanic rocks are overlain by glacial outwash and alluvium. Ground water is present in most of the geologic units (see composite stratigraphic column), and some of the units are hydraulically connected. Generally, the water occurs under water-table conditions; locally, however, the water is under artesian pressure and rises above the zone of saturation where tapped by wells. Well yields probably are more dependent on pump type and size than on aquifer characteristics. In places the Kaibab Limestone, Moenkopi Formation, Chinle Formation, volcanic rocks, glacial outwash, and alluvium contain perched ground water, which may be as much as 2,000 ft above the water table. The water is perched on the poorly permeable cherty limestone in the Kaibab Limestone, siltstone, mudstone, and clay beds in the Moenkopi and Chinle Formations, or on unfractured volcanic rocks, which impede downward movement.

In the eastern part of the area most wells obtain water from the Coconino

In the eastern part of the area most wells obtain water from the Coconino Sandstone and sandstone beds in the upper part of the Supai Group. Near Leupp, the Kaibab Limestone is hydraulically connected to the sandstone beds in the underlying Coconino and Supai; siltstone beds in the lower part of the Supai restrict the vertical movement of water between the units above the siltstone beds and the units below. Near Leupp, the depth to water ranges from 75 to 140 ft below the land surface and increases westward and northward. The depth to water is more than 1,900 ft below the land surface near Sunset Crater and almost 1,600 ft in the Wupatki National Monument. The contours near the well in sec. 6, T. 25 N., R. 9 E., may indicate greater depth to water than actually occurs in that area owing to possible structural anomalies. Wells that penetrate the Coconino and Supai are 154 to 2,400 ft deep except for one well in T. 27 N., R. 9 E., which is 3,624 ft deep and bottoms in the Redwall Limestone; well yields are 4 to 560 gal/min. In the Coconino and Supai ground-water movement generally is northward. Between Cameron and the Coconino Rim, siltstone beds in the Supai are fractured owing to folding and faulting, and water in the overlying sandstone moves downward through the fractures into the underlying Redwall and Muav Limestones. Along the Little Colorado River north of the Coconino Rim, many springs issue from the Redwall and Muav Limestones. Some wells along the Little Colorado River obtain water from the alluvium, volcanic rocks, Shinarump Member of the Chinle Formation, or Moenkopi Formation. The depth to water in these units generally is less than 100 ft below the land surface, and most wells yield less than 50 gal/min. In and near the Wupatki National Monument springs issue from perched zones in the Moenkopi Formation and discharge less than 5 gal/min.

In the southwestern part of the area most wells and springs obtain water from the alluvium or volcanic rocks. The depth to water in these units ranges from 0 to more than 900 ft below the land surface, and wells are from 6 to 1,175 ft deep. Well yields and spring discharges from the alluvium and volcanic rocks range from less than 1 to 70 gal/min and fluctuate in response to precipitation, snowmelt, and runoff; occasionally, the wells and springs are dry. Most domestic wells yield less than 30 gal/min. West of Elden Mountain and near Babbitt Lake, some wells obtain water from the Chinle or Moenkopi Formations. Depth to water is 40 to more than 200 ft below the land surface, wells are 60 to 243 ft deep, and wells yield less than 20 gal/min. In the Inner Basin most wells and springs obtain water from the glacial outwash. The depth to water in the glacial outwash ranges from 0 to about ~~250~~ 225 ft below the land surface, wells are 215 to 502 ft deep, and wells yield 300 to 859 gal/min. Near Flagstaff, Parks, and Babbitt Lake, some wells obtain water from the Kaibab Limestone. In the Kaibab Limestone water bodies are perched from about 30 to more than 400 ft below the land surface, wells are 47 to 437 ft deep, and wells generally yield less than 20 gal/min. Although the upper part of the Supai Group is at least partly saturated in most of the area, a well that penetrates the Supai near Parks was dry at a depth of 2,570 ft. Near Flagstaff, several deep wells obtain water from the Coconino Sandstone and Supai Group. Depth to water in the Coconino and Supai is 600 to more than 2,100 ft below the land surface, wells are 987 to 2,350 ft deep, and wells yield 30 to 860 gal/min.

See correction

In the northern part of the area several springs issue from the Redwall and Muav Limestones, but there are no known producing wells. At the north boundary, Blue Spring, which issues from the Redwall Limestone, flows into the Little Colorado River. In 1950 the discharge was estimated to be 107 ft^3/s or 48,000 gal/min. Blue Spring and several nearby springs sustain the base flow of the river at its mouth. Between 1952 and 1979, 14 discharge measurements were made of the combined discharge. The measured discharges ranged from 217 to 232 ft^3/s (97,400 to 104,000 gal/min) and averaged 223 ft^3/s (100,000 gal/min).

SELECTED REFERENCES

EXPLANATION

—— ——4400 - - - - POTENTIOMETRIC CONTOUR—Shows approximate altitude at which water level would have stood in tightly cased well that penetrates the Coconino Sandstone and (or) Supai Group. Short dashed where uncertain. Contour interval 100 and 200 feet. Datum is mean sea level

● 3P-352
Pc
658
495M(1963)
3715

WELL IN WHICH DEPTH TO WATER WAS MEASURED IN 1978-79—First entry, 3P-352, is well name or number assigned by the Navajo Tribe; well numbers are not shown for off-reservation sites. Second entry, Pc, is principal geologic formation from which the well obtains its water (see composite stratigraphic column for explanation of letter symbol). Third entry, 658, is depth of well in feet. Fourth entry, 495M(1963), is depth to water in feet below land surface [M, depth to water measured; R, depth to water reported; E, depth to water estimated; (1963), year in which water level was determined if other than 1978-79]. Fifth entry, 3715, is altitude of the water level in feet above mean sea level

Mr
48,000E(1950)
3165

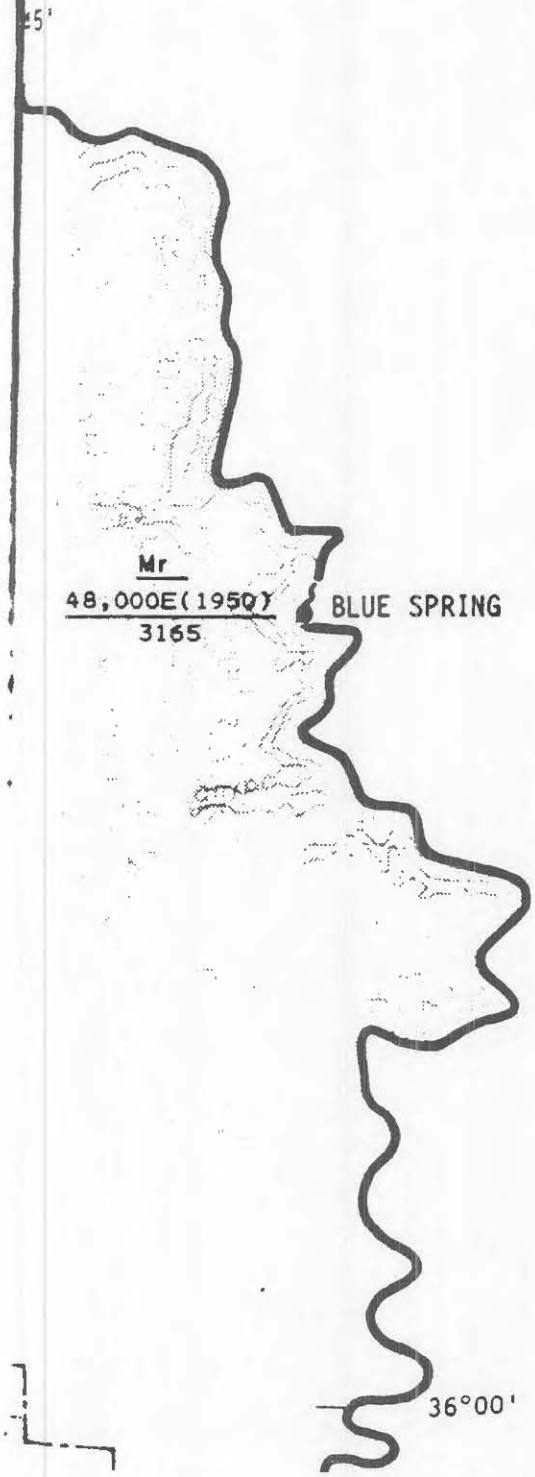
SPRING FOR WHICH DISCHARGE WAS DETERMINED IN 1978-79—First entry, Mr, is principal geologic formation from which the spring issues (see composite stratigraphic column for explanation of letter symbol). Second entry, 48,000E(1950), is discharge of spring in gallons per minute [M, discharge measured; E, discharge estimated; (1950), year in which discharge was determined if other than 1978-79]. Third entry, 3165, is altitude of the land surface in feet above mean sea level

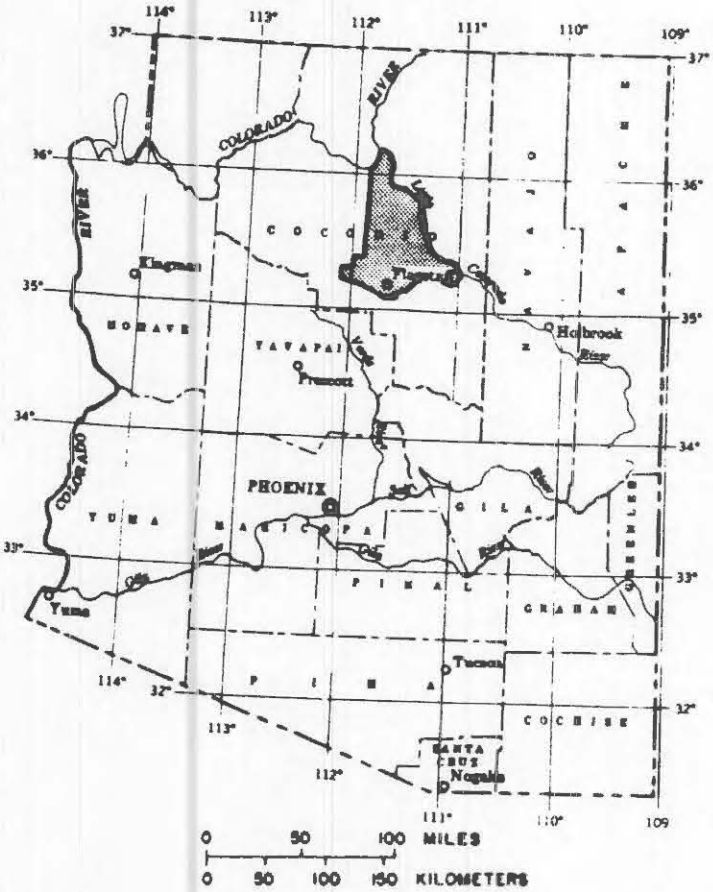
Ⓐ WELL FOR WHICH A HYDROGRAPH IS SHOWN

→ GENERALIZED DIRECTION OF GROUND-WATER FLOW IN THE COCONINO SANDSTONE AND (OR) SUPAI GROUP

ARBITRARY BOUNDARY OF GROUND-WATER AREA

PREPARED IN COOPERATION WITH THE
ARIZONA DEPARTMENT OF WATER RESOURCES

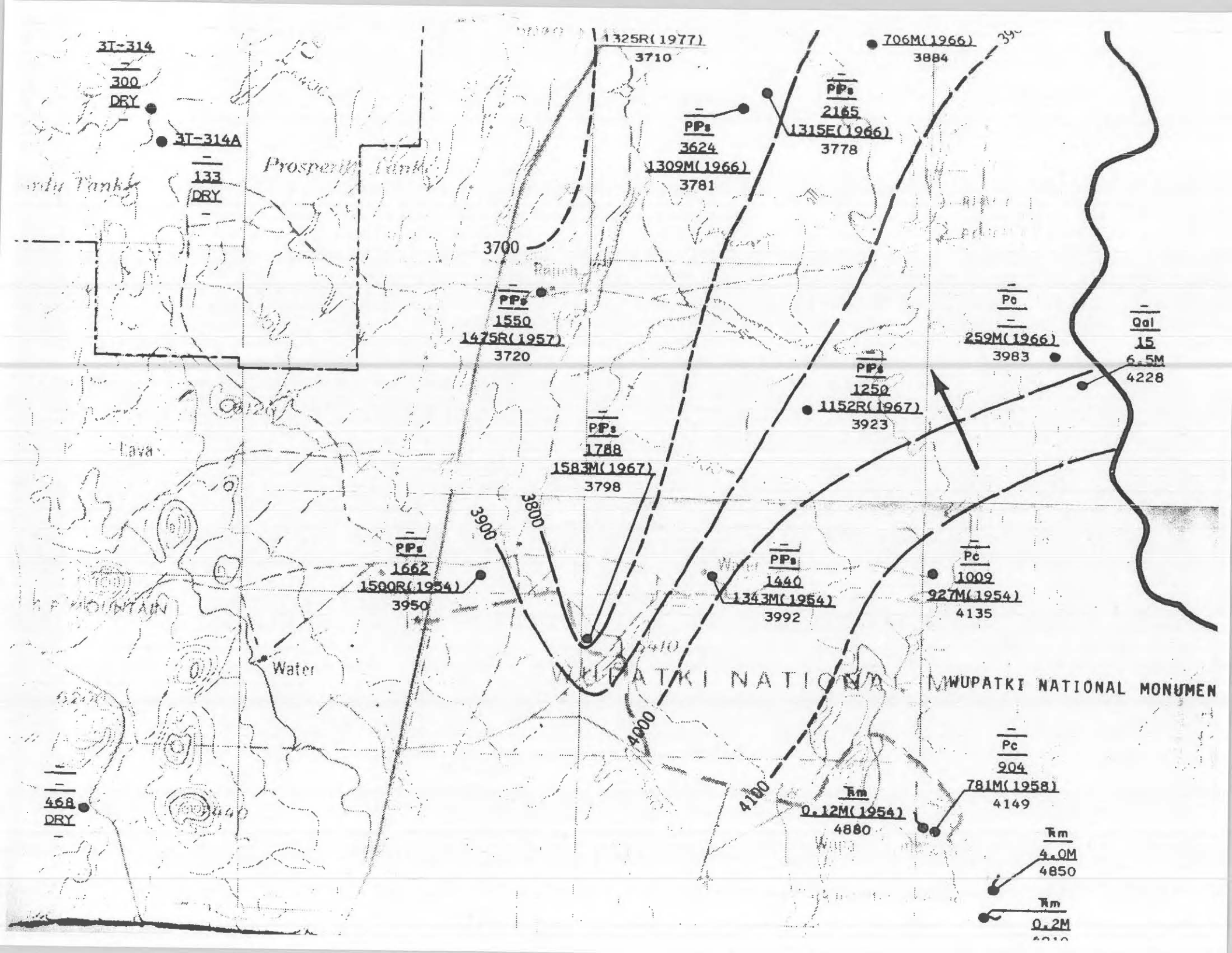


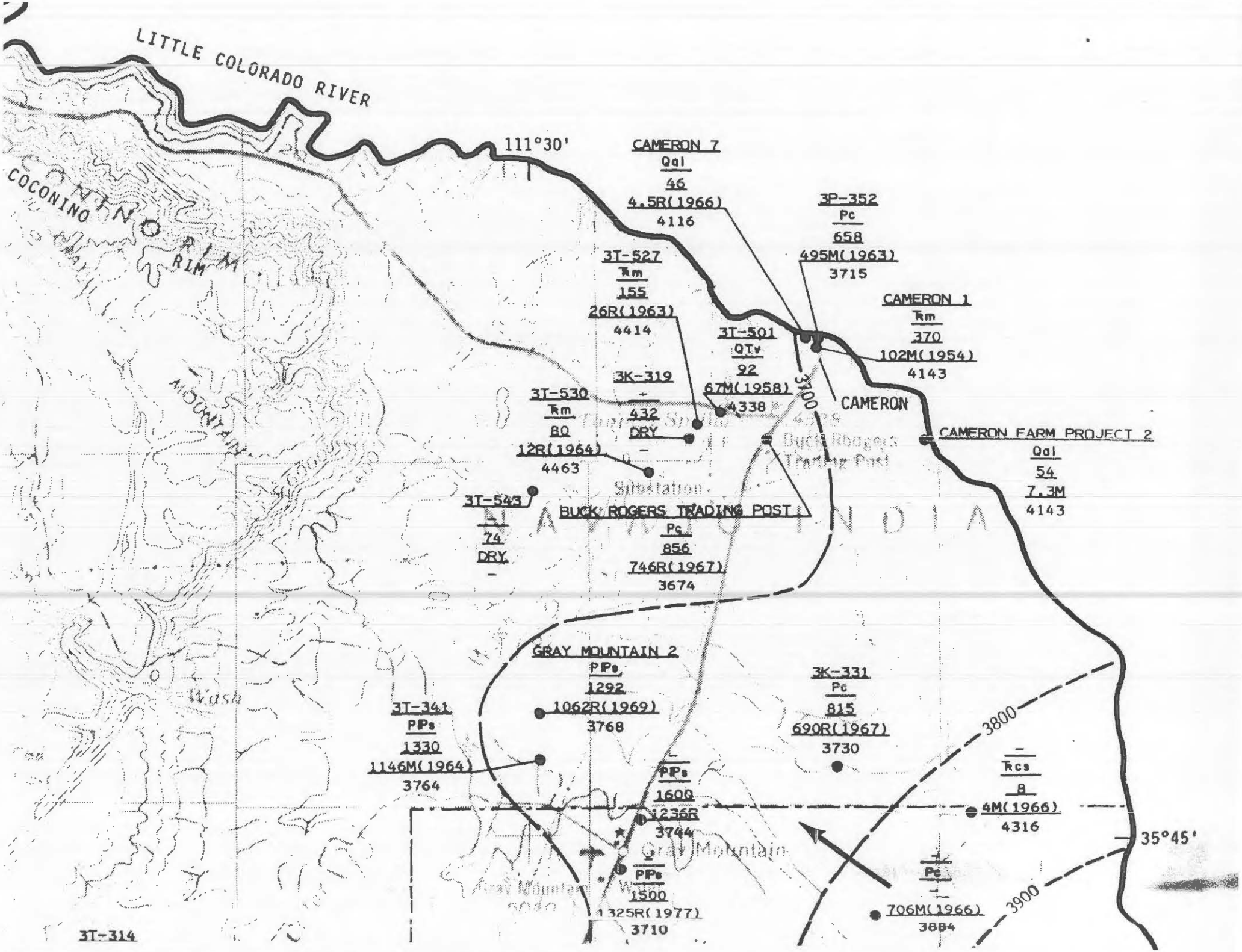


AREA OF REPORT (SHADED)

Composite stratigraphic column for the
San Francisco Peaks area

System	Group, formation, or member	Letter symbol for geologic unit
Quaternary	Alluvium Glacial outwash	Qal Qg
Quaternary and Tertiary	Volcanic rocks	QTv
Triassic	Chinle Formation Petrified Forest Member Shinarump Member Moenkopi Formation	Ꞧc Ꞧcp Ꞧcs Ꞧm
Permian	Kaibab Limestone Toroweap Formation Coconino Sandstone Hermit Shale	Pk Pt Pc Ph
Permian and Pennsylvanian	Supai Group	PIPs
Mississippian	Redwall Limestone	Mr
Devonian	Temple Butte Limestone	Dtb
Cambrian	Muav Limestone	Ꞓm

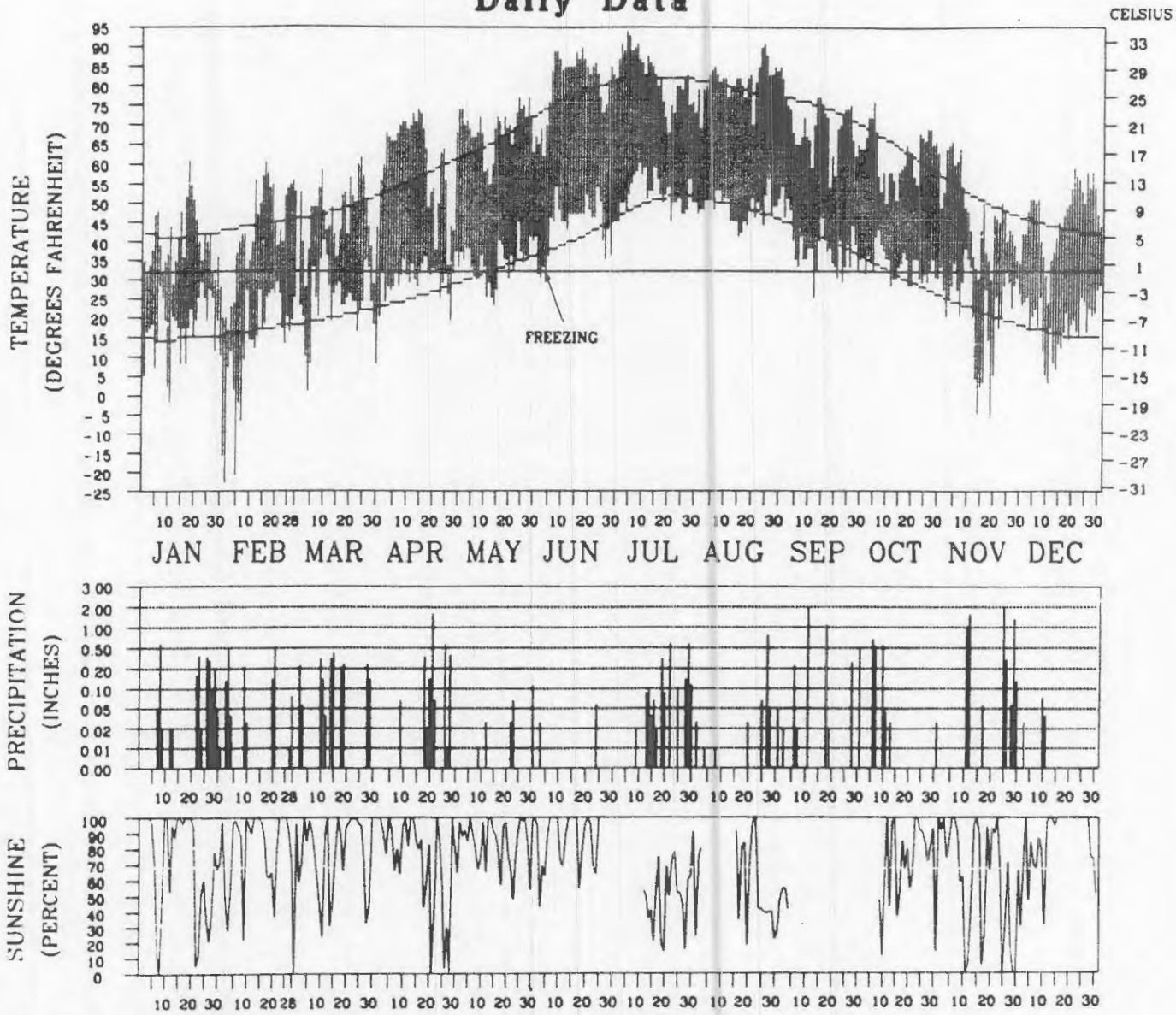

3T-314
300
DRY
3T-314A
133
DRY
Prosperity Tanks
1325R(1977)
3710
706M(1966)
3884
PPs
2165
1315E(1966)
3778
PPs
3624
1309M(1966)
3781
3700
PPs
1550
1475R(1957)
3720
Po
259M(1966)
3983
Qal
15
6.5M
4228
PPs
1250
1152R(1967)
3923
PPs
1788
1583M(1967)
3798
3900
3800
PPs
1662
1500R(1954)
3950
PPs
1440
1343M(1954)
3992
Pc
1009
927M(1954)
4135
Water
WUPATKI NATIONAL MONUMEN
4000
4100
Pc
904
781M(1958)
4149
468
DRY
Tm
0.12M(1954)
4880
Tm
4.0M
4850
Tm
0.2M


LITTLE COLORADO RIVER
111°30'
COCONINO RIM
CAMERON 7
Qal
46
4.5R(1966)
4116
3P-352
Pc
658
495M(1963)
3715
3T-527
Ꞧm
155
26R(1963)
4414
CAMERON 1
Ꞧm
370
102M(1954)
4143
3T-501
QTv
92
67M(1958)
4338
3K-319
-
432
DRY
-
3T-530
Ꞧm
80
12R(1964)
4463
3100
CAMERON
CAMERON FARM PROJECT 2
Qal
54
7.3M
4143
3T-543
-
74
DRY
-
BUCK ROGERS TRADING POST
Pc
856
746R(1967)
3674
GRAY MOUNTAIN 2
PIPs
1292
1062R(1969)
3768
3K-331
Pc
815
690R(1967)
3730
3T-341
PIPs
1330
1146M(1964)
3764
3800
-
PIPs
1600
1236R
3744
-
Ꞧcs
8
4M(1966)
4316
35°45'
-
PIPs
1500
1325R(1977)
3710
-
Pc
-
706M(1966)
3884
3900
3T-314

ISSN 0198-0564

1985 LOCAL CLIMATOLOGICAL DATA
ANNUAL SUMMARY WITH COMPARATIVE DATA
FLAGSTAFF, ARIZONA

Daily Data



TEMPERATURE DEPICTS NORMAL MAXIMUM, NORMAL MINIMUM AND ACTUAL DAILY HIGH AND LOW VALUES (FAHRENHEIT)
PRECIPITATION IS MEASURED IN INCHES. SCALE IS NON-LINEAR
SUNSHINE IS PERCENT OF THE POSSIBLE SUNSHINE

I CERTIFY THAT THIS IS AN OFFICIAL PUBLICATION OF THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, AND IS COMPILED FROM RECORDS ON FILE AT THE NATIONAL CLIMATIC DATA CENTER, ASHEVILLE, NORTH CAROLINA, 28801

Kenneth D. Wadell
DIRECTOR
NATIONAL CLIMATIC DATA CENTER

noaa
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL ENVIRONMENTAL SATELLITE, DATA AND INFORMATION SERVICE
NATIONAL CLIMATIC DATA CENTER ASHEVILLE NORTH CAROLINA

METEOROLOGICAL DATA FOR 1985

FLAGSTAFF, ARIZONA

LATITUDE: 35°08' N LONGITUDE: 111°40' W ELEVATION: FT. GRND 7006 BARO 06997 TIME ZONE: MOUNTAIN WBAN: 03103

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	YEAR
TEMPERATURE °F:													
Averages													
-Daily Maximum	39.4	43.9	47.5	62.0	68.8	81.5	82.4	81.9	68.8	62.0	46.3	47.0	61.0
-Daily Minimum	15.6	13.9	23.4	30.4	34.2	43.6	52.0	48.6	37.3	33.3	21.2	17.7	30.9
-Monthly	27.5	28.9	35.5	46.2	51.5	62.6	67.2	65.3	53.1	47.7	33.8	32.4	46.0
-Monthly Dewpt.	15.2	13.6	20.0	24.9	27.5	29.5	42.0		33.3	30.8	19.3	16.8	
Extremes													
-Highest	61	63	62	74	77	90	94	91	77	76	66	59	94
-Date	18	16	24	30	28	17	4	24	14	5	4	21	JUL 4
-Lowest	-16	-23	1	19	23	29	45	41	25	28	-6	3	-23
-Date	31	1	4	27	14	4	21	15	12	20	19	11	FEB 1
DEGREE DAYS BASE 65 °F:													
Heating	1155	1005	911	557	411	102	26	31	351	532	931	1005	7017
Cooling	0	0	0	0	0	36	102	47	0	0	0	0	185
% OF POSSIBLE SUNSHINE	71	81	78	72	84	78					62	95	
AVG. SKY COVER (tenths)													
Sunrise - Sunset	4.7	5.4	5.9	4.9	4.9	2.5	6.0	4.0	4.1	4.9	5.3	3.8	4.7
Midnight - Midnight													
NUMBER OF DAYS:													
Sunrise to Sunset													
-Clear	15	11	8	12	10	23	5	15	15	12	11	15	152
-Partly Cloudy	4	6	8	11	15	5	17	13	10	10	8	10	117
-Cloudy	12	11	15	7	6	2	9	3	5	9	11	6	96
Precipitation .01 inches or more	14	9	11	9	5	2	13	8	7	7	8	3	96
Snow, Ice pellets 1.0 inches or more	7	5	8	2	0	0	0	0	0	0	5	1	28
Thunderstorms	0	0	3	2	6	3	16	12	7	2	1	0	52
Heavy Fog, visibility 1/4 mile or less	5	0	1	1	0	0	0	0	1	1	2	0	11
Temperature °F													
-Maximum													
90° and above	0	0	0	0	0	1	5	2	0	0	0	0	8
32° and below	7	4	2	0	0	0	0	0	0	0	2	2	17
-Minimum													
32° and below	31	28	25	23	10	3	0	0	5	14	26	31	196
0° and below	2	4	0	0	0	0	0	0	0	0	2	0	8
AVG. STATION PRESS. (mb)													
RELATIVE HUMIDITY (%)													
Hour 05	71		69		63	46	59			69		70	
Hour 11 (Local Time)	59	47	49	37	28	21	33	32	40	45	54	48	41
Hour 17	54	41	46	34	28	20	35	31	35	44	52	44	39
Hour 23	68	62	61	57	51	37	51	50	58	65		64	
PRECIPITATION (inches):													
Water Equivalent													
-Total	2.38	1.67	2.54	3.39	0.26	0.09	2.36	1.07	3.68	2.44	6.64	0.15	26.67
-Greatest (24 hrs)	0.66	0.64	0.47	1.79	0.12	0.06	0.72	0.82	1.97	1.26	2.05	0.08	2.05
-Date	7- 8	20-21	14-15	20-21	31	24	29-30	27	11	6- 7	25-26	10	NOV 25-26
Snow, Ice pellets													
-Total	26.2	31.3	21.3	18.5	0.0	0.0	0.0	0.0	0.0	0.0	40.7	2.6	140.6
-Greatest (24 hrs)	9.5	12.7	5.4	9.3	0.0	0.0	0.0	0.0	0.0	0.0	18.4	1.8	18.4
-Date	7- 8	3	18-19	21-22							12	10	NOV 12
WIND:													
Resultant													
-Direction (!!!)	064	151	219	220	210	219	239		213	187	216	071	
-Speed (mph)	2.2	0.3	3.8	2.3	3.8	2.7	0.9		3.4	1.2	4.7	1.3	
Average Speed (mph)	5.7	5.0	6.5	5.9	5.8	4.9	4.0		5.1	4.8	7.0	4.7	
Fastest Mile													
-Direction (!!!)	NE	NE	SW	SW	SW	SW	NE	NW	SW				
-Speed (mph)	29	23	32	32	30	24	28	20	37				
-Date	16	23	25	20	10	25	7	31	11				
Peak Gust													
-Direction (!!!)			SW	SW	SW	S	NW		SW	S	S	SW	
-Speed (mph)			41	36	33	33	33		41	32	44	30	
-Date			2	20	10	18	7		11	9	11	8	

!!!! See Reference Notes on Page 68

NORMALS, MEANS, AND EXTREMES

FLAGSTAFF, ARIZONA

LATITUDE: 35°08'N LONGITUDE: 111°40'W ELEVATION: FT. GRND 7006 BARO 06997 TIME ZONE: MOUNTAIN WBAN: [illegible]

	(a)	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	YEAR
TEMPERATURE °F:														
Normals														
-Daily Maximum		41.7	44.5	48.6	57.1	66.7	77.6	81.9	78.9	74.1	63.7	51.0	43.6	[illegible]
-Daily Minimum		14.7	16.9	20.4	25.9	32.9	40.9	50.3	48.7	40.9	30.6	21.5	15.9	[illegible]
-Monthly		28.2	30.7	34.5	41.5	49.8	59.3	66.1	63.8	57.5	47.2	36.3	29.8	[illegible]
Extremes														
-Record Highest	36	66	70	73	78	87	96	97	92	90	85	74	68	[illegible]
-Year		1971	1977	1966	1981	1974	1970	1973	1978	1950	1980	1977	1950	JUL 1973
-Record Lowest	36	-22	-23	-16	-2	14	22	32	24	23	-2	-13	-23	-23
-Year		1971	1985	1966	1975	1975	1955	1955	1968	1971	1971	1958	1978	FEB 1985
NORMAL DEGREE DAYS:														
Heating (base 65°F)		1141	960	946	702	468	194	34	76	229	552	861	1091	7254
Cooling (base 65°F)		0	0	0	0	0	20	68	39	0	0	0	0	127
% OF POSSIBLE SUNSHINE	7	75	71	71	80	88	87	70	77	80	76	73	71	[illegible]
MEAN SKY COVER (tenths)														
Sunrise - Sunset	34	5.3	5.1	5.2	4.6	3.9	2.9	5.4	5.0	3.6	3.6	4.2	4.8	4.5
MEAN NUMBER OF DAYS:														
Sunrise to Sunset														
-Clear	34	12.4	11.4	11.8	13.0	15.8	19.1	8.8	10.3	16.0	17.2	15.5	13.9	165.1
-Partly Cloudy	34	6.0	6.0	7.7	8.4	8.9	7.4	13.1	12.9	9.6	6.9	6.3	6.4	99.4
-Cloudy	34	12.7	10.9	11.5	8.6	6.3	3.6	9.1	7.8	4.5	6.8	8.2	10.7	100.8
Precipitation .01 inches or more	36	7.5	6.5	8.4	5.8	4.1	2.5	11.8	11.0	6.4	4.7	5.4	6.2	80.2
Snow, Ice pellets 1.0 inches or more	35	4.2	3.8	5.1	2.5	0.7	0.0	0.0	0.0	0.*	0.6	2.0	3.4	22.3
Thunderstorms	30	0.*	0.3	0.6	1.3	2.6	3.7	16.6	15.7	6.7	2.2	0.7	0.2	50.5
Heavy Fog Visibility 1/4 mile or less	30	1.8	1.8	1.6	1.2	0.2	0.*	0.1	0.3	0.5	0.9	1.1	1.8	[illegible]
Temperature °F														
-Maximum														
90° and above	36	0.0	0.0	0.0	0.0	0.0	1.2	1.5	0.3	0.*	0.0	0.0	0.0	[illegible]
32° and below	36	4.7	2.6	1.9	0.2	0.0	0.0	0.0	0.0	0.0	0.1	1.2	4.5	15.2
-Minimum														
32° and below	36	30.3	27.7	29.9	25.6	14.4	3.2	0.1	0.1	2.8	18.7	28.0	30.2	210.8
0° and below	36	3.5	1.5	0.7	0.1	0.0	0.0	0.0	0.0	0.0	0.*	0.5	2.1	8.4
AVG. STATION PRESS. (mb)	5	786.7	786.9	783.0	784.8	786.4	789.2	791.7	791.6	790.6	789.7	788.2	787.6	[illegible]
RELATIVE HUMIDITY (%)														
Hour 05	28	74	73	71	66	63	54	69	76	74	71	71	72	[illegible]
Hour 11 (Local Time)	30	54	50	44	35	28	23	34	39	38	38	44	50	[illegible]
Hour 17	22	51	44	41	32	26	20	39	43	37	36	43	52	39
Hour 23	18	68	63	60	54	47	40	61	69	66	63	64	73	61
PRECIPITATION (inches):														
Water Equivalent														
-Normal		2.10	1.95	2.13	1.35	0.75	0.57	2.47	2.62	1.47	1.54	1.65	2.26	20.86
-Maximum Monthly	36	6.52	7.81	6.75	5.62	2.16	2.92	5.23	5.50	6.75	9.86	6.64	7.30	9.86
-Year		1980	1980	1970	1965	1979	1955	1964	1951	1983	1972	1985	1967	OCT 1972
-Minimum Monthly	36	0.00	T	T	0.09	T	0.00	0.32	0.26	T	T	T	T	0.00
-Year		1972	1967	1972	1962	1974	1971	1963	1962	1973	1952	1980	1958	JAN 1972
-Maximum in 24 hrs	36	2.10	2.53	2.96	1.79	1.11	2.79	2.55	2.65	3.43	2.73	3.69	3.11	3.69
-Year		1979	1980	1970	1985	1965	1956	1964	1951	1965	1972	1978	1951	NOV 1978
Snow, Ice pellets														
-Maximum Monthly	35	63.4	42.1	77.4	58.3	8.2	T			2.0	24.7	40.7	86.0	86.0
-Year		1980	1969	1973	1965	1975	1955			1965	1971	1985	1967	DEC 1967
-Maximum in 24 hrs	35	23.1	19.9	26.3	17.2	6.6	T			2.0	13.5	18.4	27.3	27.3
-Year		1980	1976	1970	1977	1965	1955			1965	1974	1985	1967	DEC 1967
WIND:														
Mean Speed (mph)	18	7.5	7.3	8.1	8.5	7.9	7.6	5.9	5.7	6.3	6.4	7.4	7.3	7.2
Prevailing Direction through 1963		NE	S	SSW	SSW	SSW	SSW	SSW	S	S	N	NNE	NE	SSW
Fastest Mile														
-Direction (!!!)	11	SW	SW	SW	SW	SW	SW	NW	SW	W	NW	SW	NE	SW
-Speed (MPH)	11	38	34	37	40	46	35	39	30	33	34	39	38	46
-Year		1975	1980	1974	1974	1975	1984	1976	1978	1974	1978	1978	1982	MAY 1975
Peak Gust														
-Direction (!!!)	1	NE	SW	SW	SW	SW	S	NW	*	SW	SW	S	SW	S
-Speed (mph)	1	39	44	41	44	40	33	33		41	39	44	33	44
-Date		1984	1984	1985	1984	1984	1985	1985		1985	1984	1985	1984	NOV 1985

(!!!) See Reference Notes on Page 6B.

PRECIPITATION (inches)

FLAGSTAFF, ARIZONA

YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	ANNUAL
1956	1.62	1.06	0.12	0.86	0.17	2.79	1.19	1.42	0.02	0.68	0.05	0.39	10.37
1957	6.46	0.85	0.92	1.04	2.02	1.59	1.57	1.65	T	3.66	4.24	0.59	24.59
1958	0.22	3.04	2.98	1.23	0.45	0.70	0.75	3.02	6.60	0.86	1.39	T	21.24
1959	0.34	3.63	0.08	1.49	0.64	0.77	2.93	4.96	0.28	2.35	0.31	3.68	21.46
1960	1.03	1.82	0.66	1.34	0.71	0.39	0.96	3.28	1.18	3.57	1.27	0.39	16.60
1961	1.15	0.12	2.89	0.35	0.28	0.37	2.03	3.37	1.92	1.89	1.43	3.15	18.95
1962	2.65	4.15	1.30	0.09	0.99	0.52	2.36	0.26	2.48	1.23	1.23	0.85	18.11
1963	0.96	1.28	1.03	2.13	0.05	T	0.32	4.96	0.79	1.25	1.39	0.36	14.52
1964	1.07	0.14	3.08	2.17	0.84	0.17	5.23	1.32	0.99	0.02	1.27	2.74	19.04
1965	3.05	2.34	3.33	5.62	1.88	0.30	2.34	1.01	4.85	0.27	4.97	6.63	36.59
1966	1.10	1.06	0.95	0.27	T	0.21	1.62	3.55	2.03	0.99	2.33	6.17	20.28
1967	0.93	T	1.11	1.90	0.41	1.05	3.80	2.68	2.25	0.30	0.54	7.30	22.27
1968	1.55	1.29	1.15	2.09	0.55	0.16	3.61	1.13	0.04	1.38	0.87	2.71	16.53
1969	4.63	3.91	3.00	0.11	1.06	0.01	3.81	1.90	1.34	1.14	2.04	0.46	23.41
1970	0.51	0.41	6.75	1.16	T	0.07	2.58	5.15	3.79	0.11	1.37	2.12	24.02
1971	0.08	1.48	0.25	0.55	1.23	0.00	1.97	4.48	2.02	4.37	0.40	4.18	21.01
1972	0.00	0.02	T	0.72	0.14	1.93	1.90	2.82	0.81	9.86	2.34	4.13	24.67
1973	1.89	3.69	6.18	1.21	1.17	0.40	1.87	1.25	T	0.03	1.90	0.12	19.71
1974	3.63	0.26	1.01	0.57	T	T	3.00	2.16	0.93	3.64	1.03	1.18	17.41
1975	1.76	1.90	2.92	2.20	1.16	0.05	2.24	0.74	1.89	0.33	2.96	1.95	20.10
1976	0.17	5.96	2.06	3.09	1.65	T	3.82	0.58	1.16	0.73	0.10	0.80	20.12
1977	1.85	0.84	0.92	1.47	0.96	0.91	3.60	3.72	1.52	1.04	0.76	1.18	18.77
1978	4.09	4.67	5.58	1.60	0.27	0.09	1.17	0.68	0.46	0.56	6.16	5.39	30.72
1979	5.54	1.73	2.52	0.31	2.16	0.18	0.79	2.38	0.13	1.30	1.14	1.50	19.68
1980	6.52	7.81	4.16	1.21	1.79	0.25	2.49	2.19	0.65	1.08	T	1.15	29.30
1981	1.31	1.16	4.04	1.50	0.72	1.09	2.87	3.73	2.54	1.81	2.43	0.17	23.37
1982	4.62	2.55	5.69	0.25	0.86	T	1.89	2.32	3.17	0.71	5.36	3.67	31.09
1983	1.61	3.04	4.36	2.18	0.06	0.28	2.86	3.53	6.75	0.75	1.53	2.52	29.47
1984	0.36	0.13	0.89	0.73	0.21	0.13	4.20	3.86	1.75	1.43	1.40	5.00	20.09
1985	2.38	1.67	2.54	3.39	0.26	0.09	2.36	1.07	3.68	2.44	6.64	0.15	26.67
Record Mean	2.00	1.95	2.07	1.33	0.69	0.50	2.73	2.77	1.77	1.50	1.50	1.93	20.73

See Reference Notes on Page 6B.

AVERAGE TEMPERATURE (deg. F)

FLAGSTAFF, ARIZONA

YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	ANNUAL
1956	33.2	26.3	36.9	40.6	51.7	61.0	64.3	60.8	61.5	45.6	33.9	30.3	45.5
1957	29.6	37.2	37.6	40.2	45.9	60.0	64.8	63.4	57.4	45.3	32.7	35.1	45.8
1958	30.5	34.1	30.7	40.8	53.9	61.1	65.8	66.4	57.0	48.4	35.0	36.5	46.7
1959	31.4	27.2	37.3	45.7	49.8	61.8	67.5	62.9	56.4	47.7	37.4	31.4	46.4
1960	22.7	25.8	39.4	43.7	50.5	62.3	67.4	65.3	59.7	45.0	36.8	28.7	45.6
1961	30.2	33.8	34.9	44.1	48.8	63.1	66.7	64.1	53.8	44.5	34.2	26.0	45.3
1962	27.1	30.3	28.1	47.6	48.0	58.2	64.6	64.9	58.7	47.5	39.8	31.6	45.5
1963	25.4	36.7	34.5	39.6	52.7	56.3	68.0	63.8	59.2	49.8	37.9	30.3	46.2
1964	25.3	26.6	30.5	39.7	49.4	57.4	66.9	63.3	56.7	51.3	31.3	30.3	44.1
1965	31.4	29.7	33.0	39.2	46.7	53.0	65.0	63.7	53.8	49.7	39.7	30.2	44.6
1966	23.5	25.1	37.2	44.7	53.7	59.1	66.4	65.2	58.6	46.9	39.5	29.7	45.8
1967	29.1	35.3	39.0	37.6	48.7	56.2	66.6	64.4	57.9	50.0	40.4	23.1	45.7
1968	25.5	35.8	37.0	40.3	50.2	59.9	64.9	59.5	55.9	46.9	35.7	25.0	44.7
1969	31.8	25.4	27.3	41.7	52.4	57.9	66.2	65.1	58.2	40.5	33.9	33.3	44.5
1970	30.9	37.1	33.7	37.5	52.6	60.4	67.7	66.3	54.4	43.9	39.5	28.5	46.1
1971	29.3	31.1	37.0	41.9	46.8	58.7	67.5	64.0	53.0	38.6	33.5	22.5	43.6
1972	28.4	31.8	40.0	39.8	46.4	57.6	66.5	62.9	56.7	45.9	29.6	21.9	43.9
1973	22.9	28.7	26.8	38.0	52.8	60.5	65.7	64.6	57.7	50.0	37.1	33.0	44.8
1974	27.8	30.5	40.4	43.2	54.8	66.5	66.3	64.7	58.7	47.9	36.8	26.8	47.0
1975	27.7	27.6	33.2	36.2	47.5	57.1	65.9	63.5	57.9	46.5	37.3	29.2	44.2
1976	30.6	35.1	35.4	41.4	52.8	58.9	66.5	62.8	57.1	47.0	39.5	31.6	46.5
1977	26.8	34.2	33.5	44.7	47.4	62.2	67.2	66.2	60.2	50.8	41.0	37.6	47.6
1978	31.5	30.7	40.3	42.2	49.4	61.4	66.6	63.7	57.3	49.8	34.6	24.3	46.0
1979	22.6	25.9	32.3	40.7	47.9	57.8	64.1	60.5	58.8	47.8	31.2	31.2	43.4
1980	30.7	32.8	32.3	41.9	45.6	60.9	69.0	66.3	59.7	49.0	41.4	39.9	47.5
1981	36.2	36.3	36.6	48.5	52.1	66.1	68.2	65.4	58.7	46.7	41.8	36.4	49.4
1982	28.3	30.5	35.3	43.5	49.9	57.1	63.8	65.6	57.6	44.0	35.2	28.1	44.9
1983	31.0	32.3	36.2	37.0	49.9	57.3	65.5	63.8	60.7	48.6	36.9	34.0	46.1
1984	31.7	32.8	38.3	40.7	56.8	58.5	65.7	63.8	59.3	42.4	35.3	29.0	46.2
1985	27.5	28.9	35.5	46.2	51.5	62.6	67.2	65.3	53.1	47.7	33.8	32.4	46.0
Record Mean	28.0	30.9	35.7	42.5	50.2	59.3	65.8	63.9	57.4	47.0	36.8	29.8	45.6
Max	41.3	44.1	49.1	57.5	66.6	77.3	81.1	78.5	73.2	62.8	51.4	43.3	60.5
Min	14.6	17.7	22.2	27.6	33.8	41.2	50.5	49.2	41.6	31.1	22.1	16.3	30.7

See Reference Notes on Page 6B.

HEATING DEGREE DAYS Base 65 deg. F

FLAGSTAFF, ARIZONA

SEASON	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	TOTAL
1956-57	51	134	103	594	928	1071	1091	771	845	735	583	156	7062
1957-58	47	73	225	603	961	919	1062	858	1054	718	338	136	6994
1958-59	27	11	235	508	894	879	1034	1054	850	572	466	98	6628
1959-60	6	66	254	528	819	1034	1303	1130	786	635	440	87	7088
1960-61	7	55	156	613	839	1116	1072	868	925	619	495	116	6881
1961-62	21	50	330	628	919	1203	1168	965	1135	517	518	213	7667
1962-63	32	38	184	536	747	1026	1218	788	940	757	372	255	6893
1963-64	0	49	168	467	804	1071	1225	1105	1061	752	477	224	7403
1964-65	9	72	245	417	1001	1070	1034	983	985	768	560	353	7497
1965-66	22	69	326	467	753	1071	1281	1109	854	603	343	171	7069
1966-67	14	32	185	556	757	1089	1111	824	799	816	498	265	6946
1967-68	11	33	207	461	733	1292	1218	839	861	733	453	172	7013
1968-69	38	164	267	554	872	1234	1021	1105	1164	693	383	207	7702
1969-70	21	37	200	753	926	978	1051	775	962	821	378	174	7076
1970-71	6	16	310	643	758	1125	1098	943	862	683	557	210	7211
1971-72	24	40	352	809	938	1310	1126	956	768	749	573	220	7865
1972-73	22	78	241	584	1055	1330	1297	1006	1176	801	370	164	8124
1973-74	39	45	212	458	829	987	1147	960	754	650	310	67	6458
1974-75	19	34	195	522	841	1178	1150	1041	978	856	536	231	7581
1975-76	23	66	207	566	821	1101	1059	862	912	702	370	190	6879
1976-77	17	71	230	553	757	1027	1177	858	970	603	540	102	6905
1977-78	9	19	157	432	715	843	1032	954	756	677	478	128	6200
1978-79	33	73	227	465	907	1254	1307	1089	1005	722	524	219	7825
1979-80	68	157	186	526	1008	1042	1056	930	1009	684	596	158	7420
1980-81	6	43	153	491	703	774	886	794	873	486	398	50	5657
1981-82	1	39	182	558	689	880	1130	963	911	640	458	230	6681
1982-83	65	22	218	643	888	1136	1046	911	888	835	461	222	7335
1983-84	26	64	134	502	837	952	1025	929	820	722	247	204	6462
1984-85	21	51	165	695	884	1109	1155	1005	911	557	411	102	7066
1985-86	26	31	351	532	931	1005							

See Reference Notes on Page 6B.

COOLING DEGREE DAYS Base 65 deg. F

FLAGSTAFF, ARIZONA

YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	TOTAL
1969	0	0	0	0	0	1	64	48	0	0	0	0	113
1970	0	0	0	0	0	44	99	64	1	0	0	0	208
1971	0	0	0	0	0	28	108	17	0	0	0	0	153
1972	0	0	0	0	0	4	76	20	0	0	0	0	100
1973	0	0	0	0	0	34	69	40	0	0	0	0	143
1974	0	0	0	0	0	120	66	33	13	0	0	0	232
1975	0	0	0	0	0	0	60	28	0	0	0	0	88
1976	0	0	0	0	0	15	70	13	0	0	0	0	98
1977	0	0	0	0	0	28	82	61	20	0	0	0	191
1978	0	0	0	0	0	25	87	38	2	0	0	0	152
1979	0	0	0	0	0	10	47	24	4	0	0	0	85
1980	0	0	0	0	0	43	133	91	2	0	0	0	269
1981	0	0	0	0	0	91	108	58	0	0	0	0	257
1982	0	0	0	0	0	1	36	46	6	0	0	0	89
1983	0	0	0	0	0	0	45	31	12	0	0	0	88
1984	0	0	0	0	2	14	49	23	2	0	0	0	90
1985	0	0	0	0	0	36	102	47	0	0	0	0	185

See Reference Notes on Page 6B.

SNOWFALL (inches)

FLAGSTAFF, ARIZONA

SEASON	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	TOTAL
1956-57	0.0	0.0	0.0	2.9	1.0	5.0	32.8	T	3.0	7.4	0.9	0.0	53.0
1957-58	0.0	0.0	0.0	0.6	8.2	1.6	2.2	15.5	28.6	14.8	0.0	0.0	71.5
1958-59	0.0	0.0	0.0	0.3	13.0	T	6.0	33.5	1.0	T	T	0.0	53.8
1959-60	0.0	0.0	0.0	3.9	2.0	17.4	14.4	24.7	4.5	7.1	3.6	0.0	77.6
1960-61	0.0	0.0	0.0	0.2	0.8	5.3	11.2	3.2	29.3	0.8	3.1	0.0	53.9
1961-62	0.0	0.0	0.0	8.2	11.7	29.6	30.8	32.4	13.0	0.0	3.2	0.0	128.9
1962-63	0.0	0.0	0.0	0.0	2.9	3.8	9.9	10.9	8.0	11.8	0.0	0.0	47.3
1963-64	0.0	0.0	0.0	0.0	10.9	4.6	10.3	1.4	38.5	19.9	3.8	0.0	89.4
1964-65	0.0	0.0	0.0	0.0	14.3	13.7	15.1	23.9	34.4	58.3	7.0	0.0	166.7
1965-66	0.0	0.0	2.0	2.2	2.9	38.5	14.5	10.8	7.4	5.1	0.0	0.0	83.4
1966-67	0.0	0.0	0.0	T	11.3	13.4	9.8	T	10.9	17.7	0.0	0.0	63.1
1967-68	0.0	0.0	0.0	0.0	5.1	86.0	15.2	9.3	10.1	22.7	2.0	0.0	150.4
1968-69	0.0	0.0	0.0	T	4.3	27.5	12.0	42.1	43.6	0.6	4.6	0.0	134.7
1969-70	0.0	0.0	0.0	1.5	3.0	4.6	5.2	2.8	67.3	11.3	0.0	0.0	95.7
1970-71	0.0	0.0	0.0	0.0	2.0	24.5	0.8	15.1	3.1	5.0	6.1	0.0	56.6
1971-72	0.0	0.0	T	24.7	4.9	18.8	0.0	0.4	T	1.5	0.0	0.0	50.3
1972-73	0.0	0.0	0.0	11.8	23.2	28.9	21.0	33.8	77.4	10.9	3.0	0.0	210.0
1973-74	0.0	0.0	0.0	T	20.7	1.2	35.3	2.4	8.8	1.6	0.0	0.0	70.0
1974-75	0.0	0.0	0.0	16.6	8.2	15.6	20.1	18.2	29.1	25.1	8.2	0.0	141.1
1975-76	0.0	0.0	0.0	T	25.2	18.9	1.5	31.2	20.4	31.2	3.2	0.0	131.6
1976-77	0.0	0.0	0.0	T	0.7	9.0	21.1	11.2	8.8	17.8	1.6	0.0	70.2
1977-78	0.0	0.0	0.0	0.0	7.0	1.6	40.4	32.1	24.5	9.3	1.3	0.0	116.2
1978-79	0.0	0.0	0.0	0.0	16.5	19.8	59.4	18.1	22.8	4.1	4.8	0.0	145.5
1979-80	0.0	0.0	0.0	0.5	5.5	20.7	63.4	32.9	42.5	11.6	T	0.0	177.1
1980-81	0.0	0.0	0.0	6.9	T	6.8	11.7	11.9	45.6	9.5	0.0	0.0	92.4
1981-82	0.0	0.0			0.0	0.0	47.5	20.4	26.7	1.9	0.4	0.0	
1982-83	0.0	0.0	T	T	22.6	27.1	15.3	25.0	38.5	13.6	0.5	0.0	142.6
1983-84	0.0	0.0	0.0	0.0	14.3	5.8	4.3	1.8	0.3	5.5	0.0	0.0	32.0
1984-85	0.0	0.0	0.0	0.6	9.4	28.7	26.2	31.3	21.3	18.5	0.0	0.0	136.0
1985-86	0.0	0.0	0.0	0.0	40.7	2.6							
Record Mean	0.0	0.0	0.1	2.3	9.8	15.1	19.8	16.2	20.8	10.4	2.1	T	96.5

See Reference Notes on Page 6B.

REFERENCE NOTES

FLAGSTAFF, ARIZONA

GENERAL
T - TRACE AMOUNT.
BLANK ENTRIES DENOTE MISSING/UNREPORTED DATA.
# INDICATES A STATION OR INSTRUMENT RELOCATION.
SEE STATION LOCATION TABLE ON PAGE 8.

SPECIFIC
PAGE 2
PM - INCLUDES LAST DAY OF PREVIOUS MONTH

PAGE 3
(a) - LENGTH OF RECORD IN YEARS, ALTHOUGH INDIVIDUAL MONTHS MAY BE MISSING.
a LESS THAN .05
NORMALS - BASED ON THE 1951-1980 RECORD PERIOD.
EXTREMES - DATES ARE THE MOST RECENT OCCURRENCE
WIND DIR.- NUMERALS SHOW TENS OF DEGRESS CLOCKWISE FROM TRUE NORTH. "00" INDICATES CALM.
RESULTANT DIRECTIONS ARE GIVEN TO WHOLE DEGREES.

EXCEPTIONS

PAGE 3
1. PERCENT OF POSSIBLE SUNSHINE IS 1973-1976 AND 1983 TO DATE.
2. MEAN WIND SPEED, THUNDERSTORMS, AND HEAVY FOG ARE THROUGH 1978.

PAGES 4A, 4B, 6A
RECORD MEANS ARE THROUGH THE CURRENT YEAR, BEGINNING IN 1900 FOR TEMPERATURE
1900 FOR PRECIPITATION
1950 FOR SNOWFALL

FLAGSTAFF, ARIZONA

Flagstaff, elevation 7,000 feet, is situated on a volcanic plateau at the base of the highest mountains in Arizona. The climate may be classified as vigorous with cold winters, mild, pleasantly cool summers, moderate humidity, and considerable diurnal temperature change. Only limited farming exists due to the short growing season. The stormy months are January, February, March, July, and August.

Based on the 1951-1980 period, the average first occurrence of 32 degrees Fahrenheit in the fall is September 21 and the average last occurrence in the spring is June 13.

Temperatures in Flagstaff are characteristic of high altitude climates. The average daily range of temperature is relatively high, especially in the winter months, October to March, as a result of extensive snow cover and clear skies. Winter minimum temperatures frequently reach zero or below and temperatures of -25 degrees or less have occurred. Summer maximum temperatures are often above 80 degrees and occasionally, temperatures have exceeded 95 degrees.

The Flagstaff area is semi-arid. Several months have recorded little or no precipitation. Over 90 consecutive days without measurable precipitation have occurred. Annual precipitation ranges from less than 10 inches to more than 35 inches. Winter snowfalls can be heavy, exceeding 100 inches during one month and over 200 inches during the winter season. However, accumulations are quite variable from year to year. Some winter months may experience little or no snow and the winter season has produced total snow accumulations of less than 12 inches.

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY PROCESS DATE 4-01-87
09401200 - LITTLE COLORADO R AT CAMERON ARIZ.

RADIOCHEMICAL ANALYSES, WATER YEAR OCTOBER 1983 TO SEPTEMBER 1984

DATE	GROSS ALPHA, DIS-SOLVED (UG/L AS U-NAT) (80030)	GROSS ALPHA, DIS-SOLVED (PCI/L AS U-NAT) (01515)	GROSS ALPHA, SUSP. TOTAL (UG/L AS U-NAT) (80040)	GROSS ALPHA, SUSP. TOTAL (PCI/L AS U-NAT) (01516)	GROSS BETA, DIS-SOLVED (PCI/L AS CS-137) (03515)	GROSS BETA, SUSP. TOTAL (PCI/L AS CS-137) (03516)	GROSS BETA, DIS-SOLVED (PCI/L AS SR/YT-90) (80050)	GROSS BETA, SUSP. TOTAL (PCI/L AS SR/YT-90) (80060)
NOV								
30...	<13	--	760	520	<7.6	560	<6.6	490
JAN								
24...	<14	--	18	12	9.7	12	8.4	10
APR								
09...	80	54	1200	820	<16	860	<14	740
JUL								
31...	24	--	<1600	--	<6.5	1200	<5.6	1000

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DATE	GROSS ALPHA, DIS-SOLVED (UG/L AS U-NAT) (80030)	GROSS ALPHA, DIS-SOLVED (PCI/L AS U-NAT) (01515)	GROSS ALPHA, SUSP. TOTAL (UG/L AS U-NAT) (80040)	GROSS ALPHA, SUSP. TOTAL (PCI/L AS U-NAT) (01516)	GROSS BETA, DIS-SOLVED (PCI/L AS CS-137) (03515)	GROSS BETA, SUSP. TOTAL (PCI/L AS CS-137) (03516)	GROSS BETA, DIS-SOLVED (PCI/L AS SR/YT-90) (80050)	GROSS BETA, SUSP. TOTAL (PCI/L AS SR/YT-90) (80060)
JAN								
13...	<6.2	--	30	20	<3.6	26	<3.4	25
MAR								
31...	17	12	<430	--	6.2	410	6.0	390
MAY								
20...	<9.7	--	<99	--	<5.5	140	<5.2	120
AUG								
04...	<33	--	13000	8800	13	5600	11	5400

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MAR								
01...	29	20	2500	1700	9.8	1700	9.5	1700
APR								
07...	5.3	3.6	390	270	2.3	170	2.2	170
AUG								
03...	22	15	3400	2300	8.4	1500	8.2	1500
SEP								
02...	26	18	<2600	--	<8.3	<1900	<8.0	<1800

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DATE	GROSS ALPHA, DIS-SOLVED (UG/L AS U-NAT) (80030)	GROSS ALPHA, DIS-SOLVED (PCI/L AS U-NAT) (01515)	GROSS ALPHA, SUSP. TOTAL (UG/L AS U-NAT) (80040)	GROSS ALPHA, SUSP. TOTAL (PCI/L AS U-NAT) (01516)	GROSS BETA, DIS-SOLVED (PCI/L AS CS-137) (03515)	GROSS BETA, SUSP. TOTAL (PCI/L AS CS-137) (03516)	GROSS BETA, DIS-SOLVED (PCI/L AS SR/YT-90) (80050)	GROSS BETA, SUSP. TOTAL (PCI/L AS SR/YT-90) (80060)
MAY								
14...	--	--	--	--	--	--	--	--
JUN								
12...	--	--	--	--	--	--	--	--
JUL								
15...	<19	13	<5700	3900	12	3200	12	3100
AUG								
04...	--	--	--	--	--	--	--	--
SEP								
08...	22	15	<3400	--	13	2500	13	2400

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OCT								
07...	--	--	--	--	--	--	--	--
NOV								
13...	--	--	--	--	--	--	--	--
DEC								
03...	--	--	--	--	--	--	--	--
JAN								
06...	--	--	--	--	--	--	--	--
FEB								
24...	35	24	1000	680	<8.9	660	<8.6	640
MAR								
27...	--	--	--	--	--	--	--	--
APR								
22...	<7.4	5.0	<210	140	<4.1	<130	<3.9	<130

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APR								
15...	--	--	--	--	--	--	--	--
MAY								
06...	--	--	--	--	--	--	--	--
05...	--	--	--	--	--	--	--	--
JUN								
06...	--	--	--	--	--	--	--	--
06...	<9.5	<6.5	2.6	1.8	7.1	1.9	6.8	1.8
JUL								
02...	--	--	--	--	--	--	--	--
AUG								
06...	--	--	--	--	--	--	--	--
SEP								
04...	--	--	--	--	--	--	--	--