

# A Tour of Abandoned Uranium Mines in Navajo Country and Beyond

Compiled by SRIC, October 2013



Red Water Pond Road resident Jack Hood with horse in front of Quivira Church Rock I Mine, circa 1975. Photo courtesy of Tony Hood.

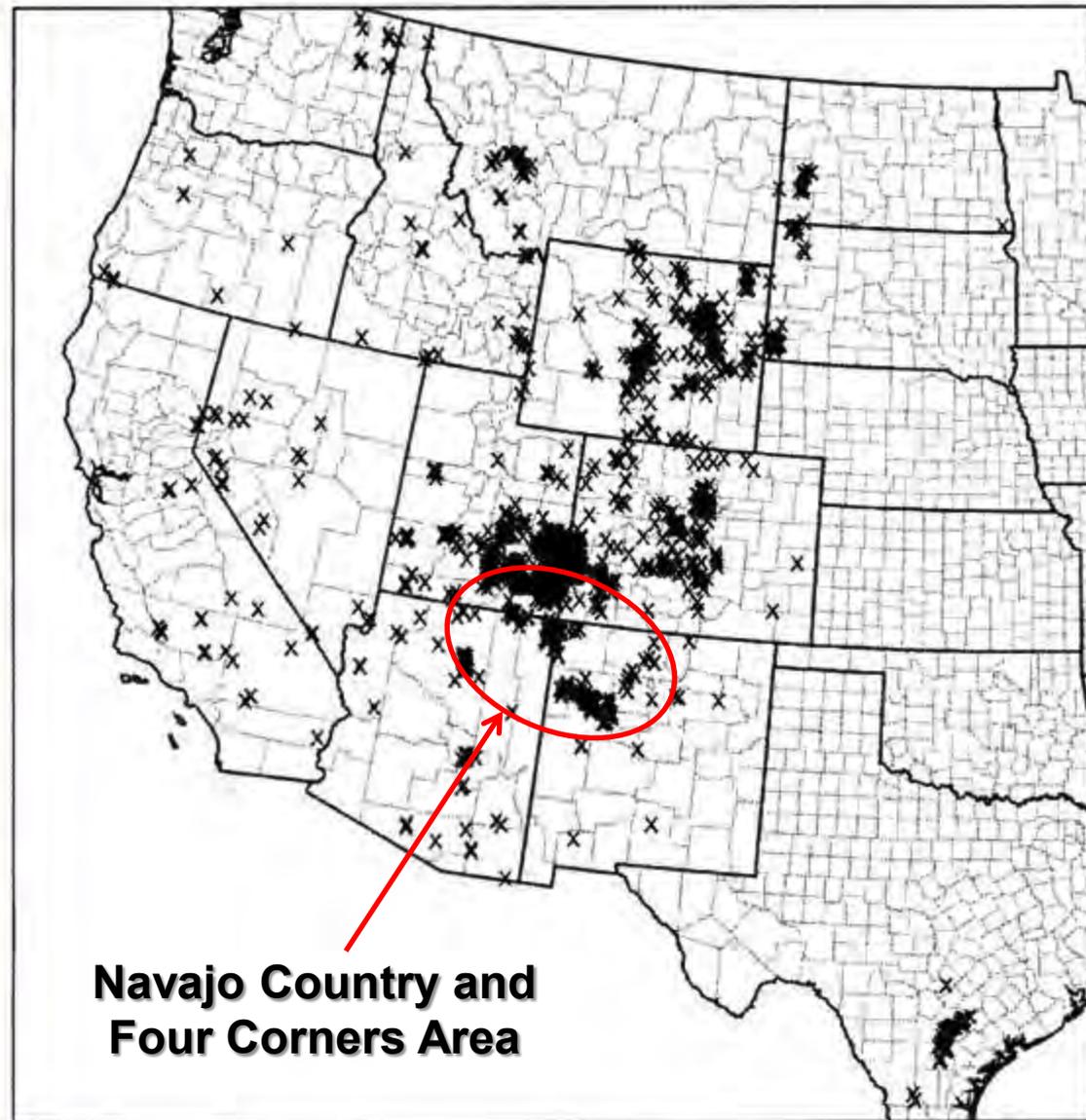


**SOUTHWEST RESEARCH AND INFORMATION CENTER**  
P.O. Box 4524 Albuquerque, NM 87196 505-262-1862 FAX: 505-262-1864 [www.sric.org](http://www.sric.org)

# The Uranium Legacy of the Western U.S.

- USEPA estimates about 10,400 abandoned uranium “mine features” in 15 western states
- U.S. Bureau of Mines estimates ~4,100 discrete uranium mines

Source:  
<http://www.epa.gov/rpdweb00/enorm/uranium.html>



**Navajo Country and  
Four Corners Area**

## Legend

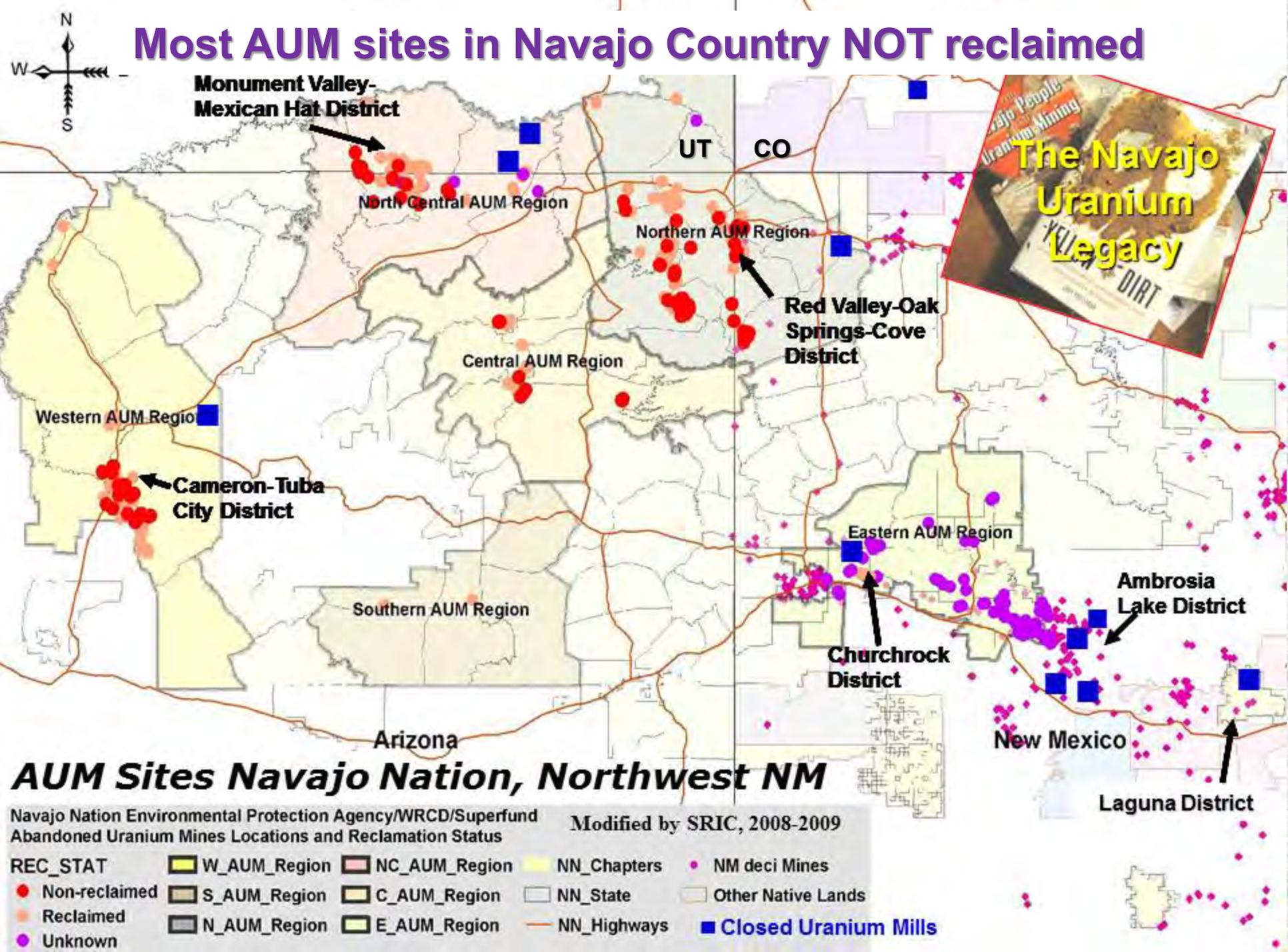
x MAS/MILS Uranium Mines

Source of Mine Information:  
EPA Uranium Location Database

Km  
500



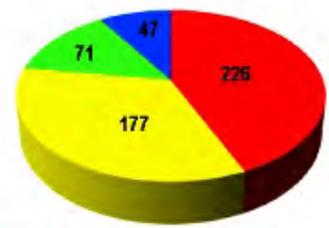
# Most AUM sites in Navajo Country NOT reclaimed



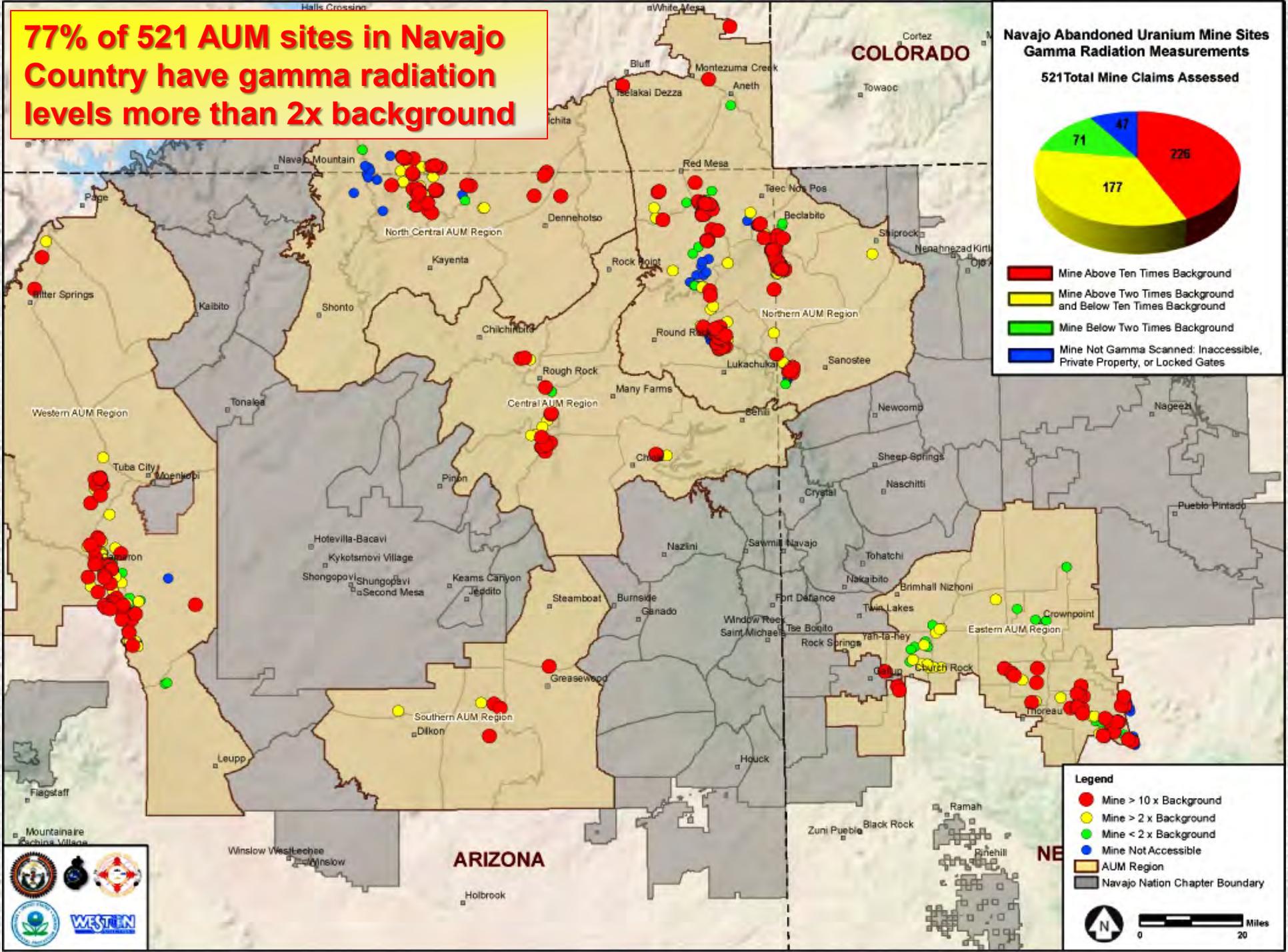
**77% of 521 AUM sites in Navajo Country have gamma radiation levels more than 2x background**

**Navajo Abandoned Uranium Mine Sites Gamma Radiation Measurements**

521 Total Mine Claims Assessed



- Mine Above Ten Times Background
- Mine Above Two Times Background and Below Ten Times Background
- Mine Below Two Times Background
- Mine Not Gamma Scanned: Inaccessible, Private Property, or Locked Gates



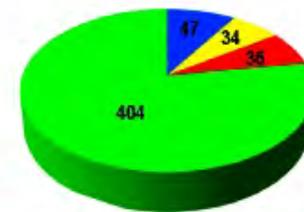
- Legend**
- Mine > 10 x Background
  - Mine > 2 x Background
  - Mine < 2 x Background
  - Mine Not Accessible
  - AUM Region
  - Navajo Nation Chapter Boundary



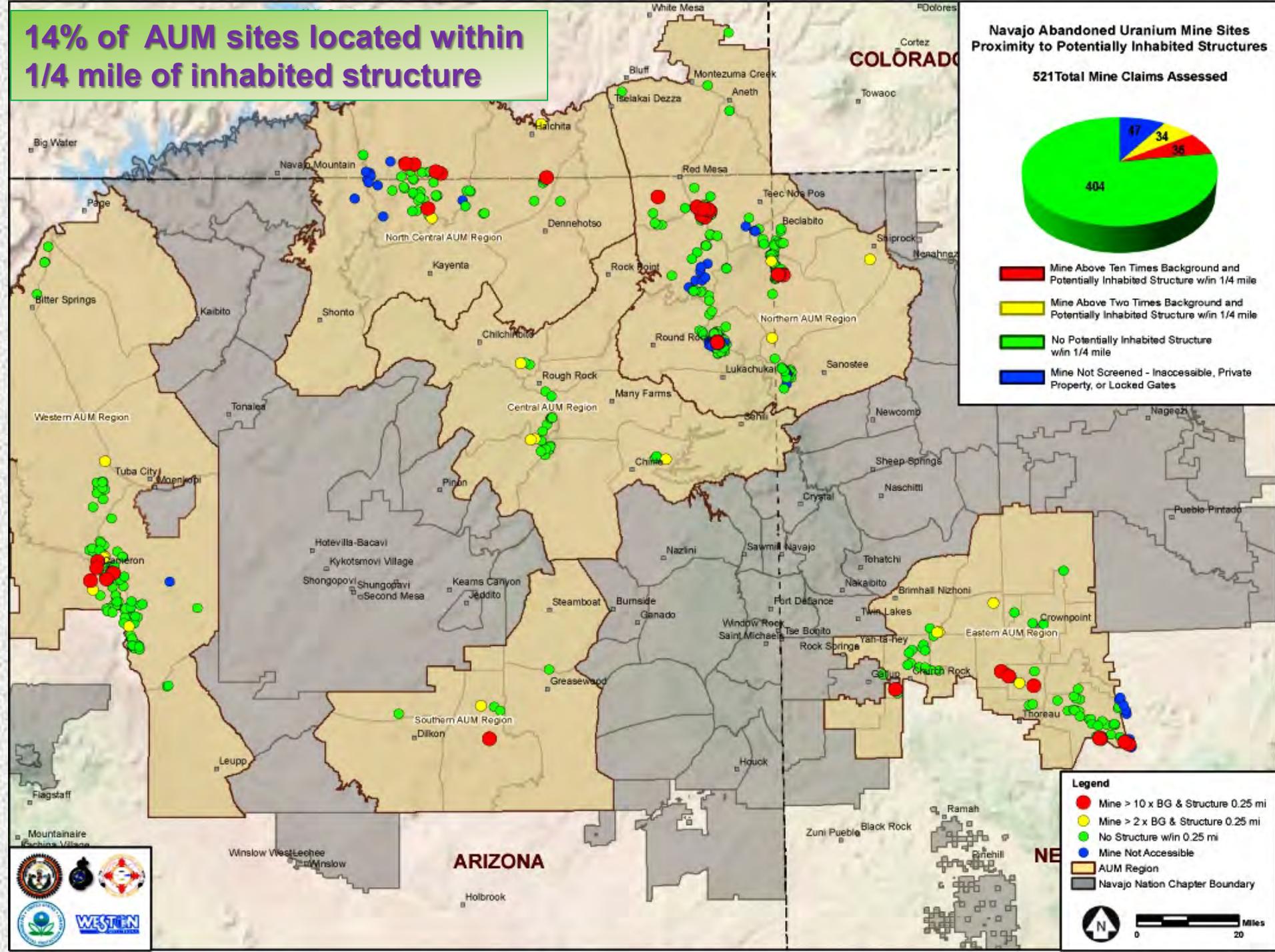
**14% of AUM sites located within 1/4 mile of inhabited structure**

**Navajo Abandoned Uranium Mine Sites Proximity to Potentially Inhabited Structures**

521 Total Mine Claims Assessed



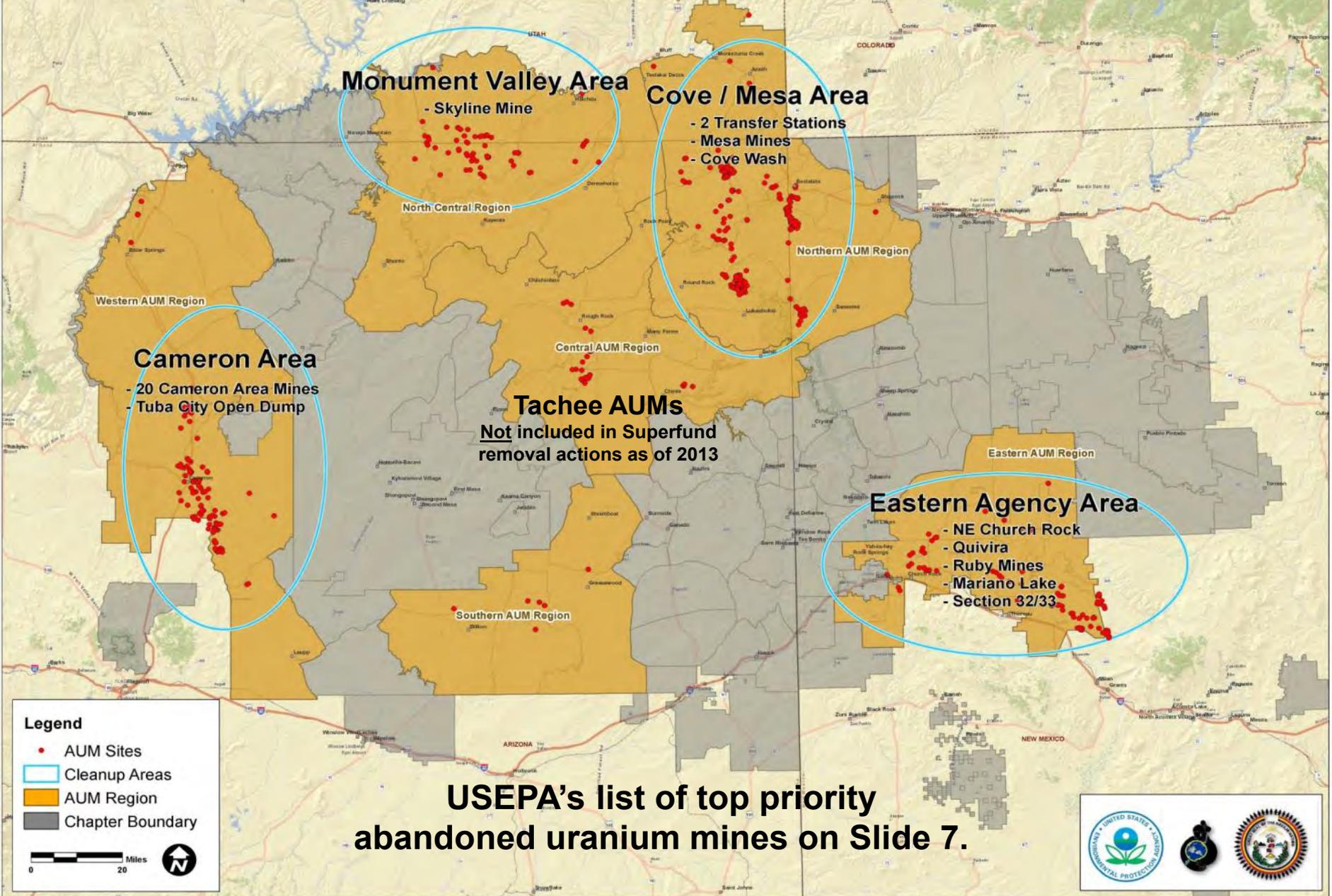
- Mine Above Ten Times Background and Potentially Inhabited Structure w/in 1/4 mile
- Mine Above Two Times Background and Potentially Inhabited Structure w/in 1/4 mile
- No Potentially Inhabited Structure w/in 1/4 mile
- Mine Not Screened - inaccessible, Private Property, or Locked Gates



- Legend**
- Mine > 10 x BG & Structure 0.25 mi
  - Mine > 2 x BG & Structure 0.25 mi
  - No Structure w/in 0.25 mi
  - Mine Not Accessible
  - AUM Region
  - Navajo Nation Chapter Boundary



# Navajo Nation Abandoned Uranium Mines Superfund Cleanup Sites



# USEPA's Top Priority Navajo AUM List\*

Mine Site	Region	Action	Status
<b>Northeast Church Rock Mine</b>	Eastern	Cleanup	Third interim action occurred September/October 2012. Cleanup to occur 2016-2020. <a href="#">Northeast Church Rock Mine</a>
<b>Mariano Lake Mine</b>	Eastern	Investigation/Cleanup	Urgent actions have been taken. Investigation ongoing. Evaluation of Cleanup options in 2013.
<b>Quivira Mine</b>	Eastern	Investigation/Cleanup	Second interim action occurred September 2012. Cleanup to occur 2016-2020. <a href="#">Quivira Mine</a>
<b>Skyline Mine</b>	North Central	Cleanup	Clean up completed October 2011; total cost of \$8M. <a href="#">Skyline Mine</a>
<b>Cove Transfer Stations</b>	Northern	Cleanup	Investigation complete. Urgent actions occurred October 2012. <a href="#">Cove Transfer Stations</a>
<b>Sections 32 and 33</b>	Eastern	Cleanup	Investigation ongoing. Urgent actions occurred October/November 2012. <a href="#">Sections 32-33 Abandoned Uranium Mine</a>
<b>Ruby Mines 1-4</b>	Eastern	Negotiations with responsible party	Starting negotiations with responsible party. Urgent actions conducted October 2012
<b>20 Mine Claims in Cameron Area</b>	Western	Negotiations with responsible party	Starting negotiations with responsible party. Site visits conducted September and November 2012.

\*<http://www.epa.gov/region09/superfund/navajo-nation/abandoned-uranium.html>

# Western AUM Area: Cameron Open Pits, Then and Now

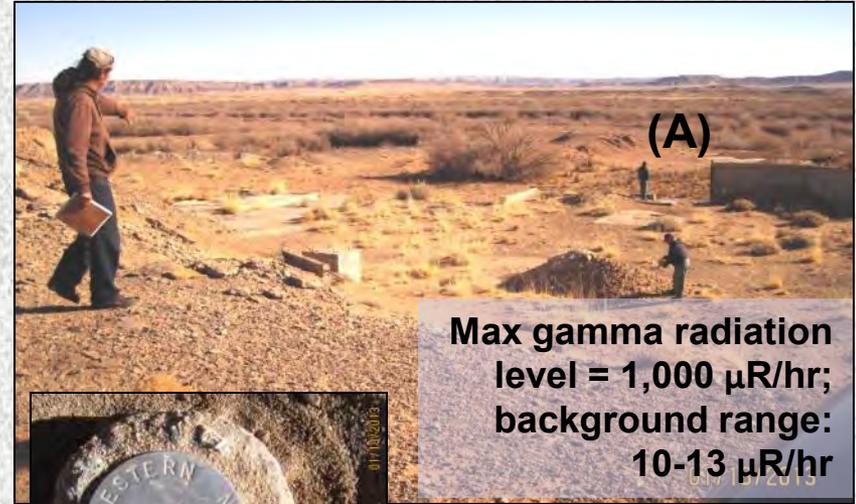
**1982:** SRIC staff took the photos below before these open pit uranium mines were backfilled and closed by NMAML in the 1990s. Most of these pits no longer have standing water. Residents and livestock consumed water from these pits, which was shown to be contaminated by uranium and other radioactive substances.



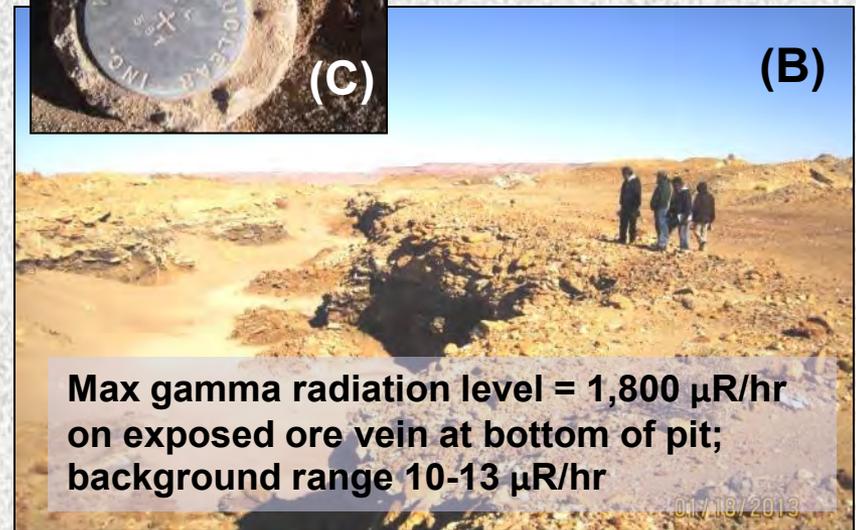
High levels of uranium & radium found in water in these pits in 1970s

EPNG will conduct site assessments in 2014 under USEPA order of 9/13/13

**2013:** (A) Unreclaimed ore transfer station and (B) open pit mine, ~10.5 mi SE Cameron Chapter within 1/4-mile Little Colorado River; (C) Western Nuclear benchmark next to open pit.

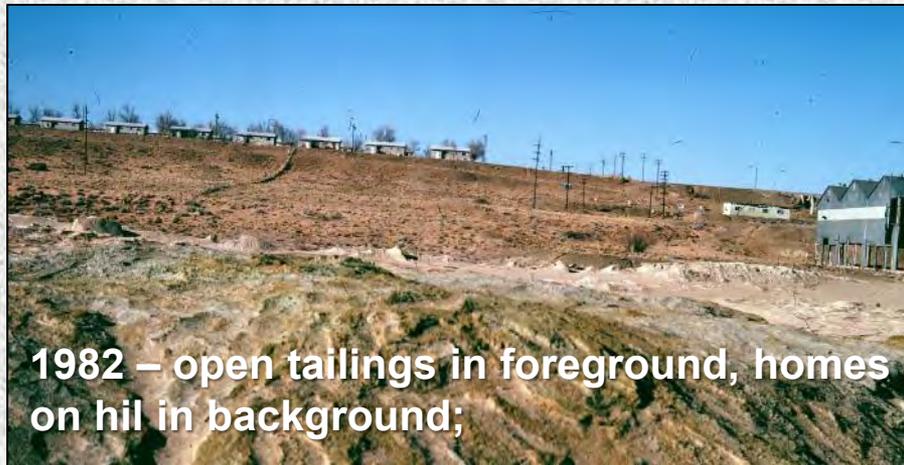


Max gamma radiation level = 1,000  $\mu\text{R/hr}$ ; background range: 10-13  $\mu\text{R/hr}$



Max gamma radiation level = 1,800  $\mu\text{R/hr}$  on exposed ore vein at bottom of pit; background range 10-13  $\mu\text{R/hr}$

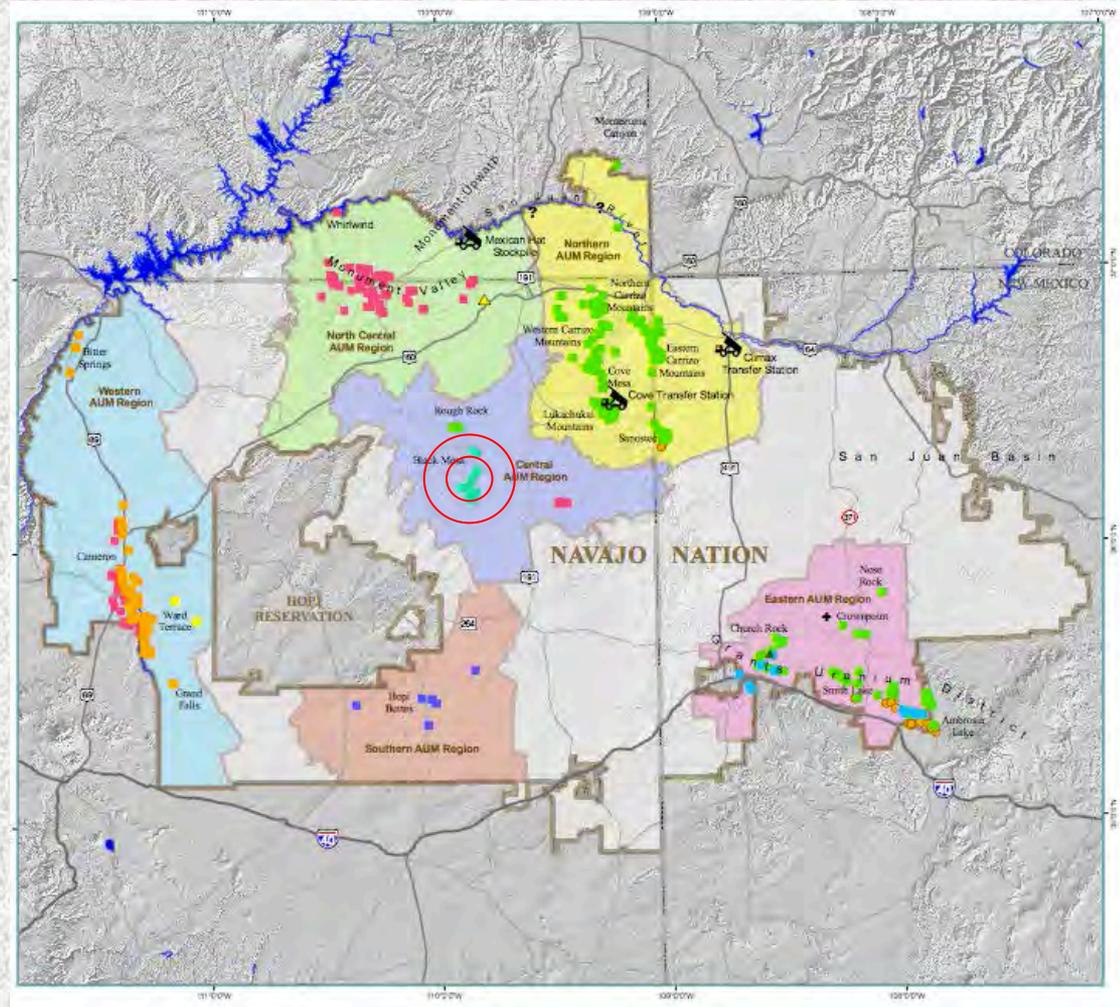
# Then and Now: Rare Metals Uranium Mill Tailings Disposal Cell (aka, Tuba City UMTRA Site)



- Operated 1956-1966, processing Cameron uranium ores
- “Stabilization-in-place”, 1986-1990
- Groundwater contamination, leakage into Moenkopi Wash ongoing after 30 years of treatment
- See, <http://www.lm.doe.gov/tuba/>

# Central Navajo AUM Area: Abandoned Uranium Mines and Contaminated Water Sources in Tachee/Blue Gap Chapter

- Tachee/Blue Gap in the central portion of Navajo Nation about 40 miles west of Chinle, AZ
- 13 different mines (open pits, rim cuts, shafts) developed on mesa tops and steep slopes, 1954-1968\*
- 16,800 tons of uranium ore yielding 55,700 lbs uranium oxide ( $U_3O_8$ )
- Young boys hired by company geologists to find radioactive anomalies, mid-1950s\*\*
- Not on USEPA top AUM priority list



\*Chenoweth, AGS CR-90A, 1990.

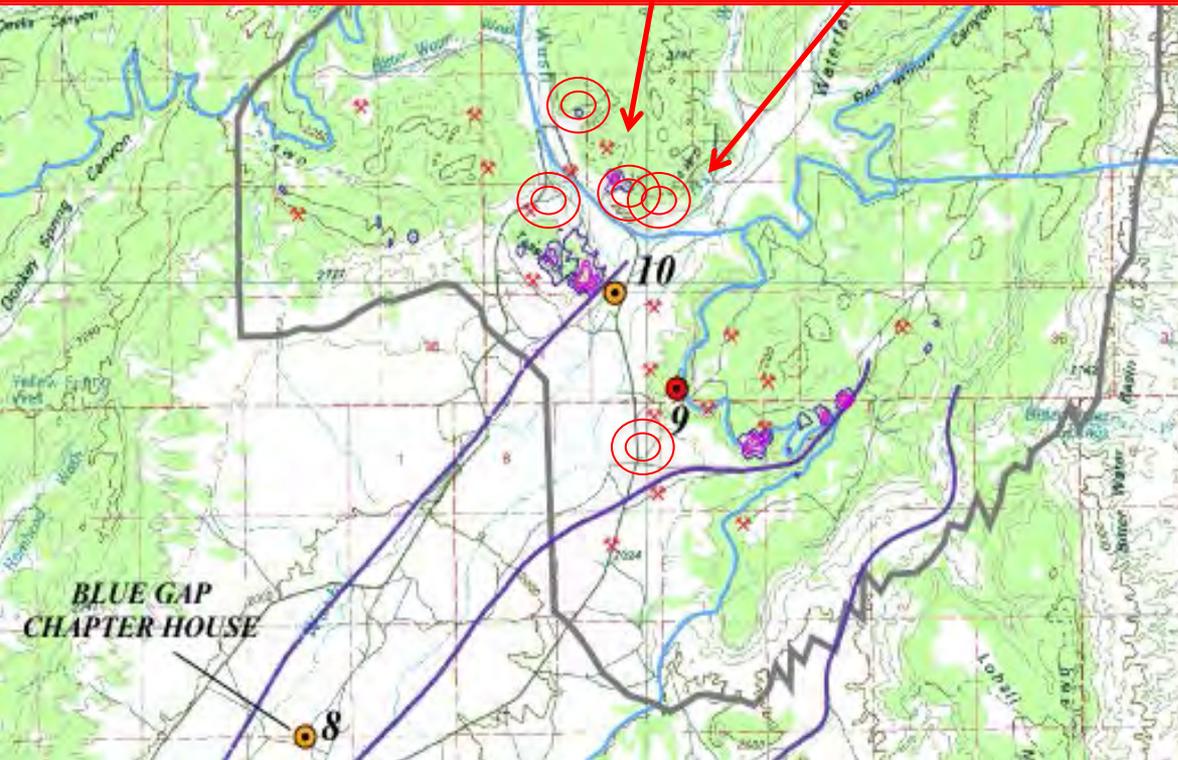
\*\*Interview with James T. Badoni Sr., July 10, 2013.

# Several Occupied Residences Close to Claim 28 Mine

Uranium mine waste dump on slope

~150 ft.

Residences



- 5 residences (20-25 people) within 1 mile of mine dump
- 3<sup>rd</sup> largest mine in terms of uranium ore production in Tachee Mining District
  - 4.2 million tons ore produced, 1957-1968
- NNAML placed dirt cover on waste dump in 1992 to stabilize materials
- NNEPA, USEPA, NNAML site assessments in 1990, 2009, 2011
- SRIC radiation survey 7/9/13:
  - Gamma radiation on waste dump slope 2 to 5 times greater than local background (i.e., 40-100 microRoentgens per hour)
  - Several “hot spots” (gamma rates at least 2x background) found in surrounding community
  - Area has higher background radiation than other places on Navajo Nation

**NOTE:**

**Waterfall Spring and White Clay Spring had uranium levels exceeding drinking water standards in samples collected in 1998. No testing has been done since then. These springs are still used by local residents.**

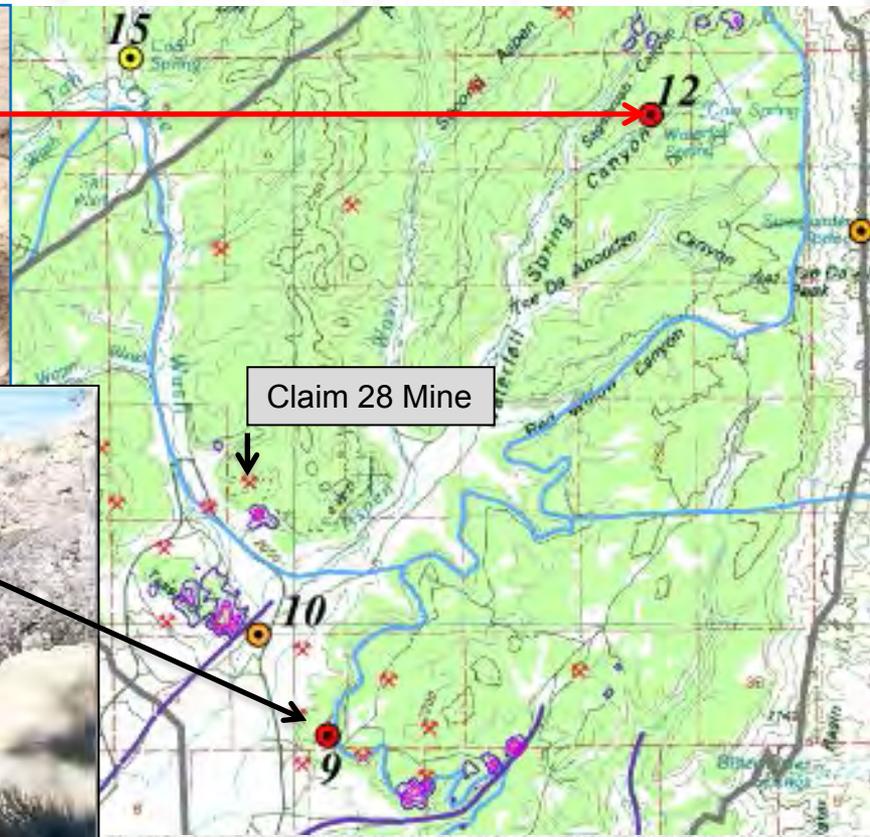
USACE Sample Name	Sample ID	Site Type	Sample Date	Total Uranium (pCi/L)
Benally Spring	KY981008CHS001	Spring	10/08/1998	47.1
Burro Spring	KY981008CHS002	Spring	10/08/1998	60.1
Cottonwood Spring	CH981123CHS001	Spring	11/23/1998	22.4
Tank 10R-51	CH990316TCW004	Wind Mill	03/16/1999	22.3
Tank 10T-533	CH981119TCW003	Wind Mill	11/19/1998	73.0
Tinyehtoh Spring	KY981008CHS003	Spring	10/08/1998	39.9
Waterfall Spring	CH981104BGS001	Spring	11/04/1998	61.7
White Clay Spring	CH981124BGS002	Spring	11/24/1998	45.9



Waterfall Spring

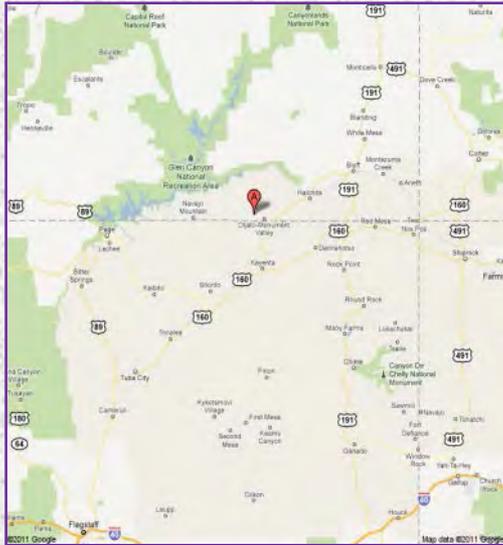


White Clay Spring



Claim 28 Mine

# Monument Valley Area: Skyline Mine, Oljato Chapter



**Mary Helen Begay (right), a member of the Cly-Begay family who lives at base of Oljato Mesa, has been active in advocating for cleanup of Skyline Mine and for community health studies. The family is featured in the documentary, *Return of Navajo Boy* (<http://navajoboy.com/>).**



# Cove Mesa Area: Cove Uranium Ore Transfer Stations

Two uranium ore transfer stations located in Cove Chapter (map on left) were the sites of removal of radioactive wastes by USEPA and Navajo EPA in 2012. The two sites were contaminated by years of dumping and storing uranium ore removed from mines on nearby mesa slopes. Radiation surveys showed high levels of gamma radiation near homes (middle map) and a school (right map). *Maps courtesy USEPA.*

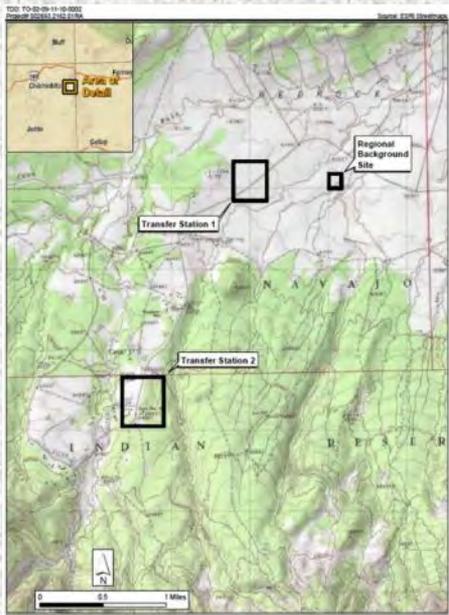
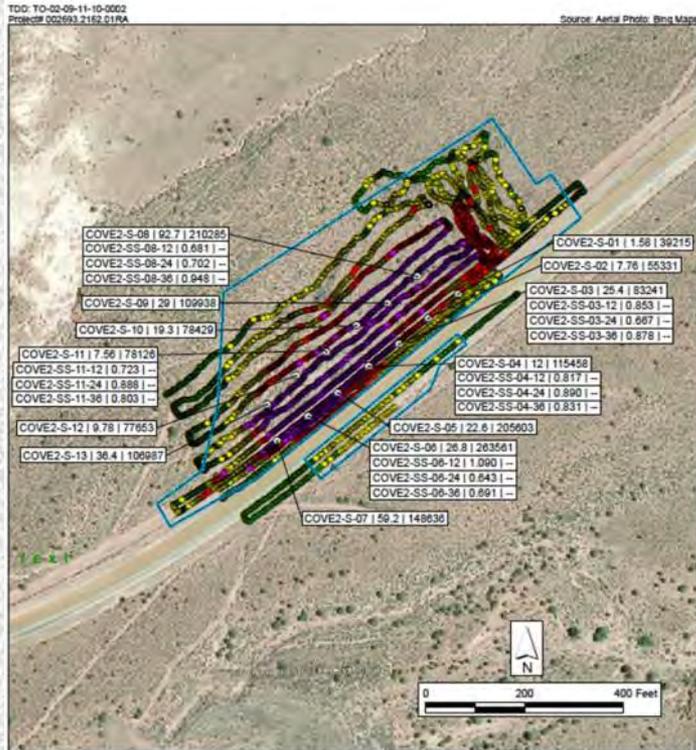


Figure 1  
Site Location Map  
Cove, Apache County, Arizona



**LEGEND**

- Proposed excavation boundary
- Ra-226 soil sample location

**Gamma Activity (cpm)**

- 0 - 36,043
- 36,044 - 46,907
- 46,908 - 79,499
- >79,500

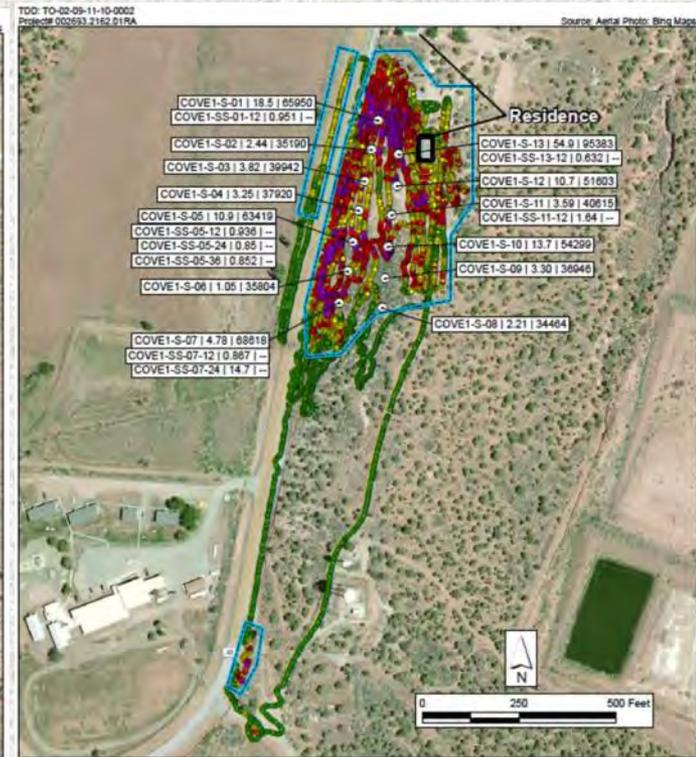
**ABBREVIATIONS**

cpm counts per minute  
pCi/g picocuries per gram  
Ra-226 Radium-226

Gamma Activity (cpm)	Correlated Ra-226 Concentration (pCi/g)
0 - 36,043	0 - 2.0
36,044 - 46,907	2.1 - 4.9
46,908 - 79,499	4.1 - 10.0
>79,500	>10.1

Depth	Sample ID	Ra-226 (pCi/g)	One Minute Gamma Activity Count (cpm)
Surface	COVE2-S-08	50.7	250,386
Subsurface	COVE2-S-08-36	9.706	---

Figure 3  
Transfer Station 2  
Surface Gamma Activity and  
Ra-226 Soil Sampling Locations  
Cove, Apache County, Arizona



**LEGEND**

- Proposed excavation boundary
- Ra-226 soil sample location

**Gamma Activity (cpm)**

- 0 - 36,043
- 36,044 - 46,907
- 46,908 - 79,499
- >79,500

**ABBREVIATIONS**

cpm counts per minute  
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Ra-226 Radium-226

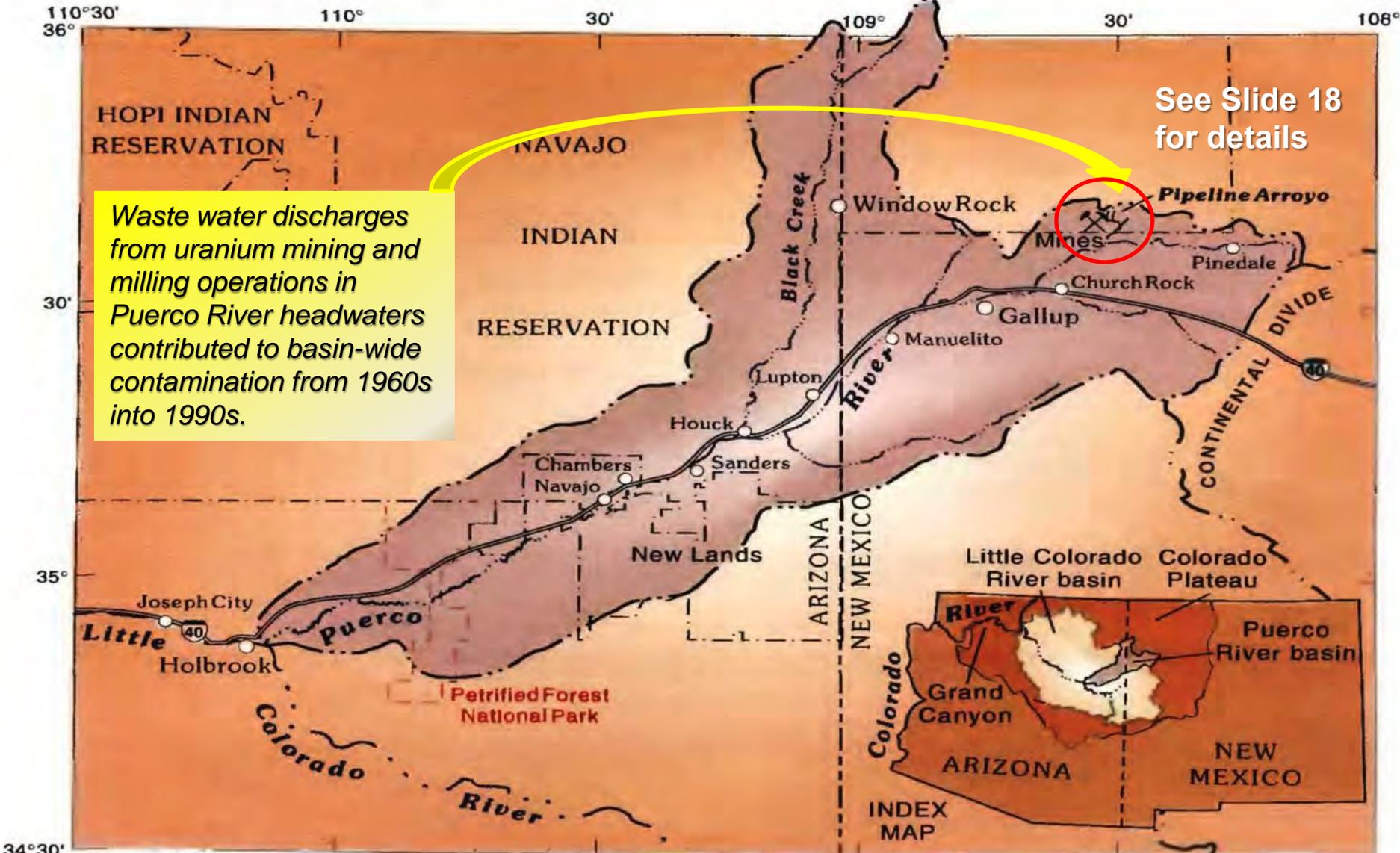
Gamma Activity (cpm)	Correlated Ra-226 Concentration (pCi/g)
0 - 36,043	0 - 2.0
36,044 - 46,907	2.1 - 4.9
46,908 - 79,499	4.1 - 10.0
>79,500	>10.1

Depth	Sample ID	Ra-226 (pCi/g)	One Minute Gamma Activity Count (cpm)
Surface	COVE1-S-01	0.305	65,950
Subsurface	COVE1-S-01-L2	0.951	---

Figure 2  
Transfer Station 1  
Surface Gamma Activity and  
Ra-226 Soil Sampling Locations  
Cove, Apache County, Arizona

In the maps above, green dots indicate “background,” or natural radiation levels. Yellow, red and purple dots indicate increasing levels of gamma radiation indicative of mining-related contamination.





*Waste water discharges from uranium mining and milling operations in Puerco River headwaters contributed to basin-wide contamination from 1960s into 1990s.*

See Slide 18 for details

Base from U.S. Geological Survey 1:24,000 and 1:62,500 quadrangles

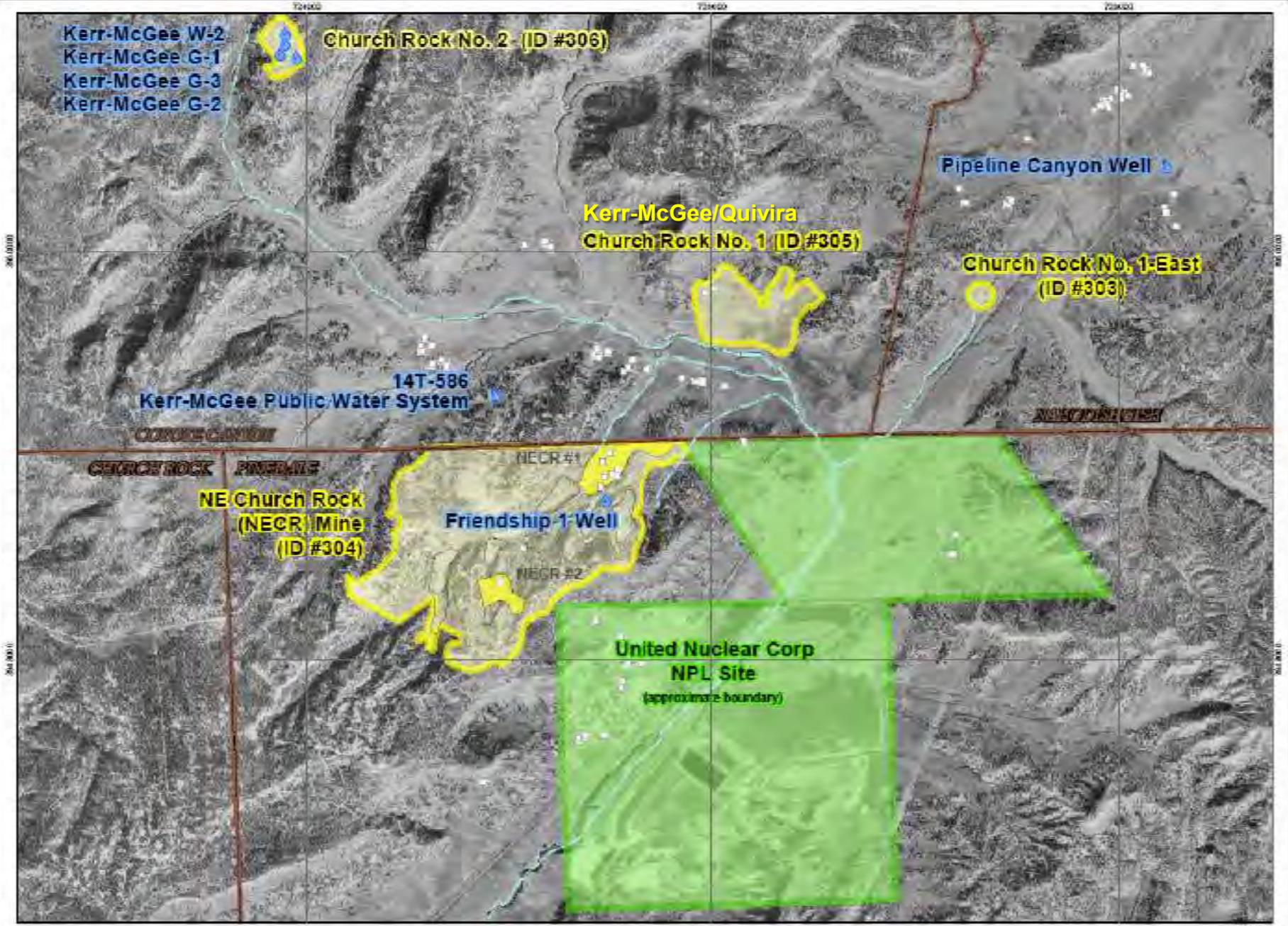
0 25 MILES  
0 25 KILOMETERS

Puerco River Basin, New Mexico and Arizona. USGS WRI 94-4192, p. 4.

# Puerco River Contaminant Source: Church Rock Uranium Mill Tailings Spill,\* July 16, 1979

**\*Largest release of radioactive wastes, by volume, in US history**





Kerr-McGee W-2  
 Kerr-McGee G-1  
 Kerr-McGee G-3  
 Kerr-McGee G-2

Church Rock No. 2 (ID #306)

Kerr-McGee/Quivira  
 Church Rock No. 1 (ID #305)

Pipeline Canyon Well

Church Rock No. 1-East  
 (ID #303)

14T-586  
 Kerr-McGee Public Water System

NE Church Rock  
 (NECR Mine  
 ID #304)

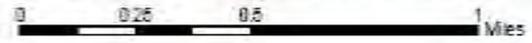
Friendship-1 Well

United Nuclear Corp  
 NPL Site  
 (approximate boundary)

Preliminary Review Draft Map  
 prepared June 13, 2005



CHURCH ROCK ABANDONED URANIUM MINES AND MILL



- Legend**
- AUM Sites  
AUM name and Mine ID from  
 Combined Pathways Score Table
  - Structures
  - Wells
  - Drainages

TSD-05140.1

# Northeast Church Rock Mine and Red Water Pond Road Community, 1972-2009

1972



Mine water discharges to Pipeline Arroyo, 1969-1983: More radioactivity released to Puerco River system by mine dewatering than 1979 tailings spill.

CRUMP radiation monitoring, 2002



1<sup>st</sup> removal action, 2007



3<sup>rd</sup> removal action, 2012



2<sup>nd</sup> removal action, 2009



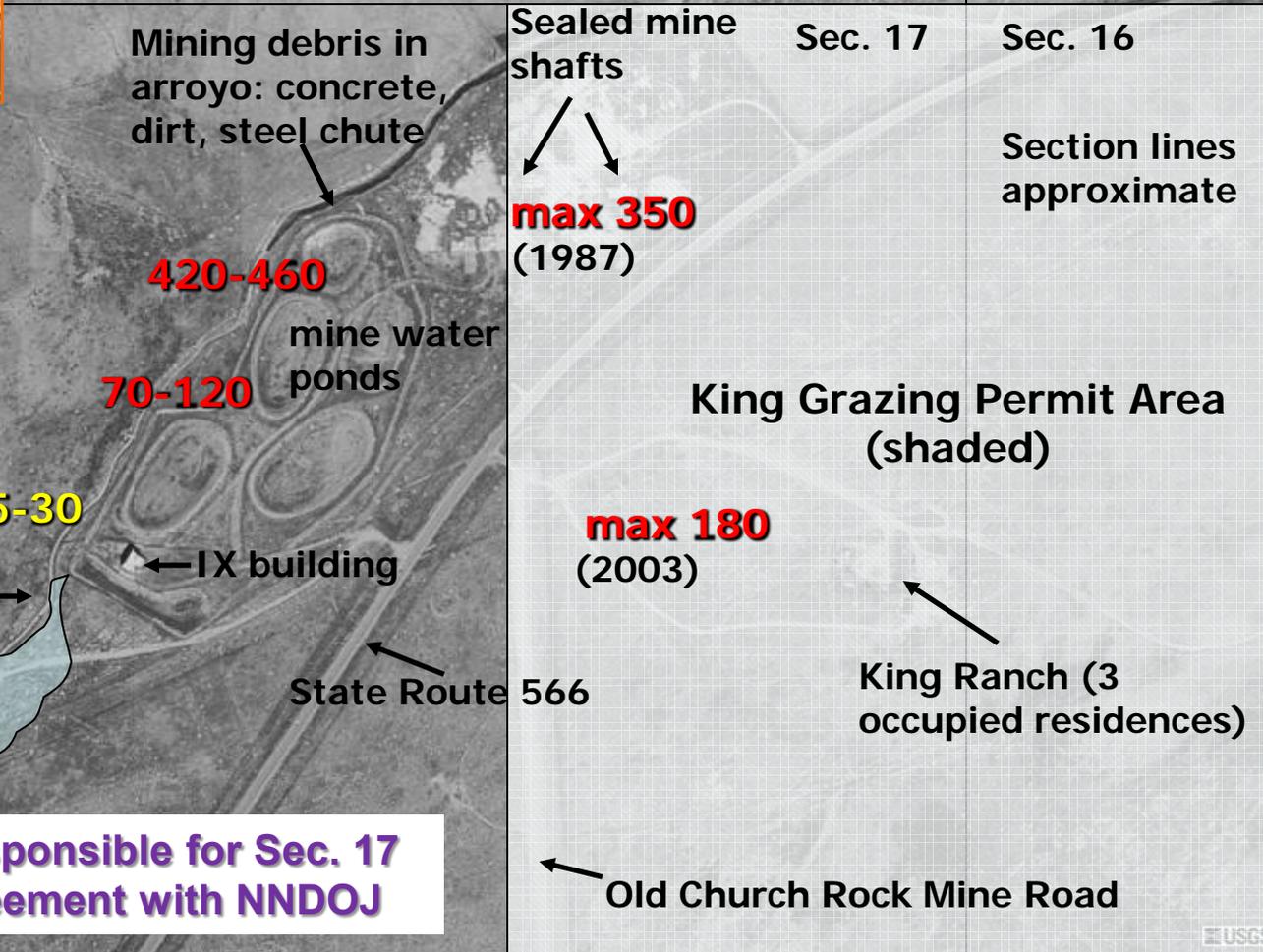
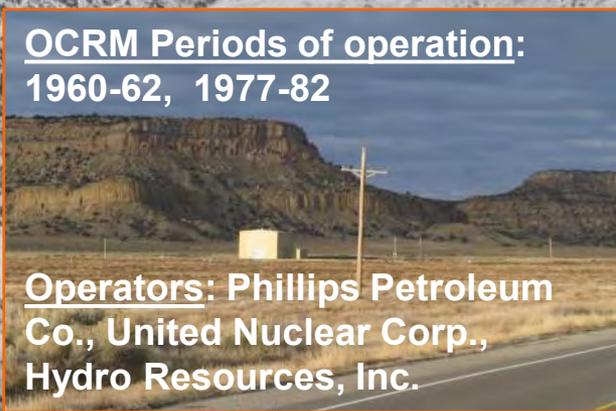
# Old Churchrock Mine site assessment after flood event, August 2006\*

(Gamma radiation rates in micro Roentgens per hour [ $\mu\text{R/hr}$ ]; background rate, 11-13  $\mu\text{R/hr}$ )

OCRM Periods of operation:

1960-62, 1977-82

Operators: Phillips Petroleum Co., United Nuclear Corp., Hydro Resources, Inc.



Approximate shape of mud delta at mouth of arroyo after flood event

**\*2013 Status: HRI/URI responsible for Sec. 17 cleanup under 2012 agreement with NNDOJ**

# Locations of home sites next to Mariano Lake Mine; radiation levels surveyed, 2009-10

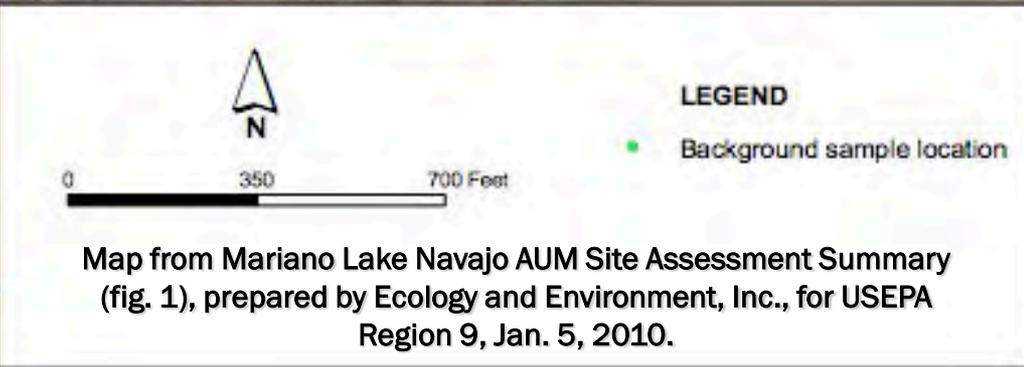
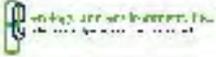
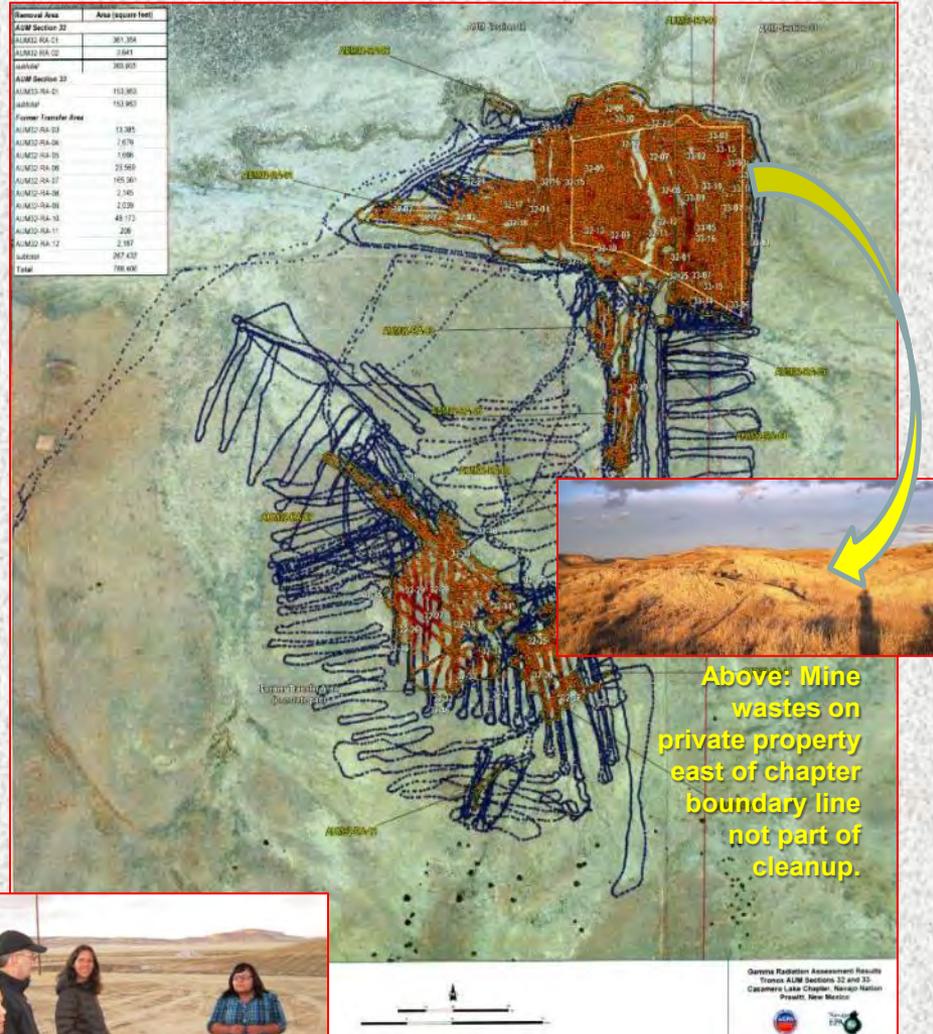
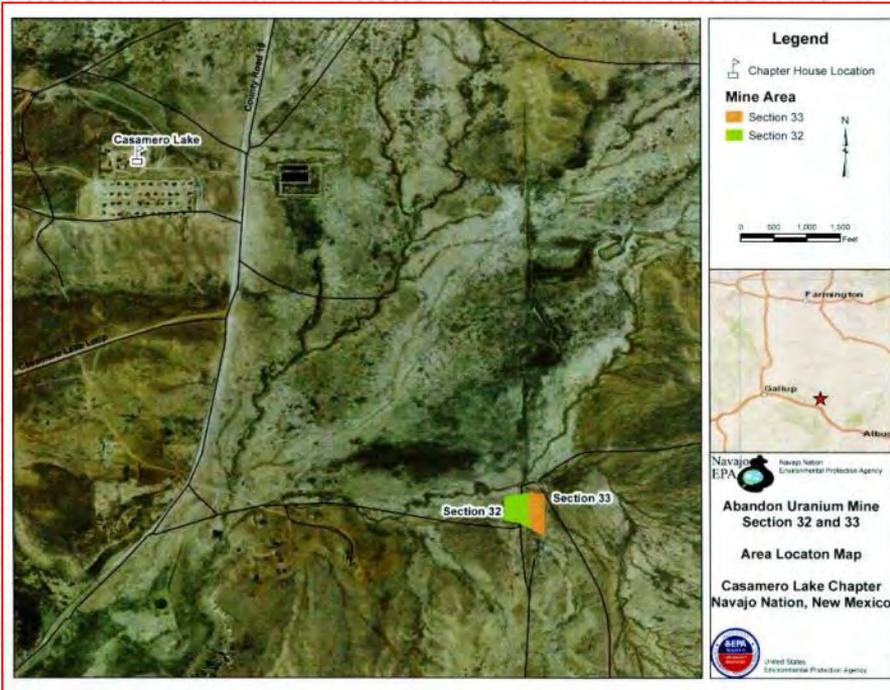


Figure 1  
**Background and Homesite  
Location Map**  
Navajo Radiation Removal  
Mariano Lake  
Navajo Nation Reservation

Map from Mariano Lake Navajo AUM Site Assessment Summary (fig. 1), prepared by Ecology and Environment, Inc., for USEPA Region 9, Jan. 5, 2010.



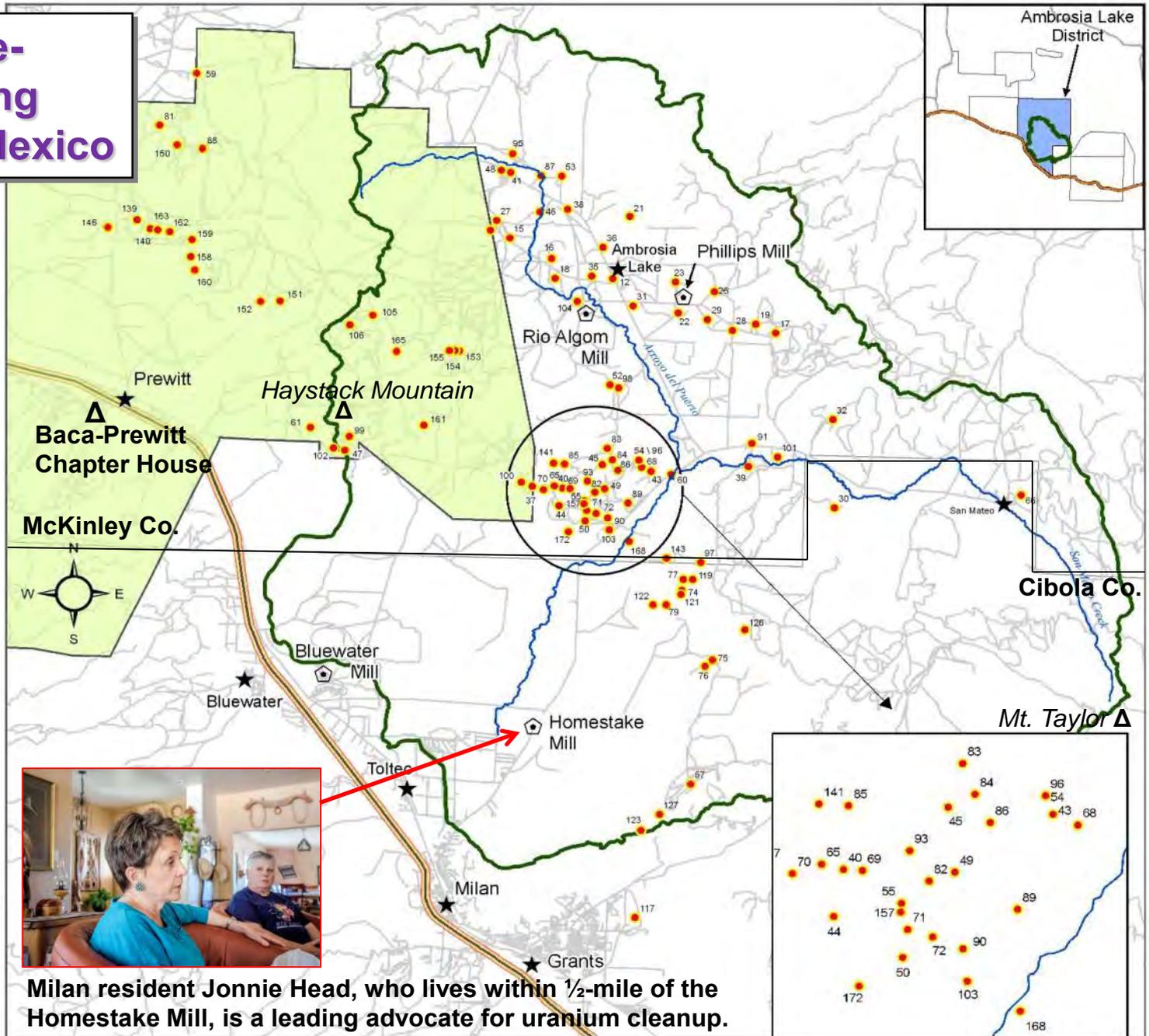
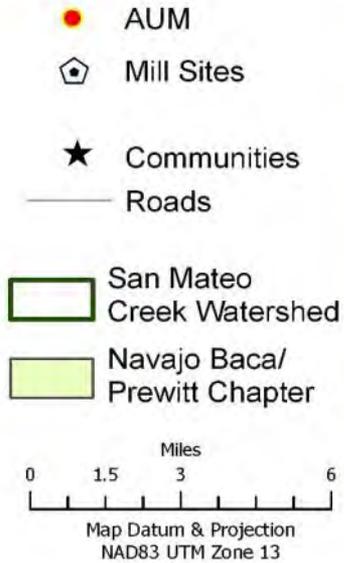
# Section 32-33 Mine Sites, Casamero Lake Chapter



USEPA consolidated uranium mine wastes and covered them with clean dirt and riprap in “interim action” in Fall 2012.

Local residents who live 0.25-mile west of site confer with USEPA and NAIHS officials.

# Ambrosia Lake-Haystack Mining District, New Mexico



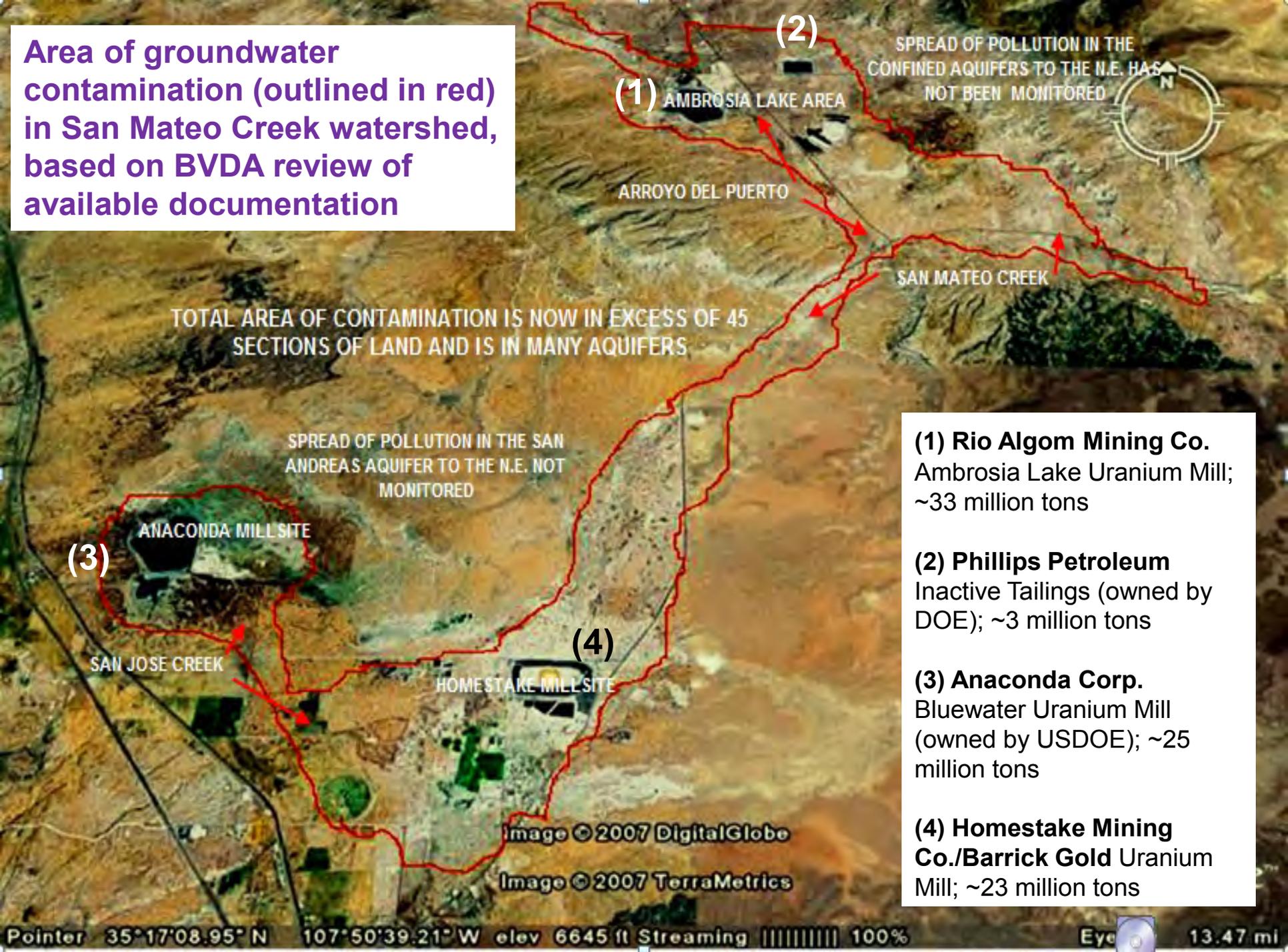
Created by New Mexico Mining & Minerals Div. , Jan 2009

Data: Mines & Mills from Mining & Minerals Div. (NM Energy, Minerals & Nat. Res. Dep.) and NM Bureau of Geology and Mineral Resources; base layers from ESRI and NM Resource GIS Program (<http://rgis.nm.edu>), US Census Bureau, Navajo AML Reclamation Program



**Milan resident Jonnie Head, who lives within 1/2-mile of the Homestake Mill, is a leading advocate for uranium cleanup.**

Area of groundwater contamination (outlined in red) in San Mateo Creek watershed, based on BVDA review of available documentation



SPREAD OF POLLUTION IN THE CONFINED AQUIFERS TO THE N.E. HAS NOT BEEN MONITORED

TOTAL AREA OF CONTAMINATION IS NOW IN EXCESS OF 45 SECTIONS OF LAND AND IS IN MANY AQUIFERS

SPREAD OF POLLUTION IN THE SAN ANDREAS AQUIFER TO THE N.E. NOT MONITORED

**(1) Rio Algom Mining Co.**  
Ambrosia Lake Uranium Mill;  
~33 million tons

**(2) Phillips Petroleum**  
Inactive Tailings (owned by DOE); ~3 million tons

**(3) Anaconda Corp.**  
Bluewater Uranium Mill  
(owned by USDOE); ~25 million tons

**(4) Homestake Mining Co./Barrick Gold**  
Uranium Mill; ~23 million tons

Image © 2007 DigitalGlobe  
Image © 2007 TerraMetrics

# Jackpile Mine, Laguna Pueblo, NM

35.135638N, -107.331767W T11N, R5W, Secs. 26, 35

Years Operated: 1953-1982

Operator: Anaconda Co.

Production: 400 million tons earth moved, 24 million tons U ore

Status: Reclamation, 1989-1995; currently off limits to humans, livestock;  
added to the Superfund National Priorities List in 2012



Paguate Village resident Larry Lente discusses mine reclamation with NIEHS director Lynda Birnbaum, March 2013.



Dorothy Purley, who drove an ore-hauling truck at the Jackpile Mine, was a leading advocate for reclamation and health studies prior to her death from cancer in 2003.

Photo showing mine at height of production in 1979.

# St. Anthony Mine, Cebolleta Land Grant (Laguna District)

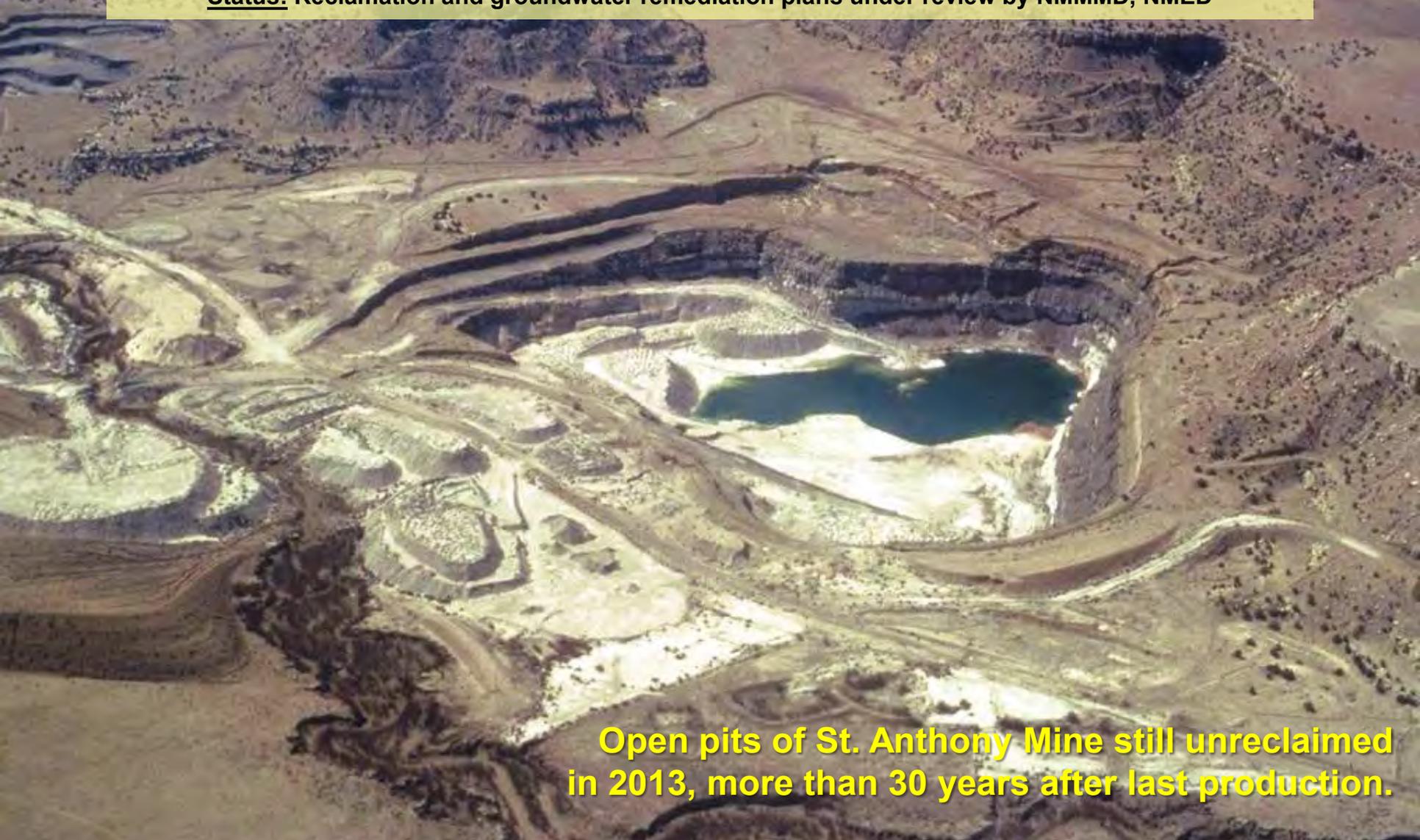
11N, 4W, Sec. 30.243; 35.15909N, -107.30614W

Period of Operation: 1951-1982

Production: 78,722 tons ore (pre-71); no data after 1971

Operators: Hanosh Mines; St. Anthony Uranium Co.; American Metal-Climax Corp.; United Nuclear Corp.

Status: Reclamation and groundwater remediation plans under review by NMMMD, NMED



**Open pits of St. Anthony Mine still unreclaimed in 2013, more than 30 years after last production.**