Kimberly MacMillan

From: **Eugene Spiering** <espiering@quaterra.com>
Date: Mon, May 2, 2011 at 10:58 PM
Subject: No AZ DEIS Comments
To: Scott Florence <azasminerals@blm.gov>

Mr. Florence,

Please find comments to the Northern AZ Proposed Withdrawal DEIS attached.

Regards,

Gene

Eugene D. Spiering

VP Exploration/Director

Quaterra Resources Inc.

#1100 - 1199 West Hastings St.

Vancouver, BC
Canada V6E 3T5

Tel. 604 681 9059

Fax 604 688 4670
email: espiering@quaterra.com

website: www.quaterraresources.com

May 3, 2011

Mr. Scott Florence
District Manager
Arizona Strip District Office
U. S. Bureau of Land Management
345 East Riverside Drive
St. George, Utah 84790-6714

Subject: Comments on the Draft Environmental Impact Statement for the Northern Arizona Proposed Withdrawal

Dear Mr. Florence:

QUATERRA RESOURCES INC. (Quaterra) focuses on making significant mineral discoveries in North America because our company believes in the importance of maintaining a viable and environmentally responsible domestic minerals industry that will benefit the economic health and long range energy security of the United States.

The Company uses in-house expertise and its pipeline of consultants, prospectors and industry contacts to identify, acquire and evaluate prospects with the greatest potential to host large and/or high-grade base, precious metal or uranium deposits. Quaterra is actively exploring prospects in Nevada (copper), Mexico (gold-silver), Texas and Montana (molybdenum) and Arizona (uranium).

Since commencing uranium exploration in 2005, the Company has invested more than $12 million in the Arizona Strip; a figure that represents approximately 30% of the Company's total exploration expenditures in North America. This local investment, along with the ongoing investment of several other resource companies, has been placed at significant risk by the proposed withdrawal of over 1 million acres of federal land.

When combined with prior withdrawals and other prohibitions in the area, an astonishing 6,818 square miles or approximately 4.36 million acres of land with extraordinary mineral potential will be lost to development. To put this in perspective, lands removed from mineral entry will be greater than the combined areas of the District of Columbia, Rhode Island and Delaware and accounts for nearly 6% of the entire state of Arizona.

The avowed purpose of the proposed withdrawal is to protect the natural, cultural and social resources of the Grand Canyon watershed from mineral exploration and development. In such a situation, the burden of proof lies squarely with the DOI to show that such activities represent a clear and present danger. The report fails to do this. Ten of the fifteen potential environmental consequences are judged in the DEIS to have no to minimal impact, and three others only minor to moderate impact. Most important, the

report describes the impact on the Virgin and Colorado Rivers as negligible. Potential contamination of the Colorado River was the principal trigger for the withdrawal.

NORTHERN ARIZONA PROPOSED WITHDRAWAL-DRAFT EIS
ENVIRONMENTAL CONSEQUENCES

ISSUE	IMPACT
Air Quality	Future exploration/development to comply with existing laws
Cultural Resources	No direct impacts to historic or prehistoric sites
American Indian Resources	No tribal trust resources or assets within proposed withdrawal area
Economic Conditions	Tourist activity and associated employment would not be affected
Fish and Wildlife	Impacts not anticipated to alter overall fish and wildlife populations
Geology and Mineral Resources	Withdrawal would cause a moderate to major long-term impact to availablity of uranium resources
Recreation	Benefit driving for pleasure, adversely impact primitive recreation opportunities, of which none exist in withdrawal area
Social Conditions	No disproportionate health or environmental impacts as a result of any alternatives
Soils	Minor to moderate
Soundscapes	Temporary increases in ambient noise levels in immediate vicinity of exploration/development sites
Special Status Species	Impacts not anticipated to alter special status species populations
Vegetation Resources	Minor long term impact on the productivity of aquatic and terrestrial habitats
Visual Resources	Potential minor to moderate long-term impact
Water Resources	Impact on Colorado and Virgin Rivers is none or negligible
Wilderness	No direct impacts on designated or proposed wilderness characteristics

Any search for clean and abundant energy with a minimal carbon footprint would inevitably lead to the vast uranium resources of the Arizona Strip. The unique mineralization of the area continues to attract the interest of the United States Geologic Survey (USGS) and resource companies because it hosts some of the largest and highest grade uranium deposits in the U.S. And, when compared to other uranium deposits in the country, the USGS (Otton, et.al. 2010) describes the study area as "having the potential of becoming the second most important uranium-producing region in the United States".

The uranium resource endowment of the Arizona Strip should not be in question. Two USGS studies have estimated an endowment in excess of 320 million lbs. yet the DEIS has incorrectly referenced a highly subjective and inaccurate comment made over 22 years ago in a single publication with no supporting data to reduce this endowment to a mere 45 million lbs. Even the (August 2010) BLM Mineral Report on the mineral potential of the proposed withdrawal area classifies the uranium potential as "(H/D)"; the highest classification possible for both potential and level of certainty and goes on to conclude, "*Failure to develop uranium resources on the subject lands .... has far reaching economic implications, which are beyond the scope of this report.*"

The assumption made in the DEIS that uranium pipes are uniformly distributed throughout the area and that the potential loss of uranium is directly proportional to the number of acres withdrawn, not which lands are withdrawn is a huge mistake. Nearly all the known mineralized pipes and all of the economically viable uranium deposits in the region have been found in a N-S trending mineralized "corridor" that is approximately 45 miles wide by 110 miles long. The hundreds of pipes mapped outside of this corridor are

barren. All of the proposed withdrawal area is within this corridor because the area of proposed withdrawal was selected by drawing a line around the focus of the claim staking activity. Most of the remaining corridor has already been withdrawn from mineral entry. Consequently, any withdrawal aside from Alternative "A" (no action) will irreparably and permanently destroy the potential development of the district.

The position of the mineralized corridor and the total number of mineralized pipes in the subject area can be estimated by examining the outcropping pipes in the Grand Canyon. The attached comments use data from all known deposits in the proposed withdrawal area and an examination of breccia pipes in the Grand Canyon to develop a third and independent estimate of the uranium endowment of the subject area. The estimate is surprisingly close to previous estimates by the USGS.

Perhaps the most erroneous assumption in the DEIS is that resources of the district are not capable of sustaining mining for 20 years. At an average production of 1.5 million lbs of uranium per year per mine, an average of 3 million lbs produced per mine, and even using a gradual ramp-up of production, six continuously operating mines could produce 160.5 million lbs in 20 years; only one half the total estimated endowment of the subject lands.

The underestimate of the districts resources and productive capacity has resulted in a seriously flawed discussion of economic impacts. The loss of jobs and income for the Fredonia-Kanab area are grossly underestimated as are the enormous loss of tax revenues to Federal, state, and local governments.

Moreover, the EIS is strangely silent on a number of issues germane to a decision on whether to withdraw these lands from mineral exploration and development, and more importantly would give an uninformed reader a sense of perspective and balance. These issues include 1) the contamination of the entire area by atmospheric testing of atomic devices by the US government; 2) the 1984 Wilderness act which set aside this area for multiple use activities based on the best science of the day and participation by both industry and environmental groups; and 3) the safe and successful exploration, mining and reclamation of seven pipes by Energy Fuels from 1980-1989 which demonstrated conclusively that uranium mining does not represent a threat to the environment.

The uranium mineralization of Arizona Strip district represents the most profitable per pound hard rock production in the US while having one of the smallest surface disturbances and environmental impacts of any uranium production in the world. The implementation of any alternative (other than "A" no action) will destroy forever a district that has the energy equivalent of all the recoverable oil in Prudhoe Bay - North America's largest oil field. This district is truly a "crown jewel" of the country and a withdrawal of its resources should not be taken lightly in these difficult economic times with widespread unemployment and an insatiable dependency on costly foreign energy.

Indeed, if the goal were to identify areas where uranium exploration and development would have the best chance of success with the least impact on the environment, the

Arizona Strip would win hands down. It is an affront to the citizens of the United States, Arizona and the towns of Fredonia and Kanab to remove this land from mineral entry.

Many of Quaterra's geological team that contributed to the following comments were part of the former exploration arm of Energy Fuels Nuclear, Inc. Together they have more than 50 years of experience in uranium exploration in the Arizona Strip district. The exploration, development and resource data presented in these comments are a result of that experience.

LEGAL DESCRIPTION OF THE WITHDRAWAL

Section 204 of the Federal Land Policy Act of 1976 requires "a legal description of the entire land area that falls within the exterior boundaries of the affected area…" While the DEIS states in several sections that the lands were identified by "legal description" in the *Federal Register* notice of July 21, 2009, this notice simply listed the townships that were included in the proposed withdrawal, which does not constitute a legal description. Had legal descriptions been provided, a comparison of active claim boundaries with the proposed withdrawal area could have been properly conducted.

Another related issue is the presence of "split estates" or land parcels within the withdrawal area that have separate surface and mineral ownership. Unfortunately, all maps in the DEIS that show ownership or control of the lands within the proposed withdrawal area are based on surface ownership rather than mineral ownership. Having at least one map in the DEIS that shows mineral ownership would make it easier to identify the split-estate sections where mineral control may not be subject to the withdrawal. Obviously, the presence of extensive split estate parcels would substantially change the key assumptions listed in the DEIS, specifically those relating to the Reasonably Foreseeable Development (RFD) scenarios discussed in Appendix B.

RIGHTS OF WAY

There is a significant unaddressed issue of rights-of-way across federal lands in the withdrawal area. Federal land access to either State Trust or private lands for mineral exploration projects, or for any roads or utility easements required for new mine development, previously required a right-of-way agreement with either the Bureau of Land Management (BLM) or the U. S. Forest Service (USFS).

If a withdrawal is authorized, the DEIS does not address the inability of a permittee on state or private lands to obtain a right-of-way across the federal lands that are closed to mineral location or entry. This issue also relates to private, state and public lands that are outside the withdrawal boundary but are essentially unavailable for mineral entry because these isolated parcels of lands are essentially landlocked by previously withdrawn federal lands.

Clearly, this is a significant omission in the DEIS because these right-of-way limitations would serve to effectively increase the withdrawal area without an appropriate evaluation of impacts as required in the NEPA process.

FLAWED URANIUM RESOURCE ESTIMATES

A significant basis for nearly every assumption and comparative analysis in the DEIS is the size of the endowment area, the number of mineralized breccia pipes and the average uranium resource of a mineralized breccia pipe. Lacking a basic understanding of the principles of breccia pipe formation, subsequent mineralization and the mechanics of breccia pipe exploration and eventual development, the DEIS constructs a seriously flawed RFD that significantly understates the massive mineral potential of the area.

There are literally thousands of breccia pipes in northern Arizona. The USGS Open File Report (OFR-89-550) shows the mapped locations of 1,296 pipes in northern Arizona.

The assumption made on page B23, Appendix B, that only "15% of the mineralized pipes could be economical to mine" is seriously flawed and the justification that "further discussions with industry experts…did not lead to a refinement of this assumption" reflects a clear bias towards minimizing the impacts of the withdrawal or a serious lack of understanding of the economic mineral potential of the subject area.

The discussion of this assumption under Undiscovered Uranium Reserves (page B26 paragraph 2) of the DEIS cites a paper by Weinrich and Sutphin (1988) as suggesting that less than 10% of the mineralized pipes might be economically feasible. The only comment in the 1988 reference related to this conclusion is:

> *"Although thousands of pipes may exist, only a small fraction of these, probably less than 8 percent, were mineralized, and an even smaller percentage of these, perhaps less than 10 percent, contain economic concentrations of minerals."*

Yet the Weinrich and Sutphin study continues by stating:

> *"The potential for additional economic mineralized breccia pipes is enormous and is greatest beneath the flat plateaus where erosion and oxidation of the ore have been minimized."*

The latter comment is referring to areas not in the Grand Canyon and is specifically relevant to the subject area of the DEIS. It is the former qualitative comment published over 22 years ago with no supporting data that has been used to erroneously determine both the total potential economic resource of the proposed withdrawal area and virtually every resulting impact.

As a result of this single publication and speculation about what grades might be economically mined, the DEIS study reduces to a mere 45 million lbs. U3O8 (uranium) a potential resource endowment of 326 million lbs. as estimated by the USGS (Otton, et.al.

2010). Because more than 90% of all known mineralized pipes lie in a N-S trending mineralized corridor 45 miles wide by 110 miles long, the impact of the proposed withdrawal will seriously affect the potential development (for 20 years and probably forever) of the only uranium mineralized area in a region that the USGS has described as "having potential of becoming the second most important uranium-producing region in the United States" and having the energy *"equivalent to 13.3 billion barrels of oil" (Singh, 2008, ADMMR No. 49)* or the equivalent to Prudhoe Bay, North America's largest oil field.

The only way to accurately estimate the potential uranium resource of the Northern Arizona Proposed Withdrawal Area (NAPWA) is to look at the results of exploration drilling in the subject area. By the end of 2009, a total of 45 breccia pipes have been confirmed in the NAPWA by deep holes drilled from the surface to explore the favorable Hermit shale horizon for uranium mineralization. The approximate location of each of these pipes is shown in Figure 1.

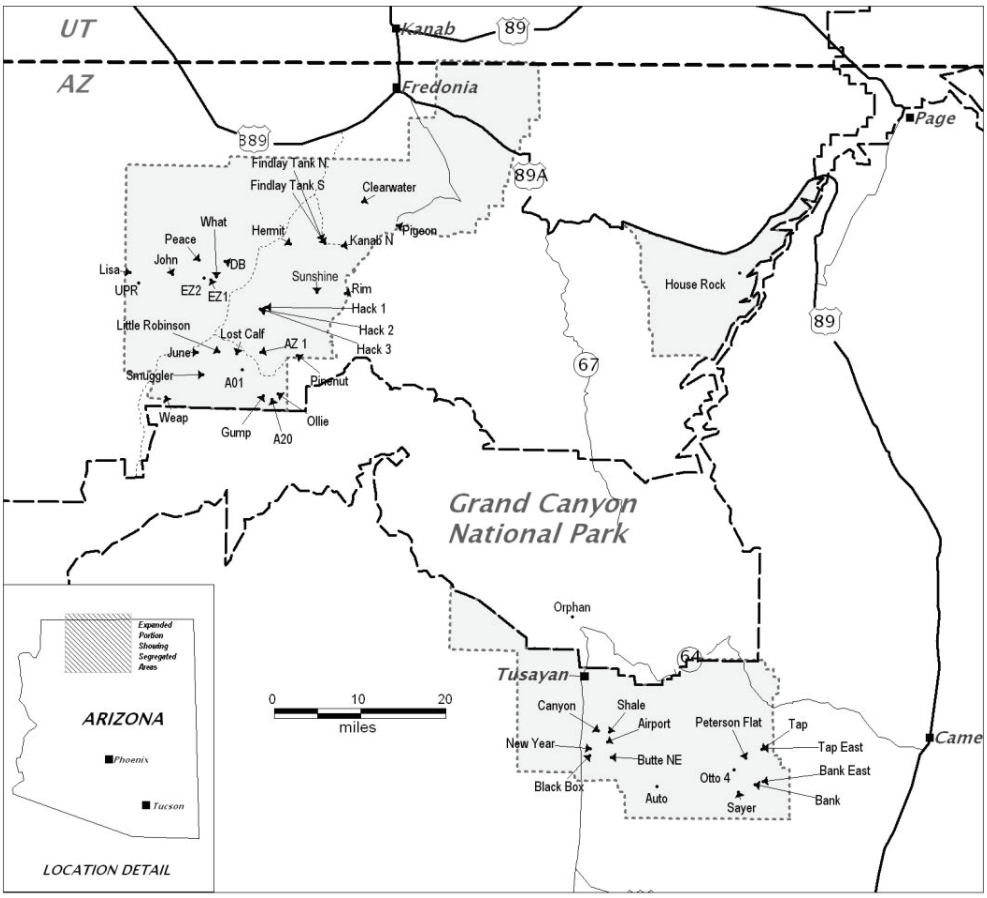


Figure 1: Map of the NAPWA showing the location of breccia pipes confirmed by exploration drilling.

These 45 confirmed breccia pipes include 16 uranium deposits defined as occurrences with estimated resources thought to exceed 100,000 lbs. of U3O8, 19 mineralized pipes

where uranium mineralization has been identified by drilling, but no estimate has been made or drill hole data are insufficient to define a resource total in excess of 100,000 lbs., and 10 pipes with an undetermined status where drilling has encountered breccia below the lower Toroweap horizon but the amount of drilling to date has not been sufficient to delineate uranium mineralization (Table 1).

January 15, 2010								Resource Estimate (4)			Production		
Pipe Name (1)	Sec	Tnshp	Rng	Deep Holes(2)	Surface Resource Drilling	Underground Drilling	Status(3)	Total Tons(4)	Grade % eU3O8	Pounds eU3O8	Total Tons(5)	Grade % eU3O8	Pounds eU3O8
SOUTH KAIBAB NATIONAL FOREST													
Airport	28	29N	3E	1	Partially Tested	None	Mineralized Pipe	No known estimates					
Auto	21	28N	4E	2	Partially Tested	None	Mineralized Pipe	No known estimates					
Bank	20	28N	6E	2	Partially Tested	None	Undetermined	No known estimates					
Bank East	21	28N	6E	1	Partially Tested	None	Undetermined	No known estimates					
Black Box	6	28N	3E	20	Partially Tested	None	Mineralized Pipe	No known estimates					
Butte NE	4	28N	3E	3	Partially Tested	None	Mineralized Pipe	No known estimates					
Canyon	**20**	**29N**	**3E**	**19**	**Resource Est. (Denison)**	**None**	**Uranium Deposit**	**70,500**	**1.08**	**1,523,000**			
New Year	31	29N	3E	22	Partially Tested	None	Mineralized Pipe	No known estimates					
Otto 4	12	28N	5E	16	Partially Tested	None	Mineralized Pipe	No known estimates					
Peterson Flat	6	28N	6E	2	Partially Tested	None	Undetermined	No known estimates					
Sayer	25	28N	5E	1	Partially Tested	None	Undetermined	No known estimates					
Shale	21	29N	3E	2	Partially Tested	None	Mineralized Pipe	No known estimates					
Tap 2	33	29N	6E	1	Partially Tested	None	Undetermined	No known estimates					
Tap East	33	29N	6E	4	Partially Tested	None	Mineralized Pipe	No known estimates					
ARIZONA STRIP													
A01	32	36N	5W	16	Partially Tested	None	Mineralized Pipe	No known estimates					
A20	13	35N	5W	4	Partially Tested	None	Mineralized Pipe	No known estimates					
Arizona 1	**22**	**36N**	**5W**	**22**	**Resource Est. (Denison)**	**U/G Defined**	**Uranium Deposit**	**70,300**	**0.68**	**956,000**			
Clearwater	22	39N	3W	16	Partially Tested	None	Mineralized Pipe	No known estimates					
DB	**25**	**38N**	**6W**	**19**	**Prelim. Estimate (EFN)**	**None**	**Uranium Deposit**	**103,649**	**0.44**	**905,321**			
EZ1	**11**	**37N**	**6W**	**34**	**Resource Est. (Denison)**	**None**	**Uranium Deposit**	**110,500**	**0.51**	**1,127,000**			
EZ2	**3**	**37N**	**6W**	**47**	**Resource Est. (Denison)**	**None**	**Uranium Deposit**	**113,700**	**0.43**	**978,000**			
Findlay Tank NW	**13**	**38N**	**4W**	**19**	**Prelim. Estimate (U1)**	**None**	**Uranium Deposit**	**14,351**	**0.40**	**114,234**			
Findlay Tank SE	**13**	**34N**	**4W**	**27**	**Prelim. Estimate (U1)**	**None**	**Uranium Deposit**	**211,000**	**0.23**	**954,000**			
Gump	14	35N	5W	6	Partially Tested	None	Mineralized Pipe	No known estimates					
Hack 1	**26**	**37N**	**5W**	**99**			**Uranium Deposit**	**Mined Out**			**133,822**	**0.530**	**1,419,623**
Hack 2	**27**	**37N**	**5W**	**35**			**Uranium Deposit**	**Mined Out**			**497,099**	**0.704**	**7,000,273**
Hack 3	**27**	**37N**	**5W**	**3**			**Uranium Deposit**	**Mined Out**			**111,263**	**0.504**	**1,121,748**
Hermit	**17**	**38N**	**4W**	**33**			**Uranium Deposit**	**Mined Out**			**36,339**	**0.760**	**552,449**
John	**1**	**37N**	**7W**	**17**	Partially Tested	**None**	Mineralized Pipe	No known estimates					
June	21	36N	6W	3	Partially Tested	None	Undetermined	No known estimates					
Kanab North	**17**	**38N**	**3W**	15	**Prelim. Estimate (EFN)**	**U/G Defined**	**Uranium Deposit**	**36,122**	**0.30**	**216,011**	**260,818**	**0.531**	**2,767,570**
L. Robinson	24	36N	6W	**9**	Partially Tested	None	Mineralized Pipe	No known estimates					
Lisa	**6**	**37N**	**7W**	**14**	Partially Tested	**None**	Mineralized Pipe	No known estimates					
Lost Calf	20	36N	5W	6	Partially Tested	None	Mineralized Pipe	No known estimates					
Ollie	18	35N	4W	7	Partially Tested	None	Mineralized Pipe	No known estimates					
Peace	28	38N	6W	16	Partially Tested	None	Mineralized Pipe	No known estimates					
Pigeon	**5**	**38N**	**2W**	**29**			**Uranium Deposit**	**Mined Out**			**406,794**	**0.643**	**5,651,862**
Pinenut	**21**	**36N**	**4W**	**18**	**Resource Est. (Denison)**	**U/G Defined**	**Uranium Deposit**	**99,200**	**0.44**	**873,000**	**25,807**	**1.020**	**526,350**
Rim	**17**	**37N**	**3W**	**13**	**Prelim. Estimate (EFN)**	**None**	**Uranium Deposit**	**27,891**	**0.35**	**195,850**			
Smuggler	3	35N	6W	3	Partially Tested	None	Undetermined	No known estimates					
Sunshine	14	37N	4W	5	Partially Tested	None	Undetermined	No known estimates					
UPR	8	37N	7W	3	Partially Tested	None	Undetermined	No known estimates					
Weap	14	35N	7W	1	Partially Tested	None	Undetermined	No known estimates					
What	**2**	**39N**	**3W**	**18**	**Prelim. Estimate (EFN)**	**None**	**Uranium Deposit**	**89,626**	**0.25**	**448,713**			
HOUSE ROCK VALLEY													
House Rock	36	38N	5E	2	Partially Tested	None	Mineralized Pipe	No known estimates					
TOTALS	**(45 Pipes)**			**655**				**946,839**	**0.44**	**8,291,129**	**1,471,942**	**0.632**	**19,039,875**

(1) A breccia pipe is considered "drill confirmed" when one or more holes have identified breccia or mineralization in or below the lower Toroweap horizon.

(2) Deep holes are considered all drill holes exceeding 600 feet (183 m) in depth on each pipe with exception of Hack 1 where mineralization could be defined by holes deeper than 100 feet (30.5 m).
(3) Considered a "Uranium Deposit" if a resource estimate exceeds 100,000 lbs. U3O8, "Mineralized Pipe" if drilling has encountered anomalous uranium mineralization but no estimate has been made and/or has not been sufficiently drilled to define in excess of 100,000 lbs. U3O8, "Undetermined" if deep drilling has not yet encountered anomalous uranium mineralization.
(4) U3O8 resource estimates in excess of 100,000 lbs only

Table 1: Inventory of drill confirmed breccia pipes in the NAPWA showing exploration status, resource estimates, and production. (Source: Energy Fuels Nuclear Inc. Internal Memorandum, 1990 updated with published resource estimates by Denison Mines Corp. 43-101 technical reports)

Thus, the number of potentially economic uranium deposits that have already been defined in the NAPWA represents 35% of the total number of breccia pipes discovered to date; not less than 1 % (10% of less than 8%) as suggested by Weinrich and Sutphin (1988) and much more than 15% as used by the DEIS study on page B-23 under 'Known Mineralized Breccia Pipes with No Estimate of Uranium Resources."

To underscore the 35% figure, one must bear in mind that the total production from developed deposits in the NAPWA has historically been more than 2.5 times the amount estimated from surface drilling alone (Table 2).

ENERGY FUELS HISTORIC RESOURCE ESTIMATES VS. PRODUCTION + REMAINING RESERVES							
	Surface Drilling Estimate			Production+Remaining Resource			
Pipe	Thousand Tons	Grade % U3O8	Million lbs. U3O8	Thousand Tons	Grade % U3O8	Pounds U3O8	Ratio (lbs)
Hack 1	132.4	0.37	0.98	133.8	0.53	1.42	1.45
Hack 2	125.4	0.57	1.43	497.1	0.70	7.00	4.90
Hack 3	21.3	0.40	0.17	111.3	0.50	1.12	6.60
Kanab North	83.3	0.45	0.75	296.9	0.50	2.98	3.98
Pigeon	119.4	1.06	2.62	406.8	0.64	5.65	2.16
Pinenut	115.3	0.47	1.09	125.0	0.56	1.40	1.28
Hermit	40.5	0.98	0.80	36.3	0.76	0.55	0.69
Total	**637.5**	**0.61**	**7.84**	**1,607.3**	**0.61**	**20.1**	**2.57**

Table 2: Energy Fuels Nuclear Inc. historic estimates based on surface drilling data compared to actual mine production and remaining resources.

Because much of the mineralization in breccia pipes is hosted in near vertical ring fractures and ore shoots, ore reserves cannot be fully defined with holes drilled from the surface. Consequently, the final determination of a deposit's resource and mineable reserves must include an extensive program of underground drilling. Additional underground drilling on the 19 partially tested pipes could easily raise the 35% figure to well above 50% or 22 potentially economic uranium deposits in the NAPWA.

Yet these estimates represent only a fraction of the total mineral potential of the proposed withdrawal area. All but two (Hack 2 and A01) of the 45 known breccia pipes have reached the surface. Hack 2 and A01 are considered "blind" pipes, because the pipe structures have stopped formation before reaching the surface. Containing 7 million lbs in a single breccia pipe, the blind Hack 2 breccia pipe is also the largest uranium deposit yet found in the district in part because it has not undergone secondary collapse. A realistic estimate of the total mineral potential of the NAPWA must include undiscovered blind pipes as well as those that are manifested at the surface.

An estimate of the total mineral potential must also take into account where the pipes occur and to what stratigraphic level they penetrate. Nearly all the known mineralized pipes and all of the economically viable uranium deposits in the region have been found

in a N-S trending mineralized "corridor" that is approximately 45 miles wide by 110 miles long. All of the proposed withdrawal area is in this corridor because the area was selected by drawing a line around the focus of the claim staking activity. Most of the remaining corridor has already been withdrawn from mineral entry. More than 3 dozen pipes drilled outside of the corridor by Energy Fuels Nuclear had large and well developed pipe structures, but lacked significant mineralization. A withdrawal of the NAPWA would not just impair 12% of the most favourable endowment (Otton and VanGosen, 2010) but would essentially destroy the productive potential of the Northern Arizona uranium district.

For a breccia pipe to be mineralized, it must have penetrated the Coconino Sandstone and preferably the lower Toroweap Formation. Sandstone breccia from the Coconino acts as the principal host for uranium mineralization in the pipes and is believed to be the conduit for uranium mineralization. The Brady Canyon member of the Toroweap is considered an important source for reductants necessary for precipitation of uranium in the pipes (Krewedl and Carisey, 1986).

The Northern Arizona uranium district is unique in the fact that a cross section through the center of the district is visible in the walls of the Grand Canyon. Both the position of the mineralized corridor and the total number of mineralized pipes within it can be estimated by examining these outcrops.

The USGS Open File Report (OFR-89-550) shows the mapped locations of 1,296 pipes in northern Arizona. A total of 379 of these mapped pipes are within the Grand Canyon National Park; many containing high grade uranium mineralization eroding naturally into the Colorado River. A surface scintilometer examination in 1979 of just a few of the naturally occurring pipes in the Park identified four pipes that peaked the instrument with more than 130 times normal background radiation. (One of these pipes, never touched by mining activities, is located in the park above and just NE of the Park Services' Phantom Ranch headquarters.)

A study of the relative pipe densities at different stratigraphic levels provides an estimate of the total number of mineralized pipes to be expected in the NAPWA. More than 90% of all the pipes mapped by the USGS are within the deeper canyons where they are exposed by erosion of the younger strata. Approximately 32 pipes per 100 square miles outcrop in Carboniferous or older strata. This same pipe density or frequency is probable at depth throughout the NAPWA, but the number of known pipes decreases dramatically below the cover of successive layers of younger sediments until fewer than 2 pipes are evident over a surface area of 500 square miles in the upper Triassic sequence (Figure 2). Clearly, the upper level of stoping by collapse varies and many blind pipes occur at depth with no surface evidence of a pipe throat. If these structures penetrate the Coconino Sandstone, an ore body may exist with no pipe feature at the surface.

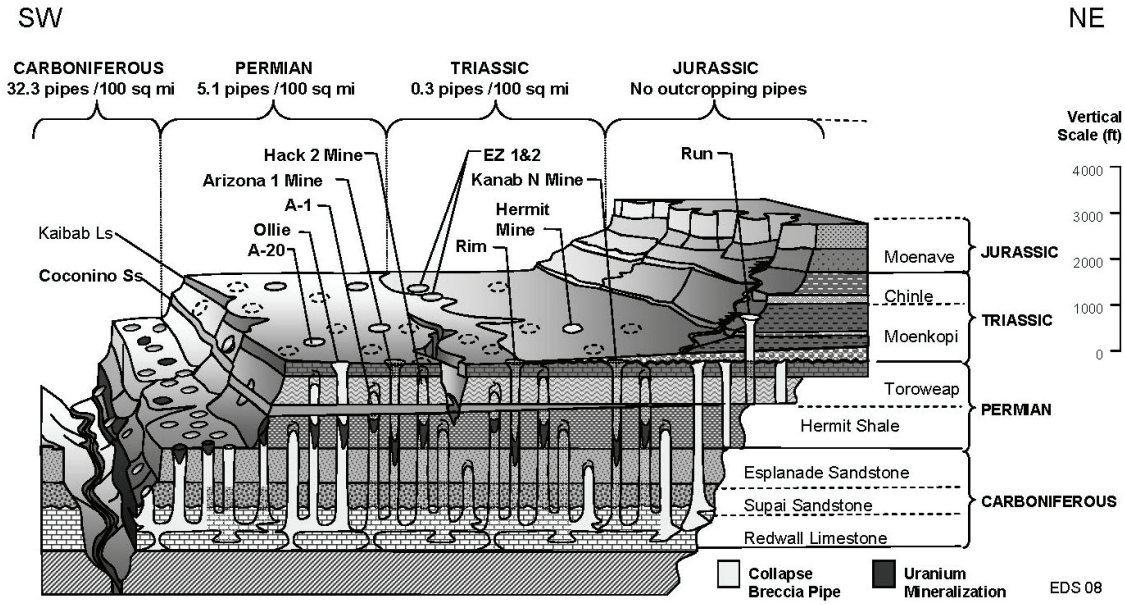


Figure 2: Diagrammatic Cross Section of the Northern Arizona Strip Uranium District showing the approximate frequency and relative distribution of solution collapse breccia pipes within various stratigraphic units. (Source: Spiering, 2010, Exploration and discovery of blind breccia pipes: the potential significance to the uranium endowment of the Arizona Strip District, Northern Arizona - Presentation to SME Annual Meeting-Phoenix, AZ.)

A log-log plot of the relative pipe densities versus the cumulative sedimentary cover is shown in (Figure 3). At the critical lower Toroweap level (thought necessary for a pipe to contain mineralization), the estimated pipe density is approximately 12 pipes per 100 square miles. When this density is multiplied times the 1,689 square mile NAPWA area, a total of approximately 220 pipes might be expected to contain mineralization. If we use the 50% estimate for the number of mineralized pipes within the mineralized corridor that are economically viable from the results of past drilling, then a total of 110 economically viable uranium deposits can be expected within the NAPWA. If a greater percentage of blind pipes contain economically viable deposits because they have not undergone post-mineral collapse, this total number could be significantly higher.

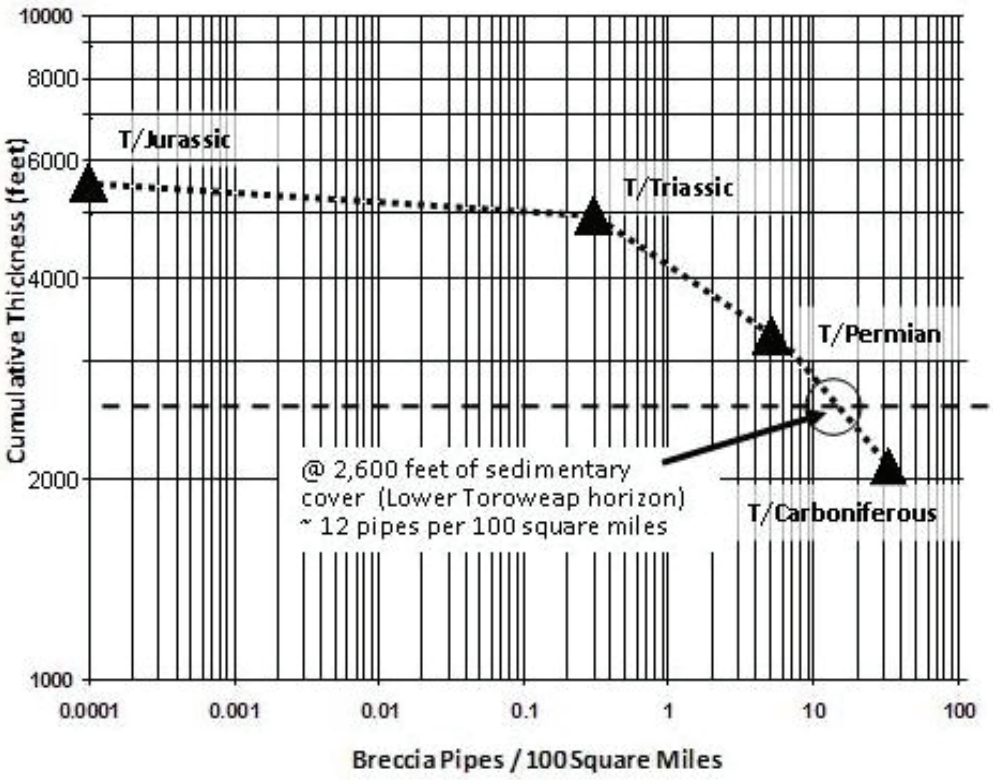


Figure 3: Log- Log plot of breccia pipe density vs. cumulative thickness of sedimentary cover. (Source: Spiering, 2010, Exploration and discovery of blind breccia pipes: the potential significance to the uranium endowment of the Arizona Strip District, Northern Arizona - Presentation to SME Annual Meeting-Phoenix, AZ.)

An average of 3 million pounds of uranium (produced and remaining) has been defined per developed (those that have been drilled from the surface and underground) deposit in the NAPWA (Table 3). If we use this average number times the estimated 110 potentially economically viable uranium deposits in the subject area, the total uranium potential of the NAPWA is approximately 330 million lbs; an estimate that is almost identical to the 326 million pounds) U3O8 estimated for the withdrawal area by the US Geological Survey (Otton and VanGosen, 2010) after a refinement of the potential resource endowment estimated by the USGS in Circular 1051 (Finch and others, 1990).

URANIUM RESOURCES OF DEVELOPED PIPES IN THE N. AZ PROPOSED WITHDRAWAL AREA			
	Production+Remaining Resource		
Pipe	Thousand Tons	Grade % U3O8	Million Pounds
Hack 1	133.8	0.53	1.42
Hack 2	497.1	0.70	7.00
Hack 3	111.3	0.50	1.12
Kanab North	296.9	0.50	2.98
Pigeon	406.8	0.64	5.65
Pinenut	125.0	0.56	1.40
Hermit	36.3	0.76	0.55
Arizona 1	70.3	0.68	0.96
Total	**1,677.6**	**0.63**	**21.1**
Av. per breccia pipe	**239.7**	**0.63**	**3.01**

Table 3: Produced and remaining uranium resources of all developed breccia pipes in the NAPWA (Source: Energy Fuels Nuclear Inc. Internal Memorandum, 1990).

The U.S. Geological Survey's estimate is less empirical and more statistical, but recent exploration in the subject area provides additional indirect evidence of the area's resource endowment. An airborne geophysical survey conducted by Quaterra Resources Inc. in 2007 that covered 422 square miles of the proposed withdrawal area identified all known pipes in the surveyed area and more than 200 anomalies with similar geophysical signatures. The initial drilling results of 7 of the anomalies achieved a 70% success record. If only 20% of the geophysical anomalies are proved to be economically viable deposits and the remaining un-surveyed portion of the NAPWA has a similar potential, approximately 160 deposits potentially representing 480 million lbs. of U3O8 may lie within the subject area.

Regardless of what the actual uranium endowment of the area is, any reasonable estimate will substantiate the assessment of the (August 2010) BLM Mineral Report on the mineral potential of the proposed withdrawal area that concludes:

> *"Failure to develop uranium resources on the subject lands that have the potential of becoming part of the second most important uranium-producing region in the United States has far reaching economic implications, which are beyond the scope of this report."*

The BLM Mineral Report classifies the uranium potential of the area as "(H/D)"; the highest classification possible for both potential and level of certainty.

ERRORS IN THE PRODUCTION TIME FRAME AND ECONOMIC IMPACT

There are several errors in the assumptions made in the production time frame (p. B-29) Appendix B of the RFD section of the DEIS that appear intentional to reduce the economic importance of the resources in question. The most important of these are "the number of mines (30) that could be sustained by all known and undiscovered resources."

The resource potential of the proposed Northern Arizona Withdrawal Area (NAPWA) has been estimated by several studies (discussed above) to exceed 300 million lbs. The assumption that this resource is not capable of sustaining mining for 20 years is erroneous. The uranium mineralization of the proposed withdrawal area represents the highest grade and most profitable per pound production in the U.S. while having one of the smallest surface disturbances and environmental impacts on any uranium district in the world.

At an average production of 1.5 million lbs of uranium per year per mine, an average of 3 million lbs produced per mine, and even using a gradual ramp-up of production, six continuously operating mines could produce 160.5 million lbs in 20 years (Table 4). Yet this represents only half of the total endowment of the NAPWA.

Because of the errors in the time frame, the economic impact of the proposed withdrawal has been seriously underestimated. An independent report prepared by Tetra Tech in September 2009 "ECONOMIC IMPACT OF URANIUM MINING ON COCONINO AND MOHAVE COUNTIES , ARIZONA" (Attached) uses a six mine - 42 year scenario to model to the economic impact of producing the entire uranium endowment of the NAPWA. The report concluded that the uranium mining operations would provide a significant long-term benefit to the area, state, and region: a direct total sales impact of $18.9 billion over the 42-year duration of the project, with indirect impacts of $10.5 billion, for a total impact of $29.4 billion, resulting in an average annual impact of $700 million.

During the 40 years of operation, the companies expect to employ a total of 390 workers annually; this total includes miners, geologists, engineers, managers, and other professional and support staff. These workers are projected to generate an additional 688 jobs in the region of influence for a total increase of 1,078 jobs during the years of full operation. Annual wages of $25 million would generate annual indirect impacts of $15 million, for a total of $40 million annually. A portion of these benefits would occur in neighboring Kane and San Juan Counties, Utah, where some workers would likely reside.

Assumptions:

6 Simultaneously Producing Mines
1.5 Million lbs production/mine-year
326 Million lbs Resource

I = Initial Permitting and Planning
D = Development
P = Production
R= Reclamation

	Mine 1	Mine 2	Mine 3	Mine 4	Mine 5	Mine 6	Mine 7	Mine 8	Mine 9	Mine 10	Mine 11	Mine 12	Mine 13	Mine 14	Mine 15	Mine 16	Mine 17	Mine 18	Mine 19	Mine 20	Mine 21	Mine 22	Mine 23	Mine 24	Mine 25	Mine 26	Mine 27	Mine 28	Mine 29	Mine 30	Mine 31	Mine 32	Mine 33	Mine 34	Mine 35	Mine 36	Mine 37	Mine 38	Mine 39	Mine 40	Mine 41	Mine 42	Mine 43	Mine 44	Mine 45	Mine 46	Mine 47	Mine 48	Mine 49	Mine 50	Mine 51	Mine 52	Mine 53	Mine 54	Mine 55	Production (Mlbs)
Year 1	P	I	I	I																																																				1.5
Year 2	P	P	I	I	I	I	I																																																	3.0
Year 3	R	P	P	P	I	I	I	I	I	I																																														4.5
Year 4		R	P	P	P	P	P	I	I	I	I	I	I																																											7.5
Year 5			R	R	P	P	P	P	P	P	I	I	I	I	I	I																																								9.0
Year 6					R	R	R	P	P	P	P	P	P	I	I	I	I	I	I																																					9.0
Year 7								R	R	R	P	P	P	P	P	P	I	I	I	I	I	I																																		9.0
Year 8											R	R	R	P	P	P	P	P	P	I	I	I	I	I	I																															9.0
Year 9														R	R	R	P	P	P	P	P	P	I	I	I	I	I	I																												9.0
Year 10																	R	R	R	P	P	P	P	P	P	I	I	I	I	I	I																									9.0
Year 11																				R	R	R	P	P	P	P	P	P	I	I	I	I	I	I																							9.0
Year 12																							R	R	R	P	P	P	P	P	P	I	I	I	I	I	I																				9.0
Year 13																										R	R	R	P	P	P	P	P	P	I	I	I	I	I	I																9.0
Year 14																													R	R	R	P	P	P	P	P	P	I	I	I	I	I	I													9.0
Year 15																																R	R	R	P	P	P	P	P	P	I	I	I	I	I	I										9.0
Year 16																																			R	R	R	P	P	P	P	P	P	I	I	I	I	I	I							9.0
Year 17																																						R	R	R	P	P	P	P	P	P	I	I	I	I	I	I				9.0
Year 18																																									R	R	R	P	P	P	P	P	P	I	I	I	I	I	I	9.0
Year 19																																												R	R	R	P	P	P	P	P	P	I	I	I	9.0
Year 20																																															R	R	R	P	P	P	P	P	P	9.0
Total Production (Million lbs. U3O8)																																																								160.5

Table 4: Estimated loss of uranium production of 6 continuously operating mines over a 20 year in the NAPWA.

Ore mined from the NAPWA would be taken to the White Mesa Mill, in Blanding, Utah, for processing, and would ensure the continued operation of the mill, along with the substantial benefits it provides to San Juan County and its residents, and would improve the economic opportunities for suppliers in Blanding, the surrounding areas, and the region.

Mining companies contract with trucking firms contracted by the mining companies to ship ore from mines to processors typically hire personnel and build service shops locally. Over the 42-year operating period, transporting the ore would generate about $1.6 billion in revenues for trucking firms, long-term stable employment for their workers, and a steady stream of revenue for their suppliers.

Other beneficiaries include national mining equipment companies; suppliers for items such as tires; oil companies providing fuel; and a host of other firms that employ workers across the United States, in areas far removed geographically but not economically from Arizona.

Federal, state, and local governments would receive a variety of tax revenues over the 42 year life of the proposed project, including corporate income taxes, severance taxes, payments to county governments, and income taxes from workers. The mining companies project payments of $2 billion in federal and state corporate income taxes and $168 million in state severance taxes over the life of the project. Local governments would receive $9.5 million in claims payments and fees. All of these payments would represent sizable benefits to the governments involved.

Local property tax bases would increase as workers moved into the area and purchased homes. Existing residents would see their incomes increase with better jobs, and could purchase larger homes or improve existing ones. Local and state sales taxes would increase from purchases by the mine operators and their suppliers, by workers and their families, and by other local residents who see their incomes rise as an indirect impact of the mining operations.

ADEQUACY OF EXISTING REGULATORY FRAMEWORK

In several sections, the DEIS notes that Alternative A would rely on the existing entitlement requirements and environmental programs to protect the resources in the Grand Canyon watershed. By implication, these statements suggest the basic need for the withdrawal is to compensate for an inadequate existing federal, state and local regulatory framework that for some unknown reason cannot protect the valuable environmental, cultural or biologic resources in the area.

However, the data presented in Section 3 clearly indicate that the existing entitlement process along with state and federal environmental regulations surrounding mine exploration and development are more than adequate to protect valuable environmental, cultural or biologic resources.

For instance, in Section 3.2.2, the DEIS requires 7 pages to briefly outline the various state and federal programs regulating air quality. Similarly, Section 4.4.3 identifies that:

> *"In accordance with current regulations, impacts to water resources resulting from mine operations are reduced and controlled by way of implementation of appropriate design features and standard operating procedures. Active mine sites are routinely audited for compliance with their approved plans of operation and other permits."*

Coupled with the myriad of engineering and permitting practices discussed on pages 4-66 and 4-67, and the vast number of state and federal agencies who regulate the complex network of permits and entitlements, it's difficult to envision some inherent inadequacies of the existing regulatory framework that would promote the wholesale degradation of the environment.

Notwithstanding the operational permits required for development, the National Environmental Policy Act (NEPA) establishes a complex framework for considering the application for development of a mineral resource on Federal lands and for identifying and mitigating any significant physical, biologic, cultural, environmental, historic, tribal and socioeconomic impacts.

This NEPA process is intentionally focused on the eliminating or mitigating the direct and indirect impacts of a particular proposed action while the existing environmental regulations are intended to prevent the "release or potential release" of any regulated compound or constituent to affected media like air, water or soils.

Consequently, stated "concerns" over potential environmental impacts to the watershed are not supported by the DEIS. Based on data collected from previous modern mining operations and cited literature, Section 4 of the DEIS concludes that an average mine will be closely regulated and have the following impacts:

- Exploration activities will temporarily disturb (subject to reclamation) 1.1 acres
- Mining activities would create a land disturbance (subject to reclamation) of approximately 20 acres
- Total mine life is approximately 7 years
- Water use during mine life estimated at 5 gallons/minute

Assuming the no action alternative discussed in 4.2.5, the DEIS estimates that the total combined land disturbance over the 20-year study period would not exceed 945 acres, 107 acres and 312 acres in the north, east and south parcels, respectively. This equates to a yearly disturbance (and subsequent reclamation) of approximately 47.25 acres, 5.35

acres and 15.6 acres in the north, east and south parcels, respectively. But, to protect this modest and transitory disturbance, it somehow becomes necessary to remove over 1,000,000 acres from mineral entry.

Yet, according to the DEIS, the typical breccia pipe would extract over 275,000 tons of ore and yield 3 million pounds of uranium compound. Due to the high ore grades and narrow breccia pipe configuration, mining in the proposed withdrawal area creates the smallest surface disturbances and related environmental impacts of any uranium district in the world.

POSSIBILITY FOR PERMANENT WITHDRAWAL FOR FUTURE MINING

Section 204 of the Federal Land Policy and Management Act allows for withdrawals to be renewable as long as the underlying reason for the withdrawal is still valid. Because the DEIS fails to demonstrate that future mineral development would have no more than a transient impact to the environment, the DEIS has essentially lowered the impact threshold to such a point that any future reversal of the withdrawal could never be contemplated.

VALID EXISTING RIGHTS

In Appendix B, the DEIS discusses uncertainty factors associated with the development of the RFD. One of the most significant factors affecting the development of mineral resources is the determination of Valid Existing Rights (VER). Unfortunately, the document fails to recognize the extreme difficulty in proving a VER and also fails to note that in order to demonstrate a VER, a potential mineral resource would need to be located and essentially proven before the initial land segregation beginning July 21, 2009. This would effectively preclude any additional development projects except for those few mines where development activities have already been approved by the BLM or FS.

Although no work could be done on any claims during the 2-year segregation or after the withdrawal unless validity had already been established or could be established in the future, the RFD goes to great length to discuss and analyze potential development projects stemming from undiscovered mineral deposits in the area. Unfortunately, these projects could NEVER be realized simply because this type of development is specifically prevented by the segregation and withdrawal process. This essentially eliminates 70% of the Reasonably Foreseeable Future Activity discussed in the RFD.

Additionally, the prescriptive and time-consuming hurdle of proving a VER could preclude additional mining from those projects without proven mineral reserves. Although it is impossible to predict the outcome of individual VER determinations, it is realistic to assume (contrary to the DEIS RFD assumptions) that not every potential mine site with proven reserves will pass the stringent determination process. In practice, it

becomes much harder to develop claims within an area that has been proposed for withdrawal, for two reasons.

First, as a precondition of approving a plan of operations within the area, the BLM or FS must determine the validity of the claims, by requiring the preparation of a mineral examination report to: (i) verify the deposits are locatable minerals rather than common variety (salable) minerals; and (ii) verify the claims are based on a bona fide discovery of potentially marketable minerals, under the "prudent man" and "marketability" tests, which essentially require tangible evidence in the record of prospecting or geological indications or sample results that justify the staked sidelines and end-lines of the claim and indicate future mineral development within the claim may be warranted. Refer to 43 C.F.R. § 3809.100 and 43 C.F.R. §§ 3830.11, 3830.12 (stating factors for determining minerals are locatable); 65 Fed. Reg. 69998, 70026-27 (explaining the "prudent" man and "marketability" tests and their part in a mineral examination report).

Second, if the area proposed for withdrawal includes an ACEC, then the BLM will not approve the plan of operations if it is not satisfied that the plan includes mitigation measures necessary not only to prevent unnecessary and undue degradation of the environment but also to preserve sufficiently the resource that the ACEC was established to protect. See 43 C.F.R. §§ 3809.11(c)(3), 3809.21.

Thus, even if the claims within an area of proposed withdrawal are determined to be valid, the BLM or FS can potentially hold the claimant in an interminable do-loop of notices of deficiency, one after the other, concerning the sufficiency of the mitigation measures proposed in the plan of operations relative to the mitigation measures specified in the RMP or FEIS for the ACEC, until the claimant gives up hope of the possibility of submitting a Plan of Operations that will satisfy the BLM.

Consequently, Quaterra contends that by not estimating the difficulty of establishing a VER and authoring an approvable Plan of Operations, the RFD significantly over-estimates the amount of potential future development in the withdrawal area. This substantially mischaracterizes the magnitude of the uranium resources lost to the withdrawal. However, an uninformed reader could assume from reviewing the RFD that uranium resources available for mining after the withdrawal would essentially match or exceed the industry's limited ability to safely extract these resources.

NATURALLY-OCCURRING URANIUM RELEASES

In Subsection B.4.1, the DEIS notes that the first breccia pipes were originally discovered as a result of their exposures in the walls of the canyons. While there are literally hundreds of exposed pipes along the canyon, the DEIS goes to great lengths to avoid a discussion of how many exposed pipes are naturally releasing uranium into the Colorado River watershed.

Many mineralized pipes exposed within the canyon have become (or are gradually becoming) barren due to the slow erosion, oxidation and leaching of the mineralized

rock. In fact, the Arizona Geological Survey (AGS) did a recent study of this, which found that the amount of uranium naturally eroding into the watershed from these exposed breccia pipes far exceeds any past releases of uranium from historic mining releases as well as all anticipated releases of uranium from future mining activity.

However, some data collected near legacy mining operations (page 3-85) do suggest that some localized groundwater impacts have occurred. But, these historic mining operations had clearly operated and closed prior to the promulgation of rigid state and federal regulations protecting surface and groundwater quality. By contrast, the principal conclusion of the 2010 USGS report on groundwater quality (Section 3.4.7) was that:

> *"Observation of groundwater-chemistry relation between concentration and mining condition were limited and inconclusive"*

If this is the case, any withdrawal based on the preposition that the cessation or prevention of uranium mining activity will somehow preclude the introduction of uranium into the Grand Canyon watershed is seriously flawed.

POTENTIAL FOR IMPACTS TO THE WATERSHED

The stated concern for justifying the withdrawal is the potential for impacts to the Grand Canyon watershed. As such the DEIS goes to great length to discuss the existing and potential impacts from mining to both surface and groundwater quality and quantity. Unfortunately, the DEIS appears to bias the results of the analysis by favoring unrealistic or unsubstantiated assumptions when quantifying the Environmental Consequences in Section 4.

Regional R-aquifer

The DEIS characterizes the R-aquifer as potentially the most prolific aquifer in the region. Generally, more than 2,000 feet below land surface, the R-aquifer occurs in gently folded limestone and dolomite units. Because of the relative depth and uncertainty of encountering productive zones within the R-aquifer, the DEIS reports that:

> *"Records indicate that no non-commercial or non-industrial entities have installed R-aquifer wells…even though the R-aquifer is recognized as the most reliable source of groundwater"*

The DEIS clearly states on pages 4-48 and 4-48 as well as Section 3.4 (reference Figure 3.4-14) that for many potential mines located in the North Parcel, there could be little to no impact to the R-aquifer and no impact to the Grand Canyon Watershed. Specifically:

> *"R-aquifer groundwater along the western, northwestern and northeastern margins of the North Parcel is likely to move to the north toward areas in south and central Utah. The R-aquifer dips deeply northward from near the Grand Canyon to thousands of feet in depth (see Figure 3.4-4) and does not directly feed*

> *springs along the Virgin River…"* and *"Only oil and gas wells are known to penetrate to these depths in Utah, where the R-aquifer is not considered a viable drinking water supply."*

Similar areas in the East and South Parcels are noted in the DEIS on pages 4-48 and 4-49 where fault zones, geologic structure and regional flow prohibit possible mining impacts to the R-aquifer and in some cases local seeps and springs from impacting the Withdrawal area.

With regards to groundwater impacts occurring from recent (modern) and future anticipated mining, the DEIS describes in 3.4.4 on pages 3-57 and 3-58 that several regulatory and independent consultant reports indicated that:

> *"Modern (post 1980) breccia pipe uranium mine sites <u>in the study area</u> (emphasis added) are generally characterized by well-cemented, very low permeability breccias and adjacent formation rocks, which do not permit the flow of groundwater through the tightly-locked mineral deposits. This condition inhibits dissolution of mineral deposits associated with these economically viable breccia pipes into groundwater. "*
>
> *"In each case, these ore deposits are on the order of 1,000 feet or more above the R-aquifer system and are underlain by the poorly permeable breccias and siltstones/mudstones of the Hermit Formation and Supai Group. Therefore (emphasis added), <u>conditions are not favorable for downward migration of leached minerals and constituents (such as uranium and arsenic) from the ore deposits to the R-aquifer</u>."*

On page 4-60, the DEIS also concludes:

> *"It is also important to recognize that, based on the information described in Section 3.4, there is currently no conclusive evidence from well and spring sampling data that (modern) breccia pipe uranium operations in the north Parcel have impacted the chemical quality of groundwater in the regional R-aquifer."*

And, also on page 4-60:

> *"…the low permeability conditions associated with ore deposits in the breccia pipes and adjacent rock strata between the base of mine openings and the R-aquifer are thought to retard the downward movement of any perched groundwater drainage into the mines and, therefore, are not favorable for downward migration of dissolved minerals from the mine openings."*

With regards to potential impacts to the quantity of water in the regional R-aquifer based on the average mine withdrawal rate of 5 gpm, the DEIS states on page 4-59 that:

> *"...drawdown was projected for a well pumping 5 gpm continuously for 5 years. Results indicate that the 5-foot water level drawdown contour could extend about 270 feet from the mine well in relatively unfractured aquifer areas and much less than 1 foot from the well in major fault zones."*

Further, regarding impacts to surrounding wells or water resources, the DEIS reports on page 4-59 that:

> *"Based on the location of existing wells and the projected construction of new (mine) wells, it is not likely that mines would be located sufficiently near a non-mine R-aquifer water supply well to cause more than negligible water level drawdown impact to the non-mine well."*

In other words, assuming that all mine wells would be located within their respective 20-acre mine site, the R-aquifer is so productive that the maximum drawdown of mine well pumping could never impact any non-mine wells because the actual drawdown from these mine wells would be entirely located within the mine footprint.

Perched Aquifer

There are several consolidated and unconsolidated perched aquifer systems discussed in the DEIS. These systems are individually discussed on pages 3-42 and 3-44 but are uniformly defined as:

> *"...temporary perched aquifer zones may occur...such perched groundwater zones are thin and discontinuous and are generally ephemeral; the stored water is gradually lost via evapotranspiration and slow downward seepage..."*

Yet, despite these earlier descriptions, the DEIS fabricates a perched groundwater flow model that simulates long-term continuous 1-gpm drainage from half of the mines projected in the RFD even though the DEIS clearly concludes:

> *"A long term continuous groundwater discharge of 1 gpm from the perched aquifer system penetrated by mine openings would exceed the conditions historically encountered in the existing and reclaimed breccia pipe mines on the North parcel (see Section 3.4). Further, most of the perched aquifer springs that have been measured or estimated on the North, East and South parcels discharge 1 gpm or less."*

The significance of this model assumption doesn't become apparent until the DEIS discusses the potential for perched water to become impacted by future mining operations on page 3-59 and goes on the state:

> *"At the breccia pipe uranium mines in the study area, perched water zones, if present (typically above the Hermit Shale basal confining unit) are small, thin*

> *and discontinuous. Water yield to mine openings from these perched zones typically decreases over the first few months to 2 years on mining, from several gallons per minute to no measurable flow."*

The DEIS goes on to conclude on pages 3-59 and 3-60:

> *"Therefore, movement of perched water away from the mine openings is not anticipated to occur during mine operations."*

Based on these facts, the apparent risk to either groundwater flow or quality to the regional R-aquifer or seeps and springs fed by the R-aquifer would appear to be negligible. However, the DEIS reaches deep into the realm of the hypothetical on page 4-60 by assuming that half of all potential mines in the study area would encounter perched water systems capable of continuous discharge.

In the most flagrant mischaracterization found in Chapter 4, the DEIS estimates that the potential drainage from 50% of the mines considered in the RFD would contain dissolved uranium concentrations of up to 440 ug/L (See Appendix F) when these discharges reach the R-aquifer. They continue with this assumption even though the DEIS notes that the 400 ug/L value is:

> *"The highest concentration detected in water samples obtained directly below the (Historic) Orphan Lode Mine (Liebe 2003). Even though the near-rim and unreclaimed conditions at the Orphan Lode Mine are not considered to be comparable to conditions at existing or historic breccia pipe mines"*

Additionally:

> *"None of the studies conducted for water quality at the R-aquifer mine wells on the North Parcel, one of which included periodic sampling for up to 9 years after the completion of mining (Hermit Mine well), concluded that uranium mining activities have affected the R-aquifer."*

Regardless of the fact that the DEIS itself acknowledges the shortcomings of the data, the DEIS continues to rely on the mine drainage data collected from the legacy Orphan Lode Mine operation prior to reclamation. As previously stated for uranium, Section 4 of the DEIS (page 4-61) also goes on to assume that the maximum arsenic value (90 ug/L) detected at the un-reclaimed Orphan Lode Mine would somehow be representative of modern breccia piped mining conducted outside the canyon. These values represent arsenic and uranium concentrations that are approximately 10 times the maximum EPA values for drinking water.

Remarkably, the DEIS also assumes:

"The potential mine drainage is not affected by attenuation or dilution…" during its migration through thousands of feet of sedimentary rock or miles of aquifer and *"…is*

only modified by instantaneous mixing with the volume of water discharging at the R-aquifer spring system for the basin analyzed".

In a profound understatement of facts, on page 4-61 the DEIS concludes:

> *"This assumption would tend to provide resultant concentrations that are conservatively high; however, sufficient data are not available to characterize flow paths and dilution rates in the R-aquifer from future mines."*

In Arizona, Aquifer Protection Permitting (APP) routinely requires the applicant to estimate the concentration and flow of any potential discharges to be permitted. The applicants are not required to use the maximum concentration values of any potential contaminant of concern unless that concentration value is representative of the actual (measured or estimated) discharge condition. Further, the impact of water quality from these discharges can be accurately measured with credible hydraulic and geochemical models that can accurately measure the water-rock and water-water interactions that occur as a discharge moves through the vadose zone, encounters and mixes with groundwater and moves laterally through the aquifer to a downgradient point of compliance or discharge.

Considering that the stated reason for conducting the DEIS was to <u>scientifically</u> evaluate concerns of potential impacts to the Grand Canyon watershed from future uranium mining, it seems irresponsible to use arbitrarily selected discharge volumes, constituent concentrations and downstream impacts that are derived from data that is clearly not representative of modern mining conditions and could easily be more accurately modeled if the process employed scientifically-based and defensible groundwater and geochemical models.

CLAIMS

In Section B.5 the DEIS reports that approximately 5,300 claims are located within the three withdrawal parcels. Unfortunately, the DEIS does not discuss the statistical probability of developing a mine from any of these claims. Empirically, only 1% to 2% of exploration projects proceed to development and then only 1% to 2% of development projects actually advance to mining. Consequently, the number of claims filed is usually 50 to 100 times larger than the number mines that would ever be developed.

Although many statements from environmental groups supporting the withdrawal cite the total number mining claims in the area as the actual number of potential mines, this is far from the reality. However, the DEIS does nothing to dissuade a reader from this assumption and, as previously discussed, does little to accurately estimate how long (and how difficult) it would take to establish a VER for all of these 5,300 mining claims.

LOSS OF OTHER LOCATABLE MINERALS

In Subsection B.7.1 the DEIS notes that the value of other commodities or metals that could be recovered from the mining of the breccia pipes would not be sufficient to drive mine development. But on pages 3-31 and 3-32 the DEIS states that a variety of precious metals including copper, gold, silver and vanadium have been found within exposed breccia pipes. The DEIS further concludes that the "presence of uranium minerals within breccia pipes has been of the most interest…" to the mining industry. Regrettably, the DEIS interprets this industry focus to mean that there are no other economically-viable minerals which may be an incorrect assumption.

Of particular interest is rare earth elements which were not specifically listed as one of the other metals considered. However, an investigation conducted by the AGS on breccia pipe exploration projects reported high concentrations of rare earth elements. Considering the world-wide interest in and demand for the rare earth elements, and the current historic commodity prices for copper gold, silver and vanadium, mineralized breccia pipes could represent a potentially valuable source for other minerals that have been completely omitted from the DEIS.

URANIUM COMMODITY PRICING AND RESOURCE AVAILABILITY

In Subsection B.7.2 the DEIS assumes that the price of uranium will remain stable at around $40 per pound for the full 20 year withdrawal. The limited range of price history shown on Figure B-4, might convince anyone not familiar with commodity price fluctuations or uranium market conditions that this is a realistic assumption.

If the price history were traced back to approximately the same time-frame as that used for production history shown on Figure B-3, the earlier price fluctuations of uranium would be evident, especially the sharp rise in the 1970's, the dramatic fall in 1979-1980 after the Three Mile Island incident and the less dramatic fall after the Fukushima disaster.

A review of the price history shown on Figure B-4 would not reveal that the price of uranium was kept artificially low from the mid 1990's to the early 2000's by the reprocessing of uranium recovered from decommissioned nuclear weapons in the arsenals of the U.S. and former Soviet Union.

However, as shown on Figure B-3, yearly reactor requirements for uranium have significantly exceeded the annual production of uranium since approximately 1990. And as global stockpiles of uranium are gradually depleted, the price of uranium will inevitably rise.

Since the DEIS was written, the price of uranium has already increased dramatically from the $40/lb. level. The spot price for uranium rose to $72/lb. in January 2011 and subsequently settled to $61/lb. in early April. Regardless, the pace of worldwide uranium

consumption suggest futures prices will remain well above the $40/lb. level assumed in the DEIS. This further discredits the RFD as commodity pricing will influence both mining activity and increase revenues associated with the alternatives analysis. It also dramatically undervalues the endowment, which incorrectly minimizes the financial impact of the withdrawal.

CONCLUSIONS

A careful review of the DEIS reveals nothing in the recent history of breccia pipe development and nothing in the Reasonably Foreseeable Developments, that would appear to justify any substantial withdrawal. Beginning with the development of the Hack Complex mine in 1981, there has been no known or suspected incident or environmental impairment during this 30 year period that would appear to justify the level of concern that could possibly warrant this massive withdrawal.

In fact, the data specifically cited in the DEIS clearly indicates that any incidental releases of uranium from current or future mining would be orders of magnitude below the uranium that has and will be naturally-released from the erosion of mineralized breccia pipes exposed in the canyon.

Further, considering that the stated purpose for conducting the DEIS was to scientifically evaluate concerns of potential impacts to the Grand Canyon watershed from future uranium mining, it seems irresponsible that the DEIS purposefully biases the Environmental Consequences in Chapter 4 by using indefensible water discharge volumes and constituent concentrations to predict future impacts. Even the DEIS states that these impacts are not accurately determined and are contrived from data that is clearly not representative of modern mining conditions. Remarkably, these conditions could easily and more accurately be estimated if the process employed scientifically-based and defensible groundwater and geochemical models that are routinely used in mine permitting projects.

Of critical importance to a scientifically-based analysis, it is particularly troubling that the DEIS artificially and arbitrarily reduces the size of this massive endowment, overestimates the amount of resources that could reasonably be extracted after proving Valid Existing Rights, and underestimates the loss of royalties, jobs, taxes and investments resulting from the withdrawal. Consequently, the RFD essentially describes the withdrawal as having no appreciable impact to the mining industry because, remarkably, even with the withdrawal the industry would barely be capable of mining the grossly underestimated uranium resource that would be subject to Valid Existing Rights.

Despite the fact that the RFD alternately relies and then subsequently discounts the USGS estimates of uranium endowment, this estimate is based solely on exposed breccia pipes or pipes with visible collapse features and does not consider the recent advances in detecting mineralized breccia pipes without surface collapse expressions. Consequently, Quaterra feels strongly that the DEIS has massively underestimated the number of

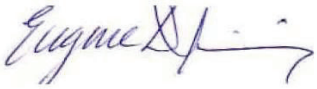
mineralized breccia pipes available for development and consequently have not adequately constructed an analysis that correctly identifies and addresses the massive financial implications of closing the withdrawal area to development.

What is particularly frustrating to the mining industry, this withdrawal places another obstacle in front of our President's stated goal of energy independence and is absolutely contrary to public policy. With the increased focus on excess CO_2 emissions from of our traditional energy sources and the current administration's stated agenda of reducing our reliance on fossil fuels, the complete withdrawal of high grade uranium deposits does nothing to reduce America's CO2 footprint and further increases our dependence on foreign-produced and less dependable energy sources.

I cannot say this in stronger terms; a withdrawal of the NAPWA would not slightly impair the "modest" uranium production potential of northern Arizona as noted in the DEIS, but would essentially destroy the entire productive potential of the highest grade and most favorable endowment of uranium mineralization found in the United States.

On behalf of Quaterra Resources, I urge you to choose the no action alternative.

Sincerely,



Eugene D. Spiering
VP Exploration and Director
Quaterra Resources Inc.

Attachments: *Economic Impact of Uranium Mining in Northern Arizona*

ECONOMIC IMPACT OF URANIUM MINING ON COCONINO & MOHAVE COUNTIES, ARIZONA

Prepared for:

ACERT

American Clean Energy Resources Trust

Contact:
Pam Hill, Director
Telephone 303.335.6426

Submitted by:

Tetra Tech

Contact:
Andrew P. Schissler, PE, PhD
350 Indiana Street, Suite 500
Golden, CO 80401
Telephone 303.217.5700

September 2009

complex world

CLEAR SOLUTIONS™

Copyright 2009 by American Clean Energy Resources Trust (ACERT).

Cover Picture: 2007 Airborne geophysical survey being conducted in northern Arizona.

Photo Credits: Unless otherwise noted, all photos used in this report are courtesy of ACERT and its members and/or Pam Hill.

ECONOMIC IMPACT OF URANIUM MINING ON COCONINO & MOHAVE COUNTIES, ARIZONA

EXECUTIVE SUMMARY

This analysis[1] was prepared to estimate the potential economic impact of mining uranium contained in 1,069,000 acres in northern Arizona (see Figure 1), in an area known as the Northern Arizona Uranium District (NAUD). The lands are being considered for withdrawal from mineral entry and claim processing by the U.S. Department of Interior.

Mining the NAUD uranium would have enormous economic impacts to businesses and households in Coconino and Mohave Counties, Arizona, nearby counties in Utah, the State of Arizona, regional mining service suppliers, and the federal government.

Economic impacts of NAUD mining:

- **1,078 new jobs in the project area**
- **$40 million *annually* from payroll**
- **$29.4 billion in output over the 42-year life of the project**
- **$2 billion in federal and state corporate income taxes**
- **$168 million in state severance taxes**
- **$9.5 million in claims payments and fees to local governments**

Coconino and Mohave Counties are the region of influence (ROI) for this analysis, which also addresses impacts on neighboring counties in Utah and on regional mining service centers. The economic impacts are based on estimates by the United States Geological Survey and private companies that 375 million pounds of uranium oxide could be derived from uranium ore in the NAUD. This analysis uses a conservative sales price of $50 per pound for uranium oxide; higher prices in the future would yield greater economic benefits.

Economic Impacts

The northern Arizona uranium mining operations would provide a significant long-term benefit to the area, state, and region: a direct total sales impact of $18,900 million over the 42-year duration of the project, with indirect impacts of $10,508 million, for a **total impact of $29,408 million, or an average annual impact of $700 million**.[2]

Summary of Economic Benefits

	ACERT Companies	Indirect Impact	Total Impact
Over the 42-year life of the project:			
Sales ($ Millions)	$18,900	$10,508	$29,408
Average Annual Impacts:			
Sales ($ Millions)	$450	$250	$700
Earnings ($ Millions)	$25	$15	$40
Employment (number of jobs)	390	688	1,078

[1] This report was prepared by Tetra Tech, Inc., an internationally known environmental consulting firm. Tetra Tech's qualifications are found in Section 9, List of Preparers. The report was commissioned by the American Clean Energy Resources Trust (ACERT), and ACERT and its members have provided production and employment estimates. The analysis is also based on other information obtained from other sources deemed to be reliable (see Section 8, References). Although funded by ACERT, the report is an independent assessment of the potential value of the uranium resource and the economic impacts of mining the resource. The report was prepared for use by third parties (legislative bodies and government agencies of the United States, Arizona, and Utah) to assist in policy decisions.

[2] These estimates are based on a conservatively assumed constant price of $50 per pound for uranium oxide, with six mines in operation per year over a 42-year period, except for start-up and close-out, when not all six mines would be in production. The analytical methodology is discussed in Section 4, Methodology & Definitions.

Earnings and employment are expressed in terms of annual impacts. Annual wages of $25 million would generate indirect impacts of $15 million, for a total of $40 million annually. The companies expect to employ a total of 390 workers annually during the years when all six mines are operating; this total includes miners, geologists, engineers, managers, and other professional and support staff. These workers are projected to generate an additional 688 jobs in the ROI, for a total increase of 1,078 jobs during the years of full operation. A portion of these benefits would occur in neighboring Kane and San Juan Counties, Utah, where some workers would likely reside.

Impacts would be lower during the initial years of the proposed project and at the end, but benefits would still be substantial. Again, this would be a significant benefit to workers, families, and businesses, and to the local, state, and federal governments.

The proposed project would lead to other area and regional economic benefits as well.

- Ore mined from the NAUD would be taken to the **White Mesa Mill, in Blanding, Utah**, for processing, and would ensure the continued operation of the mill, along with the substantial benefits it provides to San Juan County and its residents, and would improve the economic opportunities for suppliers in Blanding, the surrounding areas, and the region.

The White Mesa Mill in Blanding, Utah, employs 150 workers during full production.

- Mining companies contract with **trucking firms** to ship ore from mines to processors. The economic impact is local, as contract firms typically hire personnel and build service shops locally. Over the 42-year operating period, transporting the ore would generate about **$1.6 billion in revenues for trucking firms, long-term stable employment for their workers, and a steady stream of revenue for their suppliers**.
- Other beneficiaries include national mining equipment companies; suppliers for items such as tires; oil companies providing fuel; and a host of other firms that employ workers across the United States, in areas far removed geographically but not economically from Arizona.
- **Federal, state, and local governments** would receive a variety of tax revenues over the 42 year life of the proposed project, including corporate income taxes, severance taxes, payments to county governments, and income taxes from workers. The mining companies project payments of **$2 billion in federal and state corporate income taxes** and **$168 million in state severance taxes** over the life of the project. Local governments would receive **$9.5 million in claims payments and fees**. All of these payments would represent sizable benefits to the governments involved.
- **Local property tax bases** would increase as workers moved into the area and purchased homes. Existing residents would see their incomes increase with better jobs, and could purchase larger homes or improve existing ones.
- **Local and state sales taxes** would increase from purchases by the mine operators and their suppliers, by workers and their families, and by other local residents who see their incomes rise as an indirect impact of the mining operations.

This project would counter the paradox that exists in many resource-rich areas, where the economic development impact leaves the area with the raw material — instead, this project area and region would benefit in many ways from the economic investment by the uranium mining companies.

Proposed Project

The economic analysis is based on the following operating scenario assumptions:

- The mines would be operated under a "rolling" schedule that extends over 42 years. Except for the initial and closing years, six mines would be in production during any given year.
- Operations would include the following over a 5-year cycle for each set of six mines:
  - Year 1: Planning and permitting;
  - Year 2: Development, and installation of machinery and infrastructure;
  - Years 3 and 4: Production; and
  - Year 5: Reclamation.
- There are several advantages of the rolling schedule approach:
  - The 42-year schedule would ensure a long-term, stable workforce in the project area, avoiding the undesirable "boom-and-bust" impacts that can stress communities.
  - The project's longevity would allow local workers to work many years in an industry that provides higher-than-average wages and benefits.
  - Workers who moved into the area would bring their families and settle into the community, contributing to long-term healthy growth and strengthening the local tax base and growth of services.
  - Suppliers and other businesses could feel confident about opening or expanding in the project area, given the long-term nature of the project.
  - Impacts related to transportation of machinery and ore would be minimized, thus reducing traffic and the wear and tear on the transportation network.

The 42-year operating schedule would ensure a long-term, stable workforce and stronger communities.

The Project Area

The mining operations would take place in Coconino and Mohave Counties, Arizona, defined as the region of influence (ROI). The adjacent Utah counties of Kane, San Juan, and Washington are also addressed. Population in Coconino and Mohave Counties is heavily concentrated in the southern portion of those counties. The region near the potential mining areas, especially in the northern portion, is sparsely settled with low populations, but has experienced moderate growth during this decade. The population of the project area is largely white (Caucasian) except in San Juan County, where Native Americans comprise over 56 percent of the population. In the remaining counties, Native Americans are the predominant minority.

The project area is sparsely populated, but has grown modestly since 2000.

The ROI economies were reasonably diversified as of 2007, while the adjacent Utah counties reflect a more rural character. Tourism associated with the Grand Canyon and other regional attractions is an important economic factor. Average 2008 unemployment rates were close to the national average of 5.8 percent. By May 2009, all five counties had seen increases in unemployment, but only Mohave County equaled the national unemployment rate of 9.1 percent. See Section 3 for a more detailed description of the project area.

Northern Arizona Uranium

The NAUD represents an important domestic supply of low cost uranium. The US consumes approximately 50 million pounds of uranium annually. Uranium in fuel assemblies loaded into U.S. civilian nuclear power reactors during 2008 contained 51 million pounds of U_3O_8 (uranium

oxide), yet only 12 percent of the U_3O_8 was U.S.-origin uranium, and 88 percent was foreign-origin uranium.

The U.S. Geological Survey Circular 1051: *The 1987 Estimate of Undiscovered Uranium Endowment in the Solution-Collapse Breccia Pipes in the Grand Canyon Region of Northern Arizona and Adjacent Utah*, gives the 1,069,000 acre- (1,670 square mile-) area subject to the proposed withdrawal a calculated mean endowment of 112.4 tons of U_3O_8 per square mile and a total mean endowment of 187,690 tons (375 million pounds) of uranium oxide, equivalent to *about 42% of the total uranium resources in the United States*.

The worldwide market demand for uranium used in power generation was 114 million pounds in 2008. Annual demand is expected to rise to 170 million pounds by 2030, with a total of an *additional 599 million pounds* required over the next 22 years. The NAUD can provide 50% of this additional demand.

During the 1980s, seven mines in the NAUD produced 19 million pounds of uranium, the energy equivalent of approximately 676 million barrels of oil, with a temporary surface disturbance of less than 20 acres per mine—*an area smaller than a Wal-Mart parking lot*. The mine reclamation left the disturbance undetectable and provided a positive example of environmentally effective mining under the nation's current mining and environmental laws.

The uranium mineralization in the NAUD is hosted in cylindrical, vertical columns of broken and re-cemented rock referred to as breccia pipes. The structures are 200 to 500 feet in diameter (see Figure 2). The mineralization occurs at a depth 1,100 to 1,700 feet below the surface and the lowest occurrence is approximately 1,100 feet above the water table.

The NAUD ore averages roughly 0.65% uranium—generally about five times higher than any other uranium deposits in the United States.

- All mining is conducted by (hard rock) underground methods since neither open pit or in-situ leach methods are applicable to the mineral extraction within the district.
- A typical breccia pipe uranium mine produces 3 million pounds of uranium oxide in 231,000 tons of ore, at an average grade of 0.65% by weight.
- The average producing life of an underground breccia pipe uranium mine is two years, with an average production rate of 1.5 million pounds of U_3O_8 per year, compared to, for example, a surface copper mine with a life span of 40-50 years and beyond.
- Modern uranium mining operations are operated under strict regulations enforced by 10 federal and state agencies. The uranium industry has over 40 years of experience in applying international radiation safety regulations at uranium mines, and there are few ill effects for the miners that have been working in such mines.

Uranium is a highly productive fuel. It is easier to understand uranium's high level of efficiency by comparing it to other fuels.

For example, one pound of uranium oxide, known as "yellowcake" (U_3O_8), is equivalent to 35.6 barrels of crude oil (a barrel of oil is approximately 42 gallons).

America's 104 nuclear power reactors provide 20 percent of U.S. electric power—clean-air electricity for one in five homes and businesses.

The estimated Arizona uranium reserves would produce over 375 million pounds of U_3O_8 with an energy equivalence of *13.3 billion barrels of crude oil*—equal to the total recoverable oil in Prudhoe Bay, the largest oil field in North America.

Table of Contents

Executive Summary **ES-1**

Section 1. Background & Project Introduction **1**
The Nuclear Fuel Cycle—Mine to End User 1
Uranium as a Fuel 4
Project Introduction 6
Breccia Pipe Morphology and Origin 7
Breccia Pipe Uranium Mine Characteristics 7
Breccia Pipe Resources in the Project Area 9

Section 2. Uranium Pricing & Demand **11**
Uranium Pricing 11
Uranium Demand 11

Section 3. Project Area **13**

Section 4. Methodology & Definitions **17**
Regional Input-Output Multipliers 17
Data 18
Tax Definitions 18

Section 5. Estimated Output Impact Analysis **19**
Operating Scenario Assumptions 19
Impact Analysis 19
Economic Impact on Neighboring Counties 21
Regional and National Impacts 22
Other Local Impacts 23
Fiscal Impacts 23

Section 6. Estimated Earnings Impact Analysis **25**

Section 7. Estimated Employment Impact Analysis **27**
Conclusions 28

Section 8. References **29**

Section 9. List of Preparers **31**

Appendix A. Socioeconomic Charts and Graphs **A-1**

List of Tables & Figures

Table 1. World BTU Capacity by Energy Source 5
Table 2. A Summary of Energy Fuels Nuclear Mining History on the Arizona Strip 9
Table 3. Projected World Uranium Demand 12
Table 4. Project Area Overview 13
Table 5. Population Trends and Housing Costs, Project Area Communities 15
Table 6. Estimated Output Impact Analysis 20
Table 7. Private Sector Employment and Wages, 2007, Coconino and Mohave Counties and Comparison Areas 21
Table 8. Civilian Labor Force And Mining Employment by Residence, 2000 22
Table 9. Estimated Earnings Impact Analysis 25
Table 10. Estimated Employment Impact Analysis 27

Figure 1. Northern Arizona Uranium Breccia Pipe Resources 2
Figure 2. Breccia Pipe Morphology 8
Figure 3. Kanab North Mine, Mohave County, Arizona 10
Figure 4. Reclaimed Hack Canyon Mine 12
Figure 5. Aerial View of Kanab, Kane County, Utah 14
Figure 6. Fire Station in Fredonia, Arizona 16
Figure 7. Typical Uranium Drilling Equipment 20
Figure 8. White Mesa Mill, Blanding, Utah 22
Figure 9. Reclaimed Pigeon Mine, Northern Arizona 23
Figure 10. Hermit Mine, Northern Arizona, During Operations and After Reclamation 24
Figure 11. Western Legends Week, Kanab Utah: ACERT Poster and Booth Photo 26

Appendix A: Socioeconomic Charts & Graphs

Figure A-1. Demographic Characteristics of Project Area and Comparison Regions, 2000 ..... A-3
Figure A-2. Unemployment Trends in Project Area and Comparison Regions, 1999-2008 ..... A-3
Figure A-3. Employment by Industry, Coconino and Mohave Counties, Arizona, 2007 ..... A-4
Figure A-4. Employment by Industry, Arizona, 2007 ..... A-4
Figure A-5. Employment by Industry, Kane, San Juan, and Washington Counties, Utah, 2007 ..... A-5
Figure A-6. Employment by Industry, Kane and San Juan Counties alone, 2007 ..... A-5
Figure A-7. Sector 21, Mining, as Percent of Total Private-Sector Employment, 2001-2007 ..... A-6
Figure A-8. Sector Employment by Residence, 2000 ..... A-6
Figure A-9. Mining Sector Employment by Residence, 2000 ..... A-7
Figure A-10. Median Housing Value, 2000, Project Area and Comparison Regions A-7

SECTION 1. BACKGROUND & PROJECT INTRODUCTION

Tetra Tech, Inc.[3] (Tetra Tech) has prepared this independent analysis to estimate the potential value derived by mining the uranium contained in 1,069,000 acres in northern Arizona (the Northern Arizona Uranium District, or NAUD) (see Figure 1). Coconino and Mohave Counties are defined as the region of influence (ROI) for this analysis, which assesses the economic impacts to businesses and households in the ROI if these uranium resources were be mined. The report also qualitatively addresses impacts on neighboring counties in Utah and regional mining service centers. The region lying north of the Grand Canyon is generally referred to as the Arizona Strip.

In preparing this analysis, Tetra Tech has relied on projected operations, production, wages and benefits, and employment data provided by the American Clean Energy Resources Trust (ACERT), a consortium of mining companies, and on information from other sources deemed to be reliable, primarily federal agencies.

The Nuclear Fuel Cycle—Mine to End User[4]

Mining

Uranium deposits are found in rocks around the world and in all three major rock types (igneous, metamorphic, and sedimentary). The breccia pipe uranium ore in the NAUD is sedimentary. Uranium ore around the world varies in "grade," which refers to the percentage of mineral found in the rock. Uranium from northern Arizona is the highest grade ore in the United States.

Uranium can be recovered by conventional mining methods of excavation via surface pits or underground mine plans, or by dissolution by fluids pumped down drill holes to the resource. However, because both surface pits and dissolution mining are inapplicable to the Arizona breccia pipe deposits, these deposits would be mined by underground (hard rock) mining methods, with small amounts of water used for dust suppression and underground operations. Underground mining leaves a smaller surface footprint or disturbance. In the case of underground uranium mines, the mine plan addresses three parameters: production, mine ventilation, and roof control. Modern uranium mining operations are operated under strict regulations enforced by 10 federal and state agencies. The uranium industry has over 40 years of experience in applying international radiation safety regulations at uranium mines, and there are few ill effects for the miners that have been working in such mines. Due to advances in safety program management and mine design, U.S. underground mining of all minerals is now one of the safest industrial professions, nearing the safety records for low risk industries such as retail, banking, and insurance.

Milling

When recovered from the breccia pipe, uranium mineralization is contained within rock, which is transported to the mill where the ore is further crushed and then ground to a fine slurry. Sulfuric acid or a strong alkaline solution is used to dissolve the uranium, to allow the separation of uranium from the waste rock. It is then recovered from solution and precipitated as uranium oxide (U_3O_8) concentrate. This concentrated form is sometimes referred to as "yellowcake" and generally contains approximately 90 percent uranium. After drying and usually heating it is packed in 55-gallon drums as a concentrate. Yellowcake is not categorized as a hazardous material.

[3] Tetra Tech's qualifications are found in Section 9, List of Preparers. This report was commissioned by the American Clean Energy Resources Trust (ACERT), and ACERT has provided some production estimates. However, the report is an independent assessment of the value of the resource and the economic impacts of mining the resource. The report was prepared for use by third parties (legislative bodies and government agencies of the United States, Arizona, and Utah) to assist in policy decisions.

[4] The fuel cycle discussion was adapted from the World Nuclear Association website (WNA 2009a).

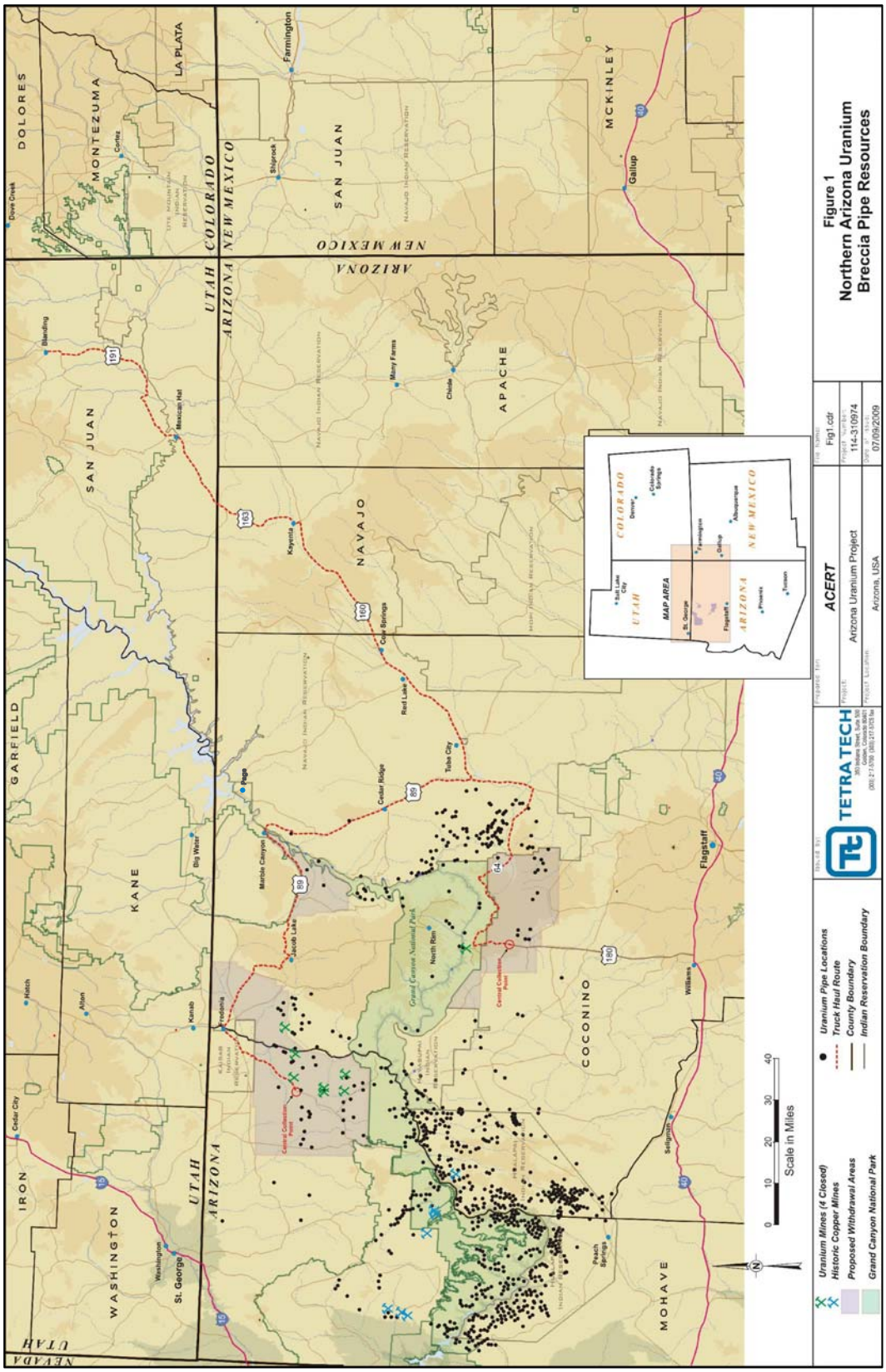


Figure 1. Northern Arizona Uranium Breccia Pipe Resources

Mills cannot separate all of the mineral from the waste. A small percentage (less than 10 percent) of the rock containing uranium, and a large percentage of the rock not containing uranium, exit the mill as waste or tailings. This waste is placed in engineered facilities near the mill. Substantial engineering design goes into the tailings disposal site so that it has long term geotechnical stability and allows for eventual revegetation of original biota (unless the mine permit allows for alternative post-mined land use). The engineering design also ensures that the refuse, which may contain low radioactivity, is isolated from any groundwater and other ecosystems.

Conversion, Enrichment and Fuel Fabrication

The yellowcake is shipped to fuel preparation facilities that further concentrate and convert the uranium to fuel quality. Most reactors use fuel enriched in the U-235 isotope. The solid uranium oxide (yellowcake) from the mine is converted into the gas UF_6, which is then enriched in the U-235 isotope by one of two physical methods of enrichment. *Diffusion* enrichment works by exploiting the different speeds at which U-235 and U-238 pass through a membrane. *Centrifuge* enrichment works by passing the gas through spinning cylinders, with the centrifugal force moving the heavier U-238 to the outside of the cylinder and leaving a higher concentration of U-235 on the inside.

Uranium dioxide pellets are produced from the enriched UF_6 gas. The pellets are then encased in long metal tubes, usually made of zirconium alloy (zircalloy) or stainless steel, to form fuel rods. The rods are then sealed and assembled in clusters to form fuel assemblies for use in the core of a nuclear reactor. The rods are then shipped to nuclear power plants or other end users.

Electricity Generation and Other Uses

Nuclear reactors produce electricity by heating water to make steam. The steam is then used to drive turbines that generate electricity. In this sense nuclear reactors are similar to other thermal power stations, where the heat from burning coal or natural gas is used to produce stream. A key difference of nuclear reactors is that they do not emit carbon dioxide. A nuclear *chain reaction* is so-called because when a U-235 atom splits (or *fissions*) in the reactor's core, the neutrons released cause other uranium atoms to also undergo fission. A moderator slows down the neutrons to achieve this. The nuclear reactor uses control rods to ensure that this chain reaction occurs at a controlled rate.

The U.S.S. Nautilus, a Nuclear-powered Submarine
[Source: STPNOC Website]

Uranium is also employed in other nuclear applications. Nuclear submarines, a critical part of America's defense, are able to travel long distances without refueling. Nuclear technology is also used in an ever-increasing variety of medical and diagnostic equipment and medical treatment.

Used Fuel Management

Used fuel from a nuclear reactor is first stored to allow most of the radioactivity to decay. Then it is either reprocessed to recover the reusable portion, or disposed of directly as waste. In reprocessing, the used fuel is dissolved and the uranium and plutonium in the used fuel are separated from the waste fission products. Plutonium can then be combined with uranium to make Mixed Oxide Fuel (MOX), which can be used in many modern reactors. Reprocessed uranium can be used in new uranium oxide fuel. No underground facilities have yet been built for used fuel, although several are planned. Low-level nuclear waste has been successfully and permanently stored at the U.S. Department of Energy's Waste Isolation Pilot Plant (WIPP) in southeastern New Mexico since 1996.

Uranium as a Fuel

Fuel Efficiency

Fuels are discussed in terms of the amount of energy they produce, traditionally expressed in British thermal units (BTU or Btu). One Btu is roughly the amount of energy needed to heat one pound of water by one degree Fahrenheit. It is perhaps easier to understand uranium's high level of efficiency by comparing it to other fuels.

One pound of yellowcake (U_3O_8) is equivalent to 35.6 barrels (bbl) of crude oil (a barrel of oil is approximately 42 gallons).

During the 1980s, seven mines in the NAUD produced 19 million pounds of uranium, the energy equivalent of approximately 676 million barrels of oil, with a temporary surface disturbance of less than 20 acres per mine—*an area smaller than a Wal-Mart parking lot*. The mine reclamation left the disturbance nearly undetectable and provided a positive example of environmentally effective mining under the nation's current mining and environmental laws.

The NAUD ore averages roughly 0.65% uranium—generally about five times higher than any other uranium deposits in the United States.

America's 104 nuclear power reactors provide 20 percent of U.S. electric power—clean-air electricity for one in five homes and businesses. Nuclear reactors use uranium measured in *pellets.* One fuel pellet is about twice the size of a pencil eraser (see illustration below). This fuel is so efficient that just one pellet provides as much energy as:

- 149 gallons of oil,
- One ton of coal, or
- 17,000 cubic feet of natural gas.
- Five fuel pellets meet a household's electricity needs for an *entire year*.

During the 1980s and 1990s, six mines in the NAUD produced approximately 20 million pounds of uranium, the energy equivalent of one billion barrels of oil, with a temporary surface disturbance of less than 20 acres per mine—an area smaller than a Wal-Mart parking lot.

The NAUD ore averages roughly 0.65% uranium—generally about five times higher than any other uranium deposits in the country. The average producing life of an underground breccia pipe uranium mine is two years, with an average production rate of 1.5 million pounds U_3O_8 per year, compared to, for example, a surface copper mine with a life span of 40-50 years and beyond.

Shown at left is the Wetlands Waterfowl Sanctuary located at the South Texas Project (STP) Nuclear Generating Station, in Matagorda County, Texas (STP website).

Estimated World Reserves in BTUs

The Energy Information Administration (EIA), which is an agency of the U.S. Department of Energy, and other reliable agencies, have estimated the extent of major worldwide energy sources. These sources are considered as commercially and technically extractable, and are measured in quintillions of Btus, which reflects the amount of heat the energy can generate.

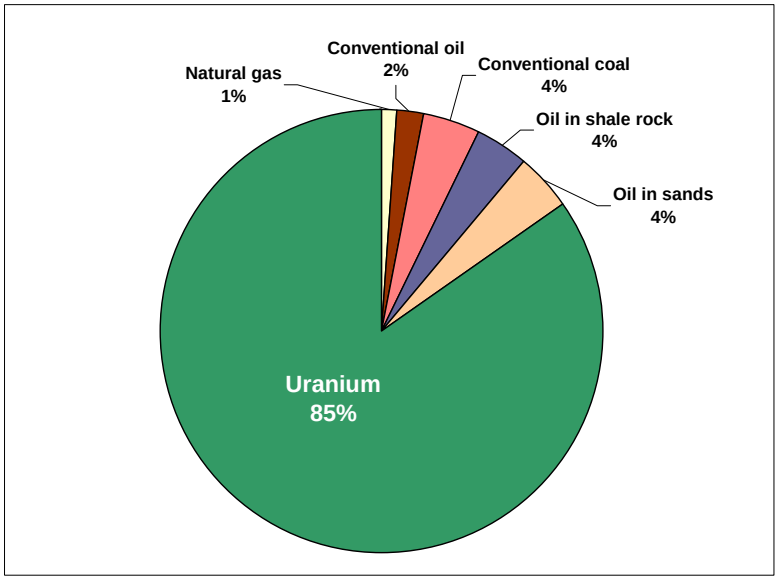
A *quintillion* is a billion billions, or 10^{18} — that's 18 zeros: 1,000,000,000,000,000,000.

Table 1. World BTU Capacity by Energy Source

Energy Type	*Reserves (quintillions of Btus)*	*Percent of Total*
Conventional natural gas	5.5	1.1%
Conventional oil	10.2	2.1%
Conventional coal	19.5	3.9%
Oil in shale rock	19.3	3.9%
Oil in sands	20.9	4.2%
Subtotal, Fossil Fuels	75.4	15.2%
Uranium	420.0	84.8%

Fossil fuels (oil, gas, and coal) were formed millions of years ago from the remains of organic life forms (plants and animals) composed of hydrogen and carbon, and are thus often referred to as hydrocarbon fuels. In terms of Btu capacity, hydrocarbon fuels provide only 15.2 percent of the total, while the world's uranium can produce 84.8 percent of the total—more than five times all hydrocarbon-based fuels together.

In 2005, the world used 0.468 quintillion Btus, and the United States used 0.101 quintillion Btus. At these usage rates, uranium could supply the world's energy for 900 years, carbon-based fuels for 12 years to 45 years.



The World's BTU Capacity by Energy Source

Project Introduction

The U.S. Department of Interior is considering the withdrawal from mineral entry and location approximately 1,069,000 acres of lands that comprise nearly all of the Northern Arizona Uranium District (NAUD) (see Figure 1). The NAUD extends through northern Arizona from the northern Coconino Plateau to the southern Utah border. Uranium mineralization in the district occurs in and around vertical columns of broken and re-cemented rock commonly 200 to 500 feet in diameter, known as collapse breccia pipes. The mineralization is restricted to depths ranging from 1100 to 1,700 feet below the surface and constitutes some of the highest grade U_3O_8 ore in the United States.

The USGS Open File Report (OFR-89-550) shows the mapped locations of 1,296 pipes in and around the NAUD. The study only identifies the location of pipe structures that outcrop at the surface, but subsequent work in the area has demonstrated that breccia pipes can stop upward growth at any stratigraphic level above the Mississippian-aged Redwall Limestone, and many pipes do not reach the surface. If these structures penetrate the Coconino Sandstone in a favorable area within the NAUD they often contain uranium mineralization, but breccia pipes outside of the NAUD are seldom mineralized.

Arizona's uranium was first discovered in 1947, but early production was limited to a single mine.

The northern area contains 40 breccia pipes historically mapped by the U.S. Geological Survey (USGS) in 1989 (USGS Open File Report (OFR) 89-550). Seven of these pipes were mined between 1980 and 1990, yielding 142,000 tons of ore averaging 0.65 percent U_3O_8, which provided about 19 million pounds of U_3O_8. No mines are currently active in the northern area; however, four breccias pipes are in standby mode awaiting mine permitting activities to restart. In addition, field studies have been completed on seven other breccia pipes and are awaiting development activities; and another four pipes have attained discovered status and are awaiting field characterization studies. Finally, numerous other pipes are in the early stage of identification and resource definition.

The Arizona Strip has the highest grade and most profitable uranium production in the US.

From 1980 to 1990, Energy Fuels Nuclear (EFN) mined 1,142,000 tons of ore that averaged 0.65% U_3O_8 from 7 breccia pipes in the NAUD and produced 19 million pounds of uranium. They were some of the last hard rock uranium producers in the US prior to the uranium price decline of the 1990s. No mines are currently active; however, four breccia pipe uranium deposits are in standby mode awaiting mine permitting activities to restart. In addition, field studies have been completed on seven other breccia pipes and are awaiting development activities; and another four pipes have attained discovered status and are awaiting field characterization studies. Finally, numerous other pipes are in the early stage of identification and resource definition.

The Hack Canyon discovery initiated modern exploration in the district.

Uranium mineralization was first discovered on the NAUD in a mineralized breccia pipe in 1947. The uranium occurred in association with copper mineralization at the Orphan mine located two miles west of the visitor's center on the south rim of the Grand Canyon. The first uranium ore was shipped by the Golden Crown Mining Company in 1956 to a buying station in Tuba City. Before closing in 1969, the Orphan operation produced a reported total of 4.4 million pounds of uranium in material averaging 0.42% U_3O_8 and 6.7 million pounds of copper**.** The Orphan mine properties were located on patented claims granted and signed by President Theodore Roosevelt before the establishment of the Grand Canyon Park. The mine was not part of the park until it was purchased by the National Park Service in 1963, and integrated into the Grand Canyon National Park when the mining rights expired in 1988.

The north district has produced >19 million pounds of uranium, averaging 0.65% U_3O_8.

Since the discovery of uranium in the Orphan Mine, extensive field work has been conducted by governmental and private concerns to define the spatial extent of the breccia pipes in the NAUD. This work has included ground and airborne geophysical surveys, mapping of rock exposures in the deep canyons of the area, mapping on aerial photos, shallow and deep hole drilling, electric logging in drill holes, laboratory analysis of drill core, and 2- and 3-dimensional computer modeling. In addition, subsurface data have been obtained from observations and measurements taken in the historic underground mines.

Breccia Pipe Morphology and Origin

The following is a brief description of the morphology and geologic origin of NAUD breccia pipes:

- **Cavern formation**. Groundwater percolating through the sedimentary rocks dissolves the Mississippian-aged Redwall Limestone forming caverns. As the size of the cavern grows, roof rock becomes unstable and collapses into the void, forming a rubble zone. This rubble material is referred to as breccia.
- **Pipe formation**. Natural mechanical and chemical processes continue to weaken the overlying sedimentary rocks, resulting in the collapse zone migrating upwards above the cavern to a vertical distance of 2,000 to 4,000 feet. These resulting pipes have a cylindrical shape, a diameter of 200 to 500 feet, and a funnel-shaped pipe throat if they extend to ground surface. The breccias filling the pipes commonly have calcite or sulfate cement.
- **Uranium mineralization**. Uranium mineralization was deposited in the NAUD breccia pipes 200-260 million years ago. Uranium minerals, mostly pitchblende, are thought to have been transported to the breccia pipes by oxidizing ground water in the Coconino Sandstone, which occurs about 1,800feet above the Redwall Limestone. The ground water first migrated laterally through the sandstone to the breccia pipes, then downward in the more porous and permeable breccias that are surrounded by the non-porous Hermit Siltstone. As the enriched water moved downward, the chemical environment changed from an oxidizing to reducing state, resulting in the precipitation of dissolved minerals such as uranium, copper, iron and numerous other metals in trace amounts. The uranium-enriched zone in the breccia pipe may occur over a vertical distance of more than 600 feet and at depths of 1,100 to 1,700 feet below ground surface, and may contain up to 7 million pounds of U_3O_8.

A generalized breccia pipe geometry is illustrated in Figure 2.

Breccia Pipe Uranium Mine Characteristics

An average breccia pipe mine produces 3 million l of uranium, and has the following characteristics:

- Uranium: 3 million pounds of uranium at a grade averaging approximately 0.65 percent, which is the equivalent of 13 pounds of U_3O_8 per ton of ore.
- Dimensions of the uranium zone: Each breccia pipe has cylindrical uranium ore zone that ranges in size from 200 ft to 500 ft diameter by 100 ft to 600 ft high."
- Mining method: Modified shrink stoping[5] underground mine plan.
- Haulage: Spiral ramp to shaft.
- Footprint: Minimal mine surface footprint and disturbance.
- Surface waste rock storage: Temporary and restricted to ramp and shaft material. All ore is excavated and shipped to an offsite mill.

[5] "Stoping" is the removal of the ore from an underground mine, leaving behind an open space known as a stope.

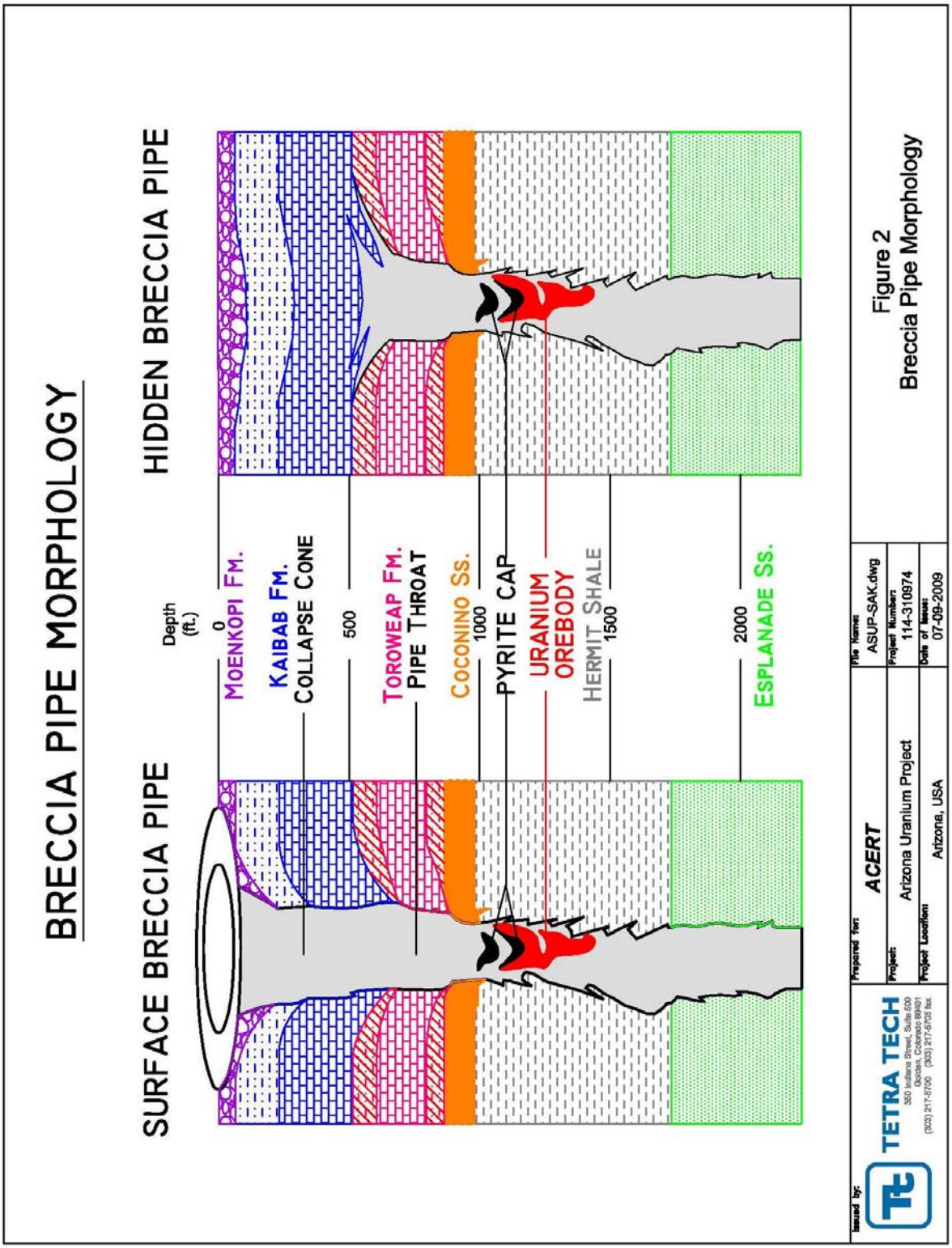


Figure 2. Breccia Pipe Morphology

Breccia Pipe Resources in the Project Area

The U.S. Geological Survey Circular 1051: *The 1987 Estimate of Undiscovered Uranium Endowment in the Solution-Collapse Breccia Pipes in the Grand Canyon Region of Northern Arizona and Adjacent Utah*, gives the 1,069,000 acre area (1,670 square miles) subject to the proposed withdrawal a calculated mean endowment of 112.4 tons of U_3O_8 per square mile and a total mean endowment of 187,690 tons (375 million pounds) of uranium oxide, equivalent to *about 42% of the total uranium resources in the United States*.

As noted above, over 19 million pounds of uranium have been produced since 1980 from the following seven mines in the Northern Arizona Uranium area:

Table 2. A Summary of Energy Fuels Nuclear Mining History on the Arizona Strip

Mine Name	Production Period	Tons Mined	Grade of U_3O_8	Total Pounds U_3O_8
Hack Canyon I	1981-1987	133,822	0.530	1,419,623
Hack Canyon II	1980-1987	497,099	0.704	7,000,273
Hack Canyon III	1981-1987	111,263	0.504	1,121,748
Pigeon	1985-1990	408,794	0.643	5,651,862
Kanab North	1988-1991	260,818	0.531	2,767,570
Pinenut	1988-	25,807	1.020	526,350
Hermit	1989-1990	36,339	0.760	552.449
Total / *Average*		**1,471,942**	***0.647***	**19,039,875**
Source: As reported in the 1998 International Uranium Corporation United States Securities and Exchange Commission Registration Statement.				

The current status of these mines is as follows:

- Hack Canyon I, II and III, Pigeon, and Hermit, owned and operated by Energy Fuels, are mined out and have been reclaimed.
- Kanab North, owned by Denison Mines, is on standby and has remaining mineable uranium reserves.
- Pinenut, owned by Denison Mines, is in the final phases of development, is awaiting permitting to restart production, and has remaining, mineable uranium reserves.
- Canyon, owned by Denison Mines, is in the final phases of development, is awaiting permitting to commence production, and has remaining, mineable uranium reserves.
- Another Denison Mines property, Arizona 1, is developed, awaiting final permitting to start production, and has mineable uranium reserves.

In addition to the developed mines, numerous other deposits have been identified; several are larger than those that are currently being permitted:

- Four deposits have been delineated from surface drilling and require underground development and drilling for final reserve definition. These deposits include EZ-1, EZ-2, Sage and Wate.
- At least 14 additional breccia pipe uranium deposits have been discovered and require additional drilling for resource delineation.
- Numerous other targets have a drill defined structure at the upper Fossil Mountain horizon but require additional deep drilling to define potential mineable targets.

Perhaps most significant to the overall potential of the NAUD, an airborne geophysical survey employing the latest in time domain electromagnetic technology was conducted by Quaterra Resources in March of 2007. The survey investigated 422 square miles; an area representing approximately one quarter of the NAUD. The program identified all of the known breccia pipes in the surveyed area ***and 200 high and moderate priority anomalies with a similar geophysical signature***. Confirmation drilling on the first two airborne anomalies discovered two new mineralized breccia pipes—the first new mineralized pipes in the NAUD in 18 years. If just 30% of these geophysical anomalies are breccia pipe uranium deposits, and a similar density of mineralized pipes can be identified in the remaining un-surveyed portion of the district, the final endowment of the NAUD may significantly exceed the 375 millions estimated by the USGS.

Figure 3. Kanab North Mine, Mohave County, Arizona

SECTION 2. URANIUM PRICING & DEMAND

This section presents information regarding projected uranium prices and demand.

Uranium Pricing

Two key organizations, the U.S. Energy Information Administration and the World Nuclear Association (WNA) have provided an outlook for uranium demand. In its newly released *Annual Energy Outlook, 2009*, the EIA reports the following. The U.S. nuclear industry's purchase demand for power generation was 51 million pounds of U_3O_8 in 2007, and 53 million pounds for 2008. In 2008, 14 percent of the demand was supplied by US mines, 42 percent from Australian and Canadian mines, and the remaining 44 percent was from other countries (Russia 23%, Kazakhstan 7%, Uzbekistan 4%, Namibia 7%, and South Africa 2%). For the period from 1994 to 2008, the U.S. purchase demand grew at an average rate of 2.4 percent per year. The report further states that for the 50-year period from 1980 to 2030, U.S. uranium power purchase demand, including both actual through 2008 and forecast to 2030, will grow at an average rate of 2.5 percent per year. For the past 50 years, by comparison, the U.S. gross domestic product has grown at an average annual rate of 3.2 percent (adjusted for inflation) (EIA 2009).

The World Nuclear Association, in its *WNA Nuclear Century Outlook*, uses a "low case" and a "high case" approach to forecast nuclear electrical power capacity from 2008 to 2030. Under the low case, capacity will grow between 99 gigawatts (GW) and 120 GW, at an average annual growth rate of 0.88 percent. Under the high case, capacity is projected at 180 GW, at an average annual growth rate of 2.75 percent (WNA 2009b).

Given these forecasts, this impact study assumes that the price of U_3O_8 in 2009 dollars will grow from its present price of approximately $52 per pound of U_3O_8 (as of July 2009) by at least 0.9 percent per year. This yields the following price predictions:

2010	$52.00
2015	$54.40
2020	$56.85
2025	$59.50
2030	$62.20

Although conservative when compared to many economic analyses of 2008 and other "high" cases, these prices represents a foundational level. In estimating the impact to the NAUD, further conservatism was applied by using a constant price of $50 per pound. These assumptions avoid overstating the expected benefits of uranium mining on northern Arizona and surrounding areas.

Uranium Demand

Studies by the USGS and private companies have determined that approximately 375 million pounds of U_3O_8 equivalent are contained in the uranium lands that could be removed from the NAUD mining opportunity that was made available by the Mining Act of 1872 and reaffirmed by the *Arizona Wilderness Act* of 1983. In 2008, the U.S. nuclear electrical power industry purchased 53 million pounds of uranium at an average price of $45.88 per pound. For the period 2009 through 2030, the median projection for uranium purchase demand is anticipated to increase by an annual average rate of 1.82 percent per year. This growth rate is the average of the low and the high electrical demand cases described above. Table 3 contains a projection of future world uranium demand for power generation, assuming this growth rate. These conservative assumptions by EIA

and WNA are based on the expectation that no large unforeseen changes occur in power generation technology, alternative fuel sources, nuclear policy, or geopolitical conditions.

Table 3. Projected World Uranium Demand

Year	World demand (millions of pounds)	World Additional demand (millions of pounds)
2008	114.0	0.0
2015	129.4	60.3
2020	141.6	112.9
2025	154.9	177.4
2030	169.6	247.9
Total	709.5	598.5

The total quantity through 2030 for world incremental uranium purchase demand is 599 million pounds. It is assumed that the NAUD can capture 50 to 65 percent of the 599 million pounds of incremental demand, or 300 million to 375 million pounds, thus reducing U.S. dependence on foreign sources, some of which could be unstable or even hostile to the U.S.

This production assumption is based on the following:

- The NAUD has demonstrated historical fundamental conditions that result in low mining cost and resource extraction; shallow access, high ore grade, and low capitalization. These factors place the NAUD toward the lower end of the supply cost curve—i.e., more efficient to produce—as compared to other U.S. uranium resource areas, which include the Gas Hills in central Wyoming, the Grants area of New Mexico, Texas, and western Colorado; and place the NAUD prominently in the world supply profile.
- Non-mining sources of uranium include spent fuel reprocessing and sales of decommissioned nuclear weaponry uranium into the power industry. Because of cost and technological barriers, these sources do not represent threats of supply substitution of NAUD fuel.

Figure 4. Reclaimed Hack Canyon Mine

SECTION 3. PROJECT AREA

This report assesses the impact of potential uranium mining operations on the economies of Coconino and Mohave Counties, Arizona, which comprise the study area (region of influence, or ROI) for this analysis (see Figure 1). Three adjacent counties in Utah could also be affected by this project. It is possible that some mine workers would reside in neighboring Kane County, where the community of Kanab is one of the nearest population centers to the northern Arizona mining sites. Uranium mined in northern Arizona would be milled in San Juan County, near the town of Blanding, at an existing facility. Some mine servicing support would come from St. George and Washington, in Washington County along Interstate 15. Impacts to the Utah counties are addressed qualitatively, along with impacts to other areas, Arizona, and the United States.

Table 4 presents a summary of indicators for the two ROI counties in Arizona, the adjacent Utah counties, and the two states (see Appendix A for graphics illustrating socioeconomic trends). In 2008, all five counties showed growth over 2000 populations. In Arizona, whose statewide growth was 26.7 percent during that period, Coconino County grew by 10.5 percent and Mohave County by 26.6 percent. Note that the major population centers in both of these geographically large counties are in the southern portions of the county. Coconino County contains the cities of Flagstaff (county seat and largest city) and Sedona, as well as the towns along the Grand Canyon's South Rim. Mohave County contains Kingman (county seat) and the cities along the Colorado River, Lake Havasu City (largest city) and Bullhead City.

Table 4. Project Area Overview

	Arizona			*Utah*			
	Statewide	**Coconino County**	**Mohave County**	**Statewide**	**Kane County**	**San Juan County**	**Washington County**
Est. Total Population, 2008[a]	6,500,180	128,558	196,281	2,736,424	6,577	15,055	137,589
% Change from 2000 Census	26.7%	10.5%	26.6%	22.5%	8.8%	4.5%	52.3%
Population Density per sq. mi.	45.2	6.2	11.6	27.2	1.5	1.8	37.2
Labor Force, 2008[b]:	3,132,667	73,433	93,421	1,383,743	3,528	5,079	62,495
Employment, 2008	2,960,199	69,679	86,918	1,336,156	3,387	4,773	59,639
Avg. annual unempl. rate, 2008	5.5%	5.1%	7.0%	3.4%	4.0%	6.0%	4.6%
Unempl. rate, May 2009	8.0%	6.3%	9.1%	5.2%	4.7%	7.4%	6.7%
Per Capita Income, 2007 ($)[d]:	$32,833	$31,855	$23,908	$29,831	$29,663	$17,170	$24,014
PCI as % of US PCI[a]	85.0%	82.5%	61.9%	77.3%	76.8%	44.5%	62.2%
Percent of population living below poverty, 2007	14.1%	16.2%	13.5%	9.8%	9.4%	31.6%	8.9%

[a] USCB 2009a. Population density is an area's population divided by its area.
[b] BLS 2009a. The May 2009 unemployment rate represents preliminary (unadjusted) data.
[c] BLS 2009b. "Empl" = employment; "unempl" = unemployment.
[d] BEA 2009a. "PCI" = per capita income. The data are the latest available.

In Utah, population increases of 8.8 and 4.5 percent occurred in Kane and San Juan Counties, respectively, between 2000 and 2008, while Washington County experienced a population increase of 52.3 percent, and Utah's statewide growth was 22.5 percent.

Coconino and Mohave Counties have population densities well below the state average of 45.2 persons per square mile, with densities of 6.2 and 11.6, respectively. Washington County has 37.2 persons per square mile, exceeding Utah's statewide density of 27.2, but Kane and San Juan are very sparsely populated, with densities of only 1.5 and 1.8, respectively (USCB 2000a).

The northern portions of both counties are in an area known as the "Arizona Strip," which is separated from the southern part of the state by the Grand Canyon. The area is characterized by small communities some distance apart, with no large towns. The nearest population centers to prospective mine locations north of the Grand Canyon are the small communities of Fredonia and Page, in Coconino County, Arizona, and Kanab, in Kane County, Utah. The prospective mining locations south of the Grand Canyon are less isolated from population centers, and workers could come from more populated areas such as Williams or Flagstaff. Characteristics of these communities are discussed in more detail below.

Figure 5. Aerial View of Kanab, Kane County, Utah

The population of the project area is largely white (Caucasian) except in San Juan County, where Native Americans comprise 56.3 percent of the population. In the remaining counties, Native Americans are the predominant minority, ranging from less than 1 percent of the population in Kane County to 27.7 percent in Coconino County. A portion of the Navajo Nation lies within San Juan County, and Coconino County is home to a portion of the Navajo Nation and the Hopi Indian Tribe. Statewide, Native Americans comprise 4.5 percent of Arizona's population and 1.2 percent of Utah's, compared to 0.9 percent nationally (USCB 2000a).

Per capita income (PCI) is total income divided by total population and is a useful measure to compare regions, even though it does not explicitly capture regional differences in cost of living. The PCI varied substantially across the project area, with San Juan County, UT having a PCI of only 44.5 percent of national levels. The highest PCI was for Arizona statewide, closely followed by Coconino County (BEA 2009a).

As of 2007, the national percentage of individuals living below poverty ("poverty rate") was 13 percent. Arizona and Mohave County were only slightly above the national poverty rate, while Coconino County was somewhat higher and San Juan County was substantially higher, with a rate of 31.6 percent. The poverty rate in Utah statewide and in Kane and Washington Counties was somewhat lower than the national average.

The average 2008 unemployment rates in Mohave County, AZ, and San Juan County, UT, were slightly higher than the national average rate of 5.8 percent, and somewhat lower in the other three counties. By May 2009, following several months of recession and job loss across the nation, all five counties had seen increases in unemployment, but only Mohave County equaled the national unemployment rate of 9.1 percent (BLS 2009a).

The economies of the ROI and adjacent counties in Utah area are reasonably diversified, according to 2007 data (BEA 2009b). The ROI is more typically urban due to the presence of Flagstaff, with the Services sectors accounting for 40.6 percent of jobs, followed by Retail Trade (13.3 percent), Construction (8.6 percent), and Manufacturing (5.1 percent). Diversification in the ROI is very similar to Arizona as a whole. The three Utah counties, however, reflect a somewhat more rural diversification, with Services accounting for only 30.9 percent of jobs, followed by construction (14.0 percent), Retail Trade (12.6 percent), and Local Government (7.5 percent). When Washington County is excluded, however, the Services sector accounts for only 18.8 percent of jobs in Kane and San Juan Counties, more typical of a very rural area. (Note that much of the employment data for these two counties have not been disclosed by the BEA, so it is difficult to assess the exact level of diversification.[6])

Table 5 presents data on the communities within or near the project area. The larger towns or those south of the Grand Canyon—Flagstaff, Sedona, Williams, and St. George—experienced strong population growth between 2000 and 2007. These communities also host tourists for the Grand Canyon, Zion National Park, and other well-known scenic attractions that draw tourists from around the world.

Table 5. Population Trends and Housing Costs, Project Area Communities

	Population[1]			Median Home Value, 2000[2]
	July 1, 2007 Estimate	Census 2000 (April 1, 2000)	% Change, 2000-2007	
Arizona towns				
Flagstaff (Coconino County)	59,746	52,894	13.0%	$161,000
Fredonia (Coconino County)	1,096	1,036	5.8%	$77,900
Page (Coconino County)	6,904	6,809	1.4%	$138,600
Sedona (Coconino County)	11,471	10,192	12.5%	$253,700
Williams (Mohave County)	3,270	2,842	15.1%	$100,300
Utah towns				
Blanding (San Juan County)	3,185	3,162	0.7%	$86,500
Kanab (Kane County)	3,769	3,564	5.8%	$106,100
St. George (Washington County)	71,161	49,663	43.3%	$143,200

[1] USCB 2008a, 2008b. Data for 2007 are the latest available for sub-county entities.
[2] USCB 2000b. Dollars are 2000, not adjusted for inflation to 2009.

Growth in the Arizona Strip communities and in Kane and San Juan Counties has been more modest. Fredonia grew by 5.8 percent between 2000 and 2007, while Page grew by only 1.4 percent. Kanab, the county seat and largest town in Kane County, grew by 5.8 percent between 2000 and 2007.

[6] County or other small area data may not be disclosed when data do not meet BLS or State agency disclosure standards regarding confidentiality or data quality. For example, if there are few firms in an area, data users could determine or approximate a firm's total payroll, hours worked, and other information that a firm may not want known to its competitors.

The San Juan County seat of Monticello[7] saw its population almost unchanged, while Blanding, the county's largest city, grew only slightly. However, St. George City, Washington County's seat and largest city, grew by 43 percent. (USCB 2000a, 2008a; 2008b).

Median home values (owner-occupied homes, as recorded in the 2000 Census) vary across the project area, as Table 5 shows. By comparison, Arizona's median home value was $121,300, Coconino County's was $142,500, and Mohave County's was $95,300. In Utah, the statewide median home value was $146,100, while it was $103,900 in Kane County, $68,400 in San Juan County, and $139,800 in Washington County. The national median home value was $119,600. Although it is expected that most of the mining labor force would be drawn from local residents, Kanab, Fredonia, and Williams have median home values well under the national and state averages, suggesting that any incoming workers could readily find affordable housing.

The city of Sedona, south of the project area and divided between Coconino County and Yavapai County, is a major tourist and retirement center. As Table 6 shows, Sedona's median home value in 2000 was substantially higher than communities closer to the project area and the county and state values. These high home values suggest that much of Coconino County's wealth may be concentrated in the southern portion of the county.

Figure 6. Fire Station in Fredonia, Arizona

[7] The town of Monticello, located north of Blanding, is considered too far from the prospective NAUD mine sites for its labor force to be employed in the possible mines. However, any increases in the amount of uranium processed at the White Mesa Mill in Blanding would lead to greater employment opportunities for residents of Monticello, Blanding, and the surrounding areas.

SECTION 4. METHODOLOGY & DEFINITIONS

This section presents Tetra Tech's assumptions and methodology in preparing this report, and describes certain taxes that can be affected by mining production.

Regional Input-Output Multipliers

In performing this analysis, Tetra Tech used the Regional Input-Output Modeling System (RIMS II) developed by the Bureau of Economic Analysis (BEA), U.S. Department of Commerce (BEA 2009c). RIMS II is widely used in both the public and private sectors for economic impact analysis. In the public sector, for example, the Department of Defense uses RIMS II to estimate the regional impacts of military base closings. State agencies use RIMS II to estimate the regional impacts of various projects such as new highways and airport construction and expansion. In the private sector, analysts and consultants use RIMS II to estimate the regional impacts of a wide variety of activities and programs such as tourist expenditures, opening or closing manufacturing plants, shopping mall development, and new sports stadiums.

RIMS II measures the economic impact of a business operation by using location-specific multipliers to determine the total output, earnings, and employment generated within a geographic region. The RIMS II multipliers reflect three types of economic impact:

- Direct impact represents the initial value of goods and services purchased by the subject business operation;
- Indirect impact represents the value of goods and services purchased by local companies to provide goods and services demanded by the subject business operation; and
- Induced impact measures the change in local household spending patterns resulting from increased earnings by employees in local industries producing goods and services for the subject business operation.

RIMS II multipliers are based on a national input-output table, which is adjusted to reflect a region's industrial structure and trading patterns. Industries are defined according to the North American Industry Classification System (NAICS) (USCB 2009b). Economic sector Mining (NAICS 21) includes oil and gas extraction and all types of mining, quarrying, and support activities. This report focuses on Sector 21, Mining.

RIMS II multipliers are available for any region composed of one or more counties. However, if an economic sector is not currently present in a county or region, a multiplier may not be available to estimate impacts resulting from increases in that sector. For this reason, this analysis uses a multiplier based on Montrose County, Colorado, which is similar to the project ROI and where uranium mining is present.

To assess the impacts of uranium mining operations on the ROI's economy, the multipliers for Industry 2122A0, Gold, Silver, and Other Metal Ore Mining, were applied to estimated sales, wages and benefits, and employment data provided by the American Clean Energy Resources Trust, a consortium of mining companies.

Data

All statistical data used in this analysis are the latest available that provide comparable, consistent, and reliable information for the geographic area under consideration.

Projected uranium production, wages and benefits, and employment data have been provided by ACERT members.

ACERT and Tetra Tech approximated potential total sales dollars using projected production and predicted prices for Arizona uranium. The pricing methodology is discussed above and is based on predictions by the EIA and WNA.

Tax Definitions

Several types of taxes are relevant in analyzing the impacts of potential uranium mining operations to the economies of Coconino and Mohave Counties and other areas. Some non-payroll taxes are listed below, with a brief definition.

- Property Tax (*ad valorem* or "according to value"), a county-levied tax on property.

  Purpose: to compensate government for the cost of services based on the value of real and personal property. Flows into the economy by County action.

- Sales and Use Tax, a State- and local-levied tax on sales of tangible personal property at rates ranging from 2.9 percent to 8.0 percent, based on local options.

  Purpose: to finance the operations of local and state governments. Flows into and out of the economy by state and local action.

- Severance Tax, a state levied tax on extracted minerals equal to 2.5 percent of 50 percent of the difference between the gross value of production and the production costs. The tax applies to all lands from which minerals are extracted, regardless of the land's ownership.

  Purpose: to compensate present and future citizens for the loss of natural resources from the land by individuals and corporations that make a profit by using up the irreplaceable natural wealth of a state. Flows back into and out of the economy by state action.

- Arizona State Corporate Income Tax, a State-levied tax on income, 6.968 percent of net income; deduction allowed for depletion, but not for Federal income taxes.

  Purpose: to finance the operations and capital improvement for state government. Flows into and out of the economy by state action.

- Federal Corporate Income Tax, a Federally-levied tax of 35 percent for taxable income over $18,333,333, with a sliding scale.

Federal, state, and local governments may also levy other taxes and fees based on production and other factors.

Mine workers who are Utah residents would pay Utah personal income tax. Any mine or worker purchases made in Utah would be subject, as applicable, to Utah sales and use taxes.

SECTION 5. ESTIMATED OUTPUT IMPACT ANALYSIS

Operating Scenario Assumptions

The economic analysis is based on the following operating scenario assumptions for the NAUD, which are premised on the USGS and private evaluations identifying the uranium resources in the area, as discussed in Section 1 of this report.

The 126 projected mines, divided into 3-mine "sets," would be developed and mined under a "rolling" schedule that extends over 42 years. Operations would include the following activities over a 5-year cycle for each set of mines: planning and permitting (Year 1); development, and installation of machinery and infrastructure (Year 2); production (Years 3 and 4); and reclamation (Year 5). Except for the first three years and the last two years of the 42-year period, two sets of mines (six mines) would be in production during any given year.

This rolling schedule approach has several advantages. First and foremost, the 42-year schedule would ensure a long-term, stable workforce in the project area, avoiding the undesirable "boom-and-bust" impacts, typical of many large projects, in which a large, short-term influx of workers can stress communities. The project's longevity would allow local workers to work many years in an industry that provides higher-than-average wages and benefits. Workers who moved into the area would bring their families and settle into the community, contributing to the long-term healthy growth of local communities, and strengthening the local tax base and the expansion of services. Suppliers and other businesses could feel confident about opening or expanding in the project area, given the long-term nature of the project.

Allocating production over a long duration would also minimize any impacts related to transportation of machinery and ore, thus reducing traffic and the wear and tear on the transportation network. Finally, the long-term nature of the project and the rolling schedule means that at any one time, operations in the NAUD would be fairly small in scale, thus avoiding the commitment of a large portion of available infrastructure resources (equipment, for example) to the NAUD effort. Such a capture of resources for one project could harm other mining operations in the region, the U.S., and even internationally.

Impact Analysis

This section estimates the impacts to the local economy from operations at the breccia mines. As such, the analysis encompasses:

- The mining companies' projected sales;
- Purchases of goods and services by the mining companies from local businesses ("suppliers");
- Sales of goods and services by other local businesses to the local and area suppliers; and
- Sales of goods and services to employees of these companies and to mining workers;

In performing this analysis, we have used the RIMS II multipliers as described in Section 4. RIMS II measures the economic impact of a business by using location-specific multipliers to determine the total output generated within a geographic region.

To determine the total estimated output impact of the mining operations on Coconino and Mohave Counties (the ROI), Tetra Tech used the RIMS II output multiplier specific to NAICS Sector 2122A0, Gold, Silver, and Other Metal Ore Mining; this multiplier of 1.5560 indicates that each

$1.00 of sales by the mine operators would generate an additional $0.5560 in sales for other local businesses (BEA 2009c). Applying this multiplier yields the results shown below.

Table 6. Estimated Output Impact Analysis

Component	Total Sales ($ Millions)
Direct – Mining Companies[1]	$18,900
Indirect – Other local businesses	$10,508
Total	$29,408
Duration of production (years)	*42*
Average Annual Total Impact	$700

[1] Direct output estimates were projected by ACERT members.

Estimated annual sales from the projected uranium mining operations could total approximately $18.9 billion over the 42 production years of the project. Application of the BEA multiplier predicts that additional sales generated by other businesses as a result of the mining operation's impacts on the local economy could be as much as $10.5 billion, yielding a total estimated output impact for the ROI of up to $29.4 billion. The average annual impact to the area could be as much as $700 million, and would represent a substantial beneficial impact to residents of the local counties and the State of Arizona, and would benefit adjacent areas as well.

A typical uranium mine in Arizona requires a minimum of $23 million of equipment for mine site surface and underground equipment (see Figure 7). The equipment is powered by electro-mechanical and diesel drive trains. A mining operation employs sophisticated maintenance planning systems to realize the lowest cost.

An integral part of cost effective mining is the presence of third party maintenance support and parts inventory near the operations areas, to avoid production delays, unscheduled shutdowns for maintenance, and subsequent loss of revenues. Mines also use consumables such as tires, fuel, explosives, and lubricants; construction support; and miscellaneous parts and services.

The mining companies have projected expenditures of $21 million for mining labor, materials, and supplies; $8 million for trucking the ore to Blanding Utah; and $23 million to process the ore at Blanding. To the greatest possible extent, the mine operators' policy would be to use local contractors and suppliers to obtain services and supplies needed in its operations, thus maximizing the impact to Coconino and Mohave Counties and neighboring areas. The company would use local providers to obtain materials from national suppliers, thus allowing a portion of those expenditures to remain within the ROI and surrounding areas, directly benefitting the local economy.

Figure 7. Typical Uranium Drilling Equipment

Economic Impact on Neighboring Counties

The uranium mining operations would be dispersed around Coconino and Mohave Counties, which would receive the primary economic benefit. However, the economic influence of these operations could also extend to other areas, including Kane, San Juan, and Washington Counties, Utah, to the north (see Figure 1). Goods and services could also be obtained from Flagstaff (in Coconino County) and other metropolitan areas, such as Grand Junction and Denver, Colorado; Farmington, New Mexico; and Salt Lake City and other Utah cities.

Mine workers residing in the neighboring counties, and the mine's purchases of goods and services from larger towns outside of the ROI, would generate additional impacts beyond the ROI. This report does not analyze those impacts in detail. However, to partially assess these effects, Tetra Tech collected employment data from the Bureau of Labor Statistics (BLS) for the ROI, Arizona, the neighboring Utah counties, Utah, and the United States (see Table 7). All data shown are for private sector employment only (government jobs are excluded).

Within the project area, Sector 21, Mining (which includes support activities) accounts for a noticeable share (7.9 percent) of total employment only in San Juan County, which is home to a uranium mill. In the remaining project area, mining accounts for less than 1 percent of total jobs (BLS 2009b). In Arizona, mining jobs make up 0.5 percent of the total, and in Utah, 1.1 percent of jobs. Data for the mining sector were not disclosed for Kane County.

Table 7. Private Sector Employment and Wages, 2007, Coconino and Mohave Counties and Comparison Areas

	Total, All Industries[1]		Sector 21, Mining		*Sector 21 as % of Total Empl.*	*Sector 21 as % of Total Wages*
	Empl.[2]	*Total Wages ($000)*	*Empl.*	*Total Wages ($000)*		
United States	114,012,221	$5,057,540,759	660,276	$54,154,901	0.6%	1.1%
Arizona	2,248,274	92,267,716	11,449	$714,865	0.5%	0.8%
Coconino Co.	44,842	1,394,924	91	$3,092	0.2%	0.2%
Mohave Co.	44,857	1,332,253	153	$6,109	0.3%	0.5%
Utah	1,024,330	37,555,611	11,034	$749,990	1.1%	2.0%
Kane Co.3	2,437	56,935	(ND)	(ND)	N/A	N/A
San Juan Co.	2,585	66,808	205	$10,534	7.9%	15.8%
Washington Co.	46,840	1,337,093	307	$7,041	0.7%	0.5%

[1] All data are for private sector firms only.
[2] Empl. = Employment (number of jobs) located in each area.
[3] (ND) = Non-disclosed (do not meet BLS confidentiality criteria). N/A = not applicable.
Source: BLS 2009b. Data for 2007 are the latest available at this level of disaggregation.

Data in these counties for the industry subsector including uranium mining were not available or were not disclosed due to confidentiality concerns (USCB 2009b). In every area but Washington County, Sector 21 wages reflect a higher percentage of the total than the employment numbers for those sectors, revealing that this industry pays higher than average wages.

The 2000 Census collected information regarding residents' employment by industry sector (later data are not available for these counties). Tetra Tech used these data to assess the number of mining workers residing in the area. As Table 8 shows, only in San Juan County were more than 1 percent of the resident labor force employed in the mining sector.

Table 8. Civilian Labor Force And Mining Employment by Residence, 2000

	Arizona				Utah		
	State-wide	Coconino County	Mohave County	State-wide	Kane County	San Juan County	Washington County
Total civilian labor force (residents over age 16)	2,233,004	55,510	60,517	1,044,362	2,666	4,235	35,646
Total employed in Sector 21, Mining	10,746	218	140	8,151	11	141	56
as % of total employment	0.5%	0.4%	0.2%	0.8%	0.4%	3.3%	0.2%

Note: This table shows the number of each area's residents who work in the mining sector (regardless of where the jobs are located). By contrast, Table 7 shows the number of jobs located in each area, by sector, and does not consider the residence location of the workers.

Source: USCB 2000b. These are the latest data available at this level of disaggregation.

The White Mesa Mill at Blanding, in San Juan County, is the only operating facility of its type in the United States. In 1980, the mill began processing uranium ore that contained nominally 0.3 percent or greater U_3O_8 ore into yellowcake uranium concentrate containing 90 percent U_3O_8. Since its opening, the mill has been owned by several companies, and it is currently owned by Denison Mines Corporation (DMC) of Toronto, Canada. The mill also recovers vanadium as a by-product (DMC 2009a). Figure 1 shows the mill's location; Figure 8 is an aerial view of the mill.

The capacity of the mill between 1980 and 2008 was 2,000 tons per day (tpd) of raw ore feed. In April 2008, a $31 million expansion and modernization program was completed. According to local newspapers, the mill's employment has ranged from approximately 103 employees in 1985 to 150 employees in 2007 (*Deseret News* 1985; *Telluride Watch* 2007). Current employment is about 150 when the mill is in full operation (DMC 2009b).

Figure 8. White Mesa Mill, Blanding, Utah

Based on the projected NAUD mining operations production of up to 375 million pounds over 42 years, the existing White Mesa Mill would have adequate capacity to support the NAUD projection. This proposed production would ensure the continued operation of the White Mesa Mill, along with the substantial benefits the Mill provides to San Juan County, Utah, and its residents, and would maintain the economic opportunities for suppliers in Blanding, the surrounding areas, and the region.

Regional and National Impacts

Grand Junction, Colorado, with an estimated 2007 population of 48,425, is 425 miles northeast of NAUD and is a major regional support center for the mining and oil & gas industry. Mining support vendors located there include two general mining parts warehouses, and parts warehouses for major mining equipment manufacturers.

Farmington, New Mexico, with an estimated 2007 population of 42,425, is 275 miles east of the NAUD. It is also a major regional support center for the mining and oil & gas industry.

Other suppliers for the uranium mining operations could be found in major metropolitan areas of the region, such as Denver and Salt Lake City.

Other major beneficiaries of NAUD production would include trucking companies. Historically, mining companies in the western United States have faced the need to haul ore and waste long distances to mills, railheads, and disposal sites. This need has been driven by the effect of diverse topography, lower population density, the absence of alternative transportation, and other factors. In the case of the NAUD, the raw ore extracted from the breccia pipes would be trucked to the White Mesa Mill at Blanding, Utah. The Blanding area is not served by railroads.

Mining companies have historically employed third-party trucking firms for efficiency and cost savings. The economic impact is local, as contract firms typically hire personnel and build service shops such that the truckers and trucks return to home base at the end of every shift. For 375 million pounds of U_3O_8 over a 42-year period, the total ore to be transported would equal nearly 29 million tons, generating about $1.6 billion in today's dollars for trucking firms, long-term stable employment for their workers, and a steady stream of revenue for their suppliers. As with most of the economic impact involved in the NAUD mining, these dollars would build the local economy, contradicting the paradox that exists in so many resource-rich areas, where the economic development impact leaves the area with the raw material.

Yellowcake, the output of the processing mill, is shipped to converters and refiners in 55-gallon drums that weigh an average of 800 pounds. Drums are shipped to conversion plants, where the yellowcake is ultimately converted to fuel for nuclear power plants. An average truck shipment contains approximately 40 drums, or 17.5 tons of yellowcake. This shipping would also generate revenues for trucking firms and their suppliers, as described above. As noted previously, yellowcake is not categorized as a hazardous material for shipping purposes.

Other beneficiaries would include mining equipment companies; equipment suppliers for items such as tires; oil companies; and a host of other firms that employ workers across the United States, in areas far removed geographically but not economically from Arizona.

Other Local Impacts

In addition to their economic contributions, uranium mine company workers residing in the area would contribute to the well-being of the area through their companies' environmental and safety efforts, from workers and their families volunteering and participating in local activities, and from company efforts in and donations to the community.

Reclamation of the mine sites as shown in Figure 9 becomes a source of pride to the local communities and residents.

Figure 9. Reclaimed Pigeon Mine, Northern Arizona

Fiscal Impacts

It is estimated that in addition to the benefits described above, various levels of government would collect the following additional revenues over the 42-year life of the project:

- $2 billion in federal and state corporate income taxes
- $168 million in state severance taxes
- $9.5 million in claims payments and fees to local governments.

Figure 10. Hermit Mine, Northern Arizona,
During Operations (Above) and After Reclamation (Below)

SECTION 6. ESTIMATED EARNINGS IMPACT ANALYSIS

The estimated earnings impact analysis measures the wages and benefits that could be received by households in the local economy. As such, it encompasses:

- Wages and benefits projected to be paid by uranium mining companies;
- Wages and benefits that would be paid by local businesses providing goods and services to mining companies ("suppliers");
- Wages and benefits that would be paid by other local businesses selling goods and services to suppliers; and
- Wages and benefits that would be paid by local businesses providing goods and services to the employees and families of all these companies.

To determine the total and annual average estimated earnings impact of the mining operations on Coconino and Mohave Counties (the ROI), Tetra Tech used the RIMS II earnings multiplier specific to NAICS Sector 2122A0, Gold, Silver, and Other Metal Ore Mining; this multiplier of 1.5751 indicates that each $1.00 of sales by the mine operators would generate an additional $0.5751 in sales for other local businesses (BEA 2009c). Applying this multiplier yields the results shown below.

Table 9. Estimated Earnings Impact Analysis

Component	Total Annual Earnings During Full Employment (approximately 38 years) ($ Millions)
Direct – Mining Companies[1]	$25.64
Indirect – Other local businesses	$14.74
Total	$40.38

[1]Earnings are based on employment projections by ACERT members and a weighted average annual wage of $65,741 (Infomine 2009).

The direct spending on local wages and benefits for potential NAUD mining operations is projected to total over $25.6 million annually during the years when all activities are underway (roughly 38 years of the 42). Additional wages would be generated by other businesses as a result of the mine operations; this impact on the local economy is estimated to total over $14.7 million annually, yielding a total earnings impact for the ROI at an estimated $40 million annually. Impacts would be somewhat lower during the initial years of the proposed project, before production begins, and at the end, when all that remains is reclamation of the final sets of mines.

Note that it is likely that some mine workers, especially in the Northern Tract, could reside in Kane County, Utah, and possibly in San Juan County as well. Much of the indirect impact would be tied to the counties where the workers actually reside, since this is generally where they shop and obtain services. For this reason, some of the indirect earnings impact would occur within Kane and San Juan Counties, and impacts to Coconino and Mohave Counties would be slightly overstated.

SECTION 7. ESTIMATED EMPLOYMENT IMPACT ANALYSIS

The estimated employment impact analysis measures the number of jobs that could be generated and sustained in the local economy. As such, it encompasses:

- Persons that would be employed by uranium mine operators;
- Persons that would be employed by local businesses providing goods and services to mining companies;
- Persons that would be employed by other local businesses selling goods and services to the local businesses providing goods and services to mining companies; and
- Persons that would be employed by local businesses providing goods and services to the employees of all these companies.

To determine the total and annual average estimated earnings impact of the mining operations on Coconino and Mohave Counties (the ROI), Tetra Tech used the RIMS II earnings multiplier specific to NAICS Sector 2122A0, Gold, Silver, and Other Metal Ore Mining; this multiplier of 2.7642 indicates that each NAUD uranium mining job would generate an additional 1.7642 jobs in the ROI (BEA 2009c). Applying this multiplier yields the results shown below.

Table 10. Estimated Employment Impact Analysis

Component	Number of Jobs During Full Employment (approximately 38 years)
Direct – Mining Companies[1]	390
Other local businesses	688
Total	1,078

[1] Employment projections were supplied by ACERT members and are based on projected mine employment of 65 persons per mine and two sets of 3 mines each (6 mines) operating per year. It is assumed that when production is complete on one set of mines, the same mine personnel would move on to the next set of mines.

Annual employment was estimated to be 390 workers (65 workers per mine[8] and 6 mines operating per year), with an additional 688 jobs to be created by other businesses as a result of the mining operations. The employment impact on the local economy is estimated to total 1,078 jobs. However, as noted above, it is likely that some mine workers could reside in Kane County or San Juan County, Utah, and that some of the indirect employment increases could occur in those counties. As noted above, impacts would be somewhat lower during the initial years of the proposed project, before production begins, and at the end, when all that remains is reclamation of the final sets of mines.

Although this is a relatively small increase over existing employment in the ROI counties, these well-paid jobs would provide substantial employment opportunities to residents in the less populated and more remote areas of the Arizona Strip and adjacent areas of Utah.

[8] The job total includes miners, geologists, engineers, managers, and other professional and support staff.

Conclusion

The NAUD represents an important domestic supply of low-cost uranium of the highest grade in the United States, which consumes approximately 50 million pounds of uranium annually. Only 12 percent of the U_3O_8 used by U.S. nuclear power plants was U.S.-origin uranium, while 88 percent was of foreign origin. The NAUD uranium endowment is estimated to produce over 375 million pounds of U3O8 with an energy equivalence of 13.3 billion barrels of crude oil — equal to the total recoverable oil in Prudhoe Bay, the largest oil field in North America.

Mining the lands proposed for withdrawal in the NAUD would produce significant economic benefits to the local area, to Arizona and Utah, and nationally:

- 1,078 new jobs in the project area
- $40 million annual impacts from payroll
- $29.4 billion in output impacts over the 42-year life of the project
- $2 billion in federal and state corporate income taxes
- $168 million in state severance taxes
- $9.5 million in claims payments and fees to local governments
- $1.6 billion to trucking firms transporting ore
- Continuation of 150 jobs at White Mesa Mill in Blanding, San Juan County, Utah, and the indirect jobs those workers support
- Increased business for regional and national mining support vendors
- Increased property taxes for local governments
- Increased state and local sales taxes

The proposed project's 42-year schedule would ensure a long-term, stable workforce in the project area, and businesses could feel confident about opening or expanding in the project area. The environmental cost of the NAUD mining would be low. The breccia pipe mines have a small footprint and a two-year life, and after reclamation, formerly mined areas are undetectable.

In short, uranium mining in northern Arizona would allow the United States to secure an important domestic source of fuel while providing significant economic benefits with minimal environmental impacts.

View of the "Arizona Strip"

SECTION 8. REFERENCES

BEA 2009a. Bureau of Economic Analysis, U.S. Department of Commerce. Regional Economic Accounts, Local Area Personal Income: Table CA04 – Personal income and employment summary. Available at http://www.bea.gov/bea/regional/reis/. Viewed June 2009.

BEA 2009b. Bureau of Economic Analysis, U.S. Department of Commerce. Regional Economic Accounts, Local Area Personal Income: Table CA25 – Total employment by industry. Available at http://www.bea.gov/bea/regional/reis/. Viewed July 2009.

BEA 2009c. Bureau of Economic Analysis, Economic and Statistics Administration, U.S. Department of Commerce. RIMS II Multipliers 1997/2006: Table 1.5, Total Multipliers for Output, Earnings, Employment, and Value Added by Detailed Industry, Montrose County, CO (Type II). U.S. Department of Commerce. Washington, D.C. Obtained July 2009.

BLS 2009a. Bureau of Labor Statistics, U.S. Department of Labor. Local Area Unemployment Statistics. Labor Force, Employment, and Unemployment Data. Available at http://data.bls.gov/. Viewed June 2009.

BLS 2009b. Bureau of Labor Statistics, U.S. Department of Labor. Quarterly Census of Employment and Wages. Available at http://data.bls.gov/. Viewed June 2009.

DMC 2009a. Denison Mines Corporation. "Denison Mines Corp. 2008 Annual Report". Denison Mines Corp., Toronto, Canada, 2009.

DMC 2009b. Denison Mines Corporation. Website: White Mesa Mill. Available at http://www.denisonmines.com/SiteResources/ . Viewed July 2009.

Deseret News 1985. "UMETCO Reopening White Mesa Mill near Blanding with 103 New Workers." *The Deseret News*, Salt Lake City, Utah, October 7, 1985.

EIA 2009. Energy Information Administration. Annual Energy Outlook 2009. Available at http://www.eia.doe.gov/oiaf/aeo/. March. Viewed July 2009.

InfoMine 2008. Mining Cost Service. CostMine, a division of InfoMine USA, Inc., Spokane Valley, Washington, 2008 edition.

STP 2009. South Texas Project Nuclear Operating Company. Website photo gallery. Available at http://www.stpnoc.com/gallery.htm. Viewed August 2009.

Telluride Watch 2007. "Mill Plans Emerge with Upsurge in Uranium Mining". *The Telluride Watch*, Telluride, Colorado, November 1, 2007.

USCB 2000a. U.S. Census Bureau. Census of Population and Housing. Data Set: Census 2000 Summary File 1 (SF 1) – 100-Percent Data. GCT-PH1. Population, Housing Units, Area, and Density: 2000. Available at: http://factfinder.census.gov/. Viewed June 2009.

USCB 2000b. U.S. Census Bureau. Census of Population and Housing. Data Set: Census 2000 Summary File 3 (SF 3) – Sample Data. Available at: http://factfinder.census.gov/. Viewed June 2009.

USCB 2008a. U.S. Census Bureau. American Factfinder. Arizona Places. Data Set: 2007 Population Estimates. Available at http://factfinder.census.gov/. Viewed June 2009.

USCB 2008b. U.S. Census Bureau. American Factfinder. Utah Places. Data Set: 2007 Population Estimates. Available at http://factfinder.census.gov/. Viewed June 2009.

USCB 2009a. U.S. Census Bureau. State and County QuickFacts for Arizona, Coconino and Mohave Counties, AZ, Utah, and Kane, San Juan, and Washington Counties, UT. Last Revised: Tuesday, May 5, 2009. Available at http://quickfacts.census.gov/. Viewed June 2009.

USCB 2009b. U.S. Census Bureau. North American Industry Classification System (NAICS): Frequently Asked Questions. Available at: http://www.census.gov/eos/www/naics/faqs/faqs.html#q1. Viewed June 2009.

USGS 1987. U.S. Geological Survey. *Circular 1051: The 1987 Estimate of Undiscovered Uranium Endowment in the Solution-Collapse Breccia Pipes in the Grand Canyon Region of Northern Arizona and Adjacent Utah.*

USGS 1989. U.S. Geological Survey. *Open File Report (OFR) 89-550: Map of locations of collapse-breccia pipes in the Grand Canyon region of Arizona.*

WNA 2009a. World Nuclear Association. Website: Information on Uranium Fuel Cycle. Available at http://www.world-nuclear.org/. Viewed July 2009.

WNA 2009b. World Nuclear Association. *WNA Nuclear Century Outlook*. Available at http://www.world-nuclear.org/outlook/clean_energy_need.html. Viewed July 2009.

SECTION 9. LIST OF PREPARERS

About Tetra Tech, Inc.

Tetra Tech is a leading provider of specialized consulting and technical services, offering infrastructure and environmental services to public and private sector clients. Our technical consulting services include research and development, applied science, engineering and construction management, operations and maintenance, and restoration and remediation. Founded in 1966, Tetra Tech has more than 10,000 employees located in 275 offices worldwide.

Tetra Tech's mining group provides geological, geotechnical, environmental, and mine engineering services to the mining industry. Our technical mining expertise includes research and development, applied science, engineering design, construction management, operations support, and site reclamation—supporting sustainable mining throughout the complete mine life cycle. Tetra Tech is also experienced in supporting economic and socioeconomic analysis related to mine feasibility studies and impact analysis.

Preparers:

Andrew P. Schissler, P.E., Ph.D., Project Manager. Principal Mining Engineer, Tetra Tech, Inc.

- B.Sc. and Ph.D., Mining and Earth Sciences Engineering; M.B.A.
- 35 years experience in mining engineering and management for private and government clients.

Stephen A. Krajewski, P.G., Ed. D., Senior Geologist Modeling & GIS, Tetra Tech, Inc.

- B.S. Geography, M.S. Geology, Ed. D. Earth Science
- 35 years experience in computerized modeling of mineral deposits internationally for academic institutions, government agencies and public and private companies.

Kristin L. Sutherlin, Socioeconomist, Tetra Tech, Inc.

- B.A., Economics; M.A. Candidate, Urban Studies / Planning.
- 25 years of experience in socioeconomic and economic impact analysis for government and private clients in the energy sector and other industries.

Leroy Aga, Senior Mine Planner, Tetra Tech, Inc.

- Assoc. Science.
- 25 years experience in developing mine optimization, reserve estimation, production scheduling, and mine planning.

This page intentionally left blank.

APPENDIX A. SOCIOECONOMIC CHARTS AND GRAPHS

Section 3, Project Area, describes social and economic characteristics of the Region of Influence (ROI), surrounding areas, and comparison regions. This appendix presents charts and graphs illustrating selected characteristics discussed in Section 3.

List of Figures

Figure A-1. Demographic Characteristics of Project Area and Comparison Regions, 2000 ..... A-3
Figure A-2. Unemployment Trends in Project Area and Comparison Regions, 1999-2008 ..... A-3
Figure A-3. Employment by Industry, Coconino and Mohave Counties, Arizona, 2007 ..... A-4
Figure A-4. Employment by Industry, Arizona, 2007 ..... A-4
Figure A-5. Employment by Industry, Kane, San Juan, and Washington Counties, Utah, 2007 ..... A-5
Figure A-6. Employment by Industry, Kane and San Juan Counties Alone, 2007 ..... A-5
Figure A-7. Sector 21, Mining, as Percent of Total Private-Sector Employment, 2001-2007 ..... A-6
Figure A-8. Sector Employment by Residence, 2000 ..... A-6
Figure A-9. Mining Sector Employment by Residence, 2000 ..... A-7
Figure A-10. Median Housing Value, 2000, Project Area and Comparison Regions A-7

This page intentionally left blank.

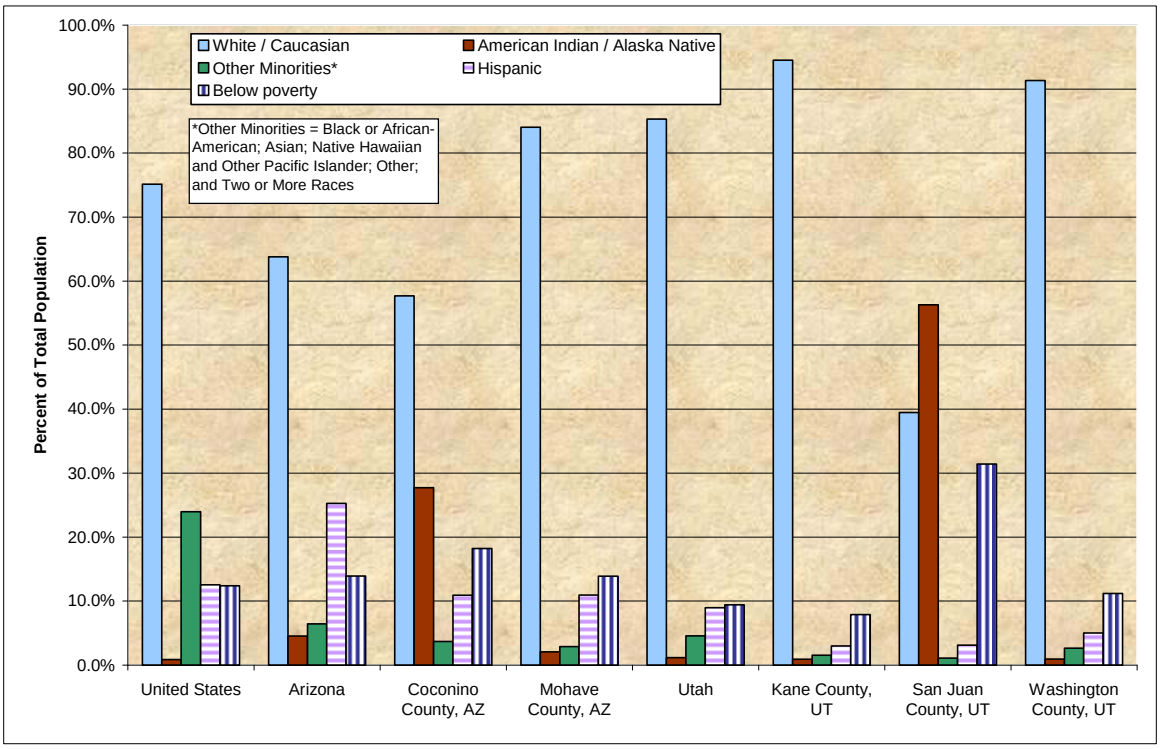


Figure A-1. Demographic Characteristics of Project Area and Comparison Regions, 2000

Note: White, American Indian, and Other Minorities sum to 100 percent. Hispanics may be of any race, and thus are not included in the total for racial categories. Below Poverty is a separate characteristic that is also not part of the 100 percent.

Source: USCB 2000a; USCB 2000b

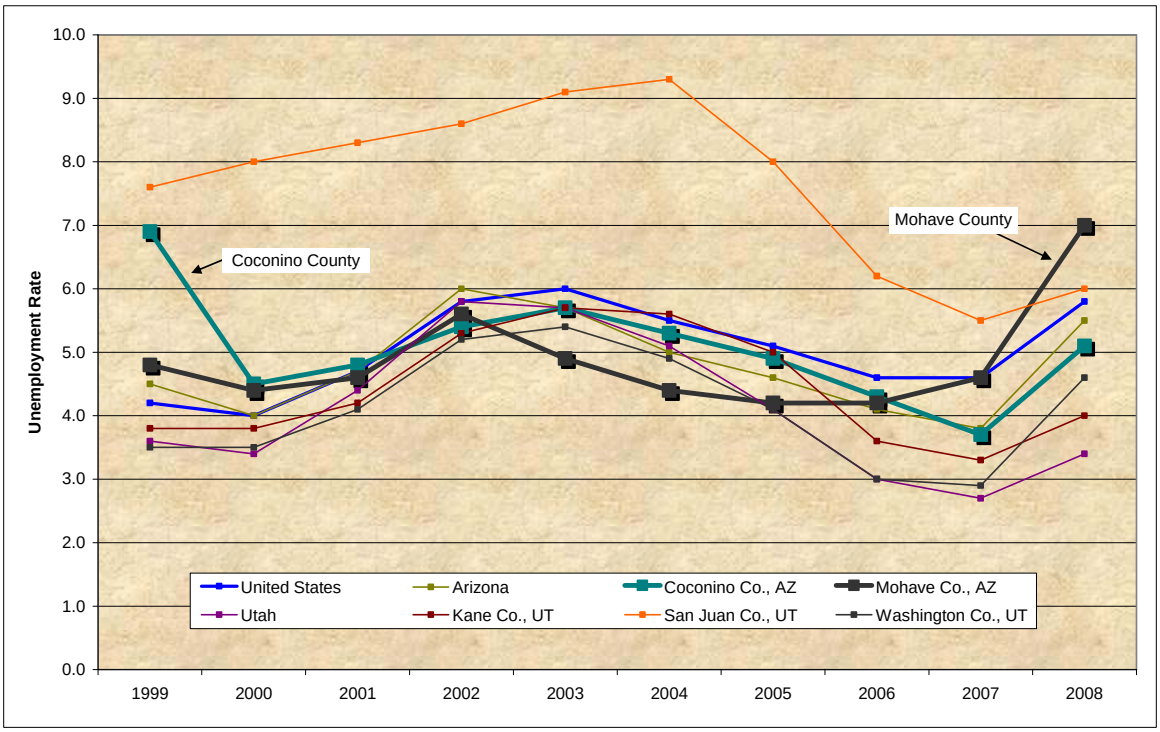


Figure A-2. Unemployment Trends in Project Area and Comparison Regions, 1999-2008

Source: BLS 2009a

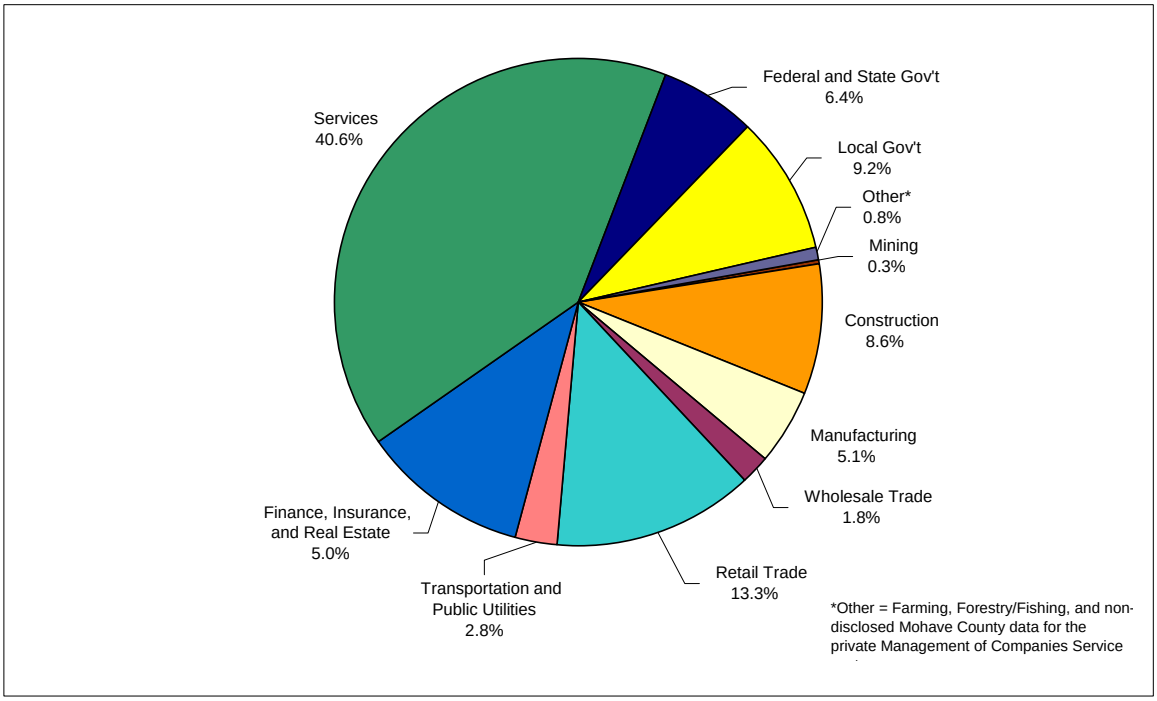


Figure A-3. Employment by Industry, Coconino and Mohave Counties, Arizona, 2007

Source: BEA 2009b

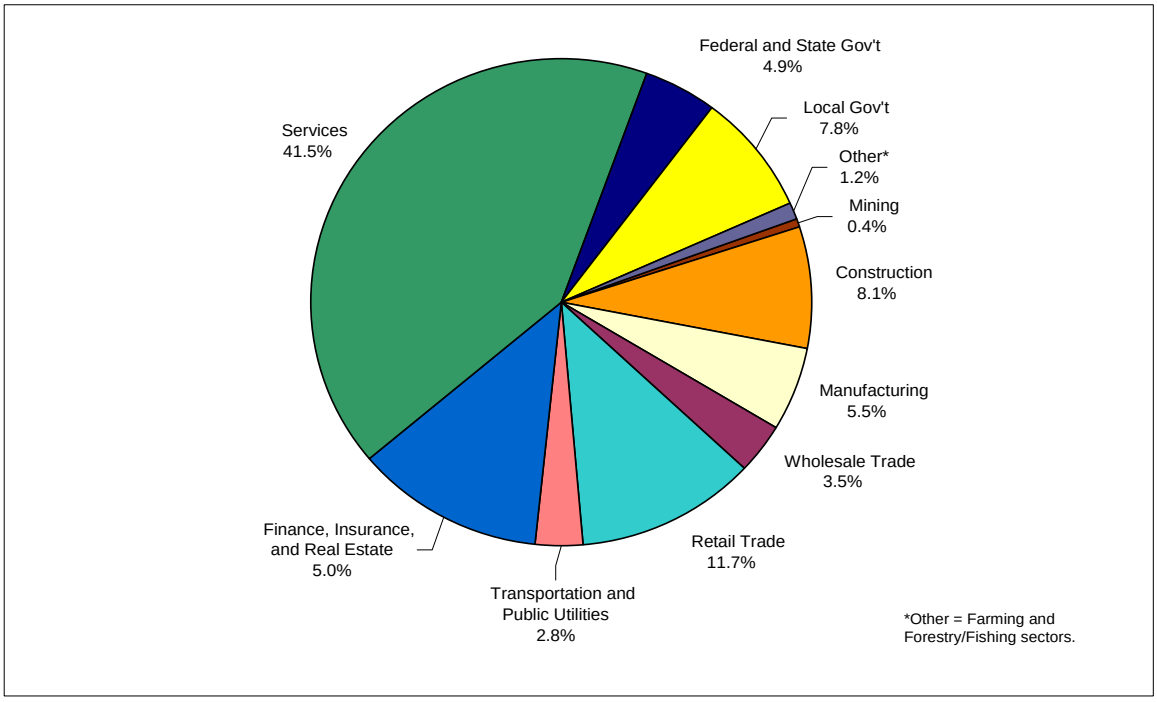


Figure A-4. Employment by Industry, Arizona, 2007

Source: BEA 2009b

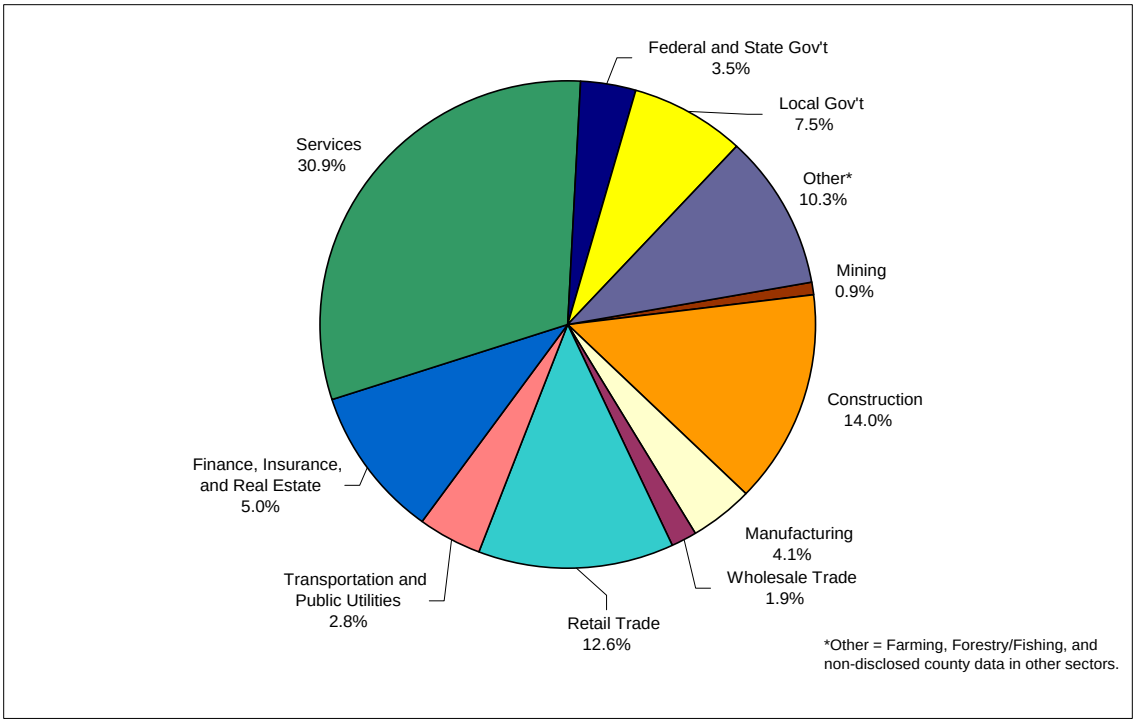


Figure A-5. Employment by Industry, Kane, San Juan, and Washington Counties, Utah, 2007

Source: BEA 2009b

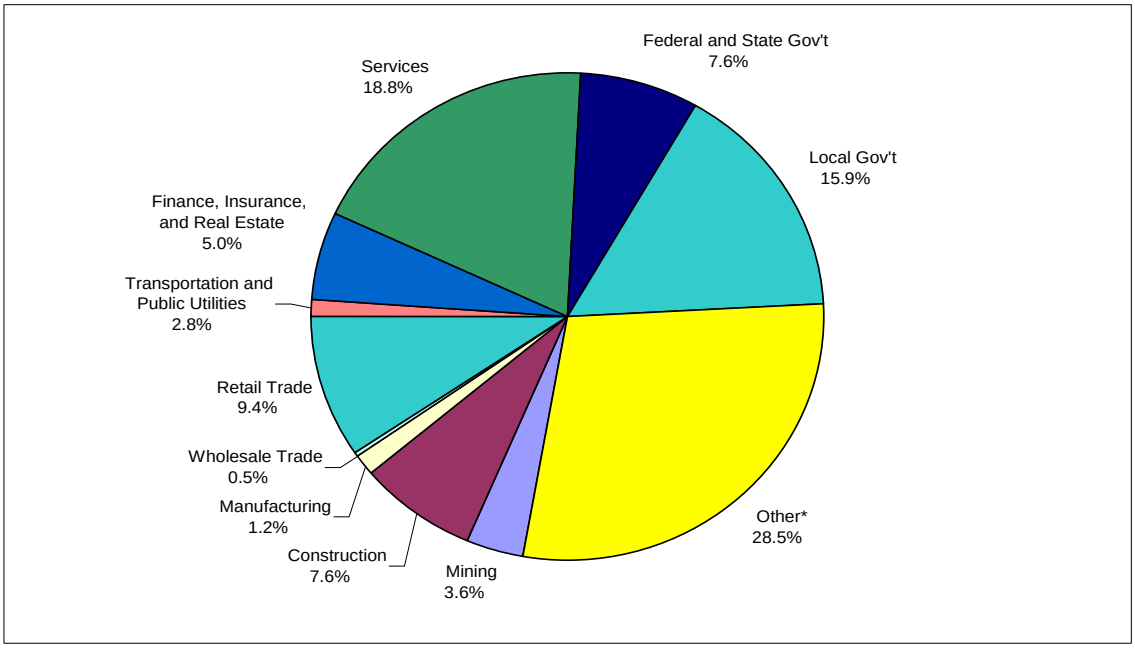


Figure A-6. Employment by Industry, Kane and San Juan Counties alone, 2007

Source: BEA 2009b

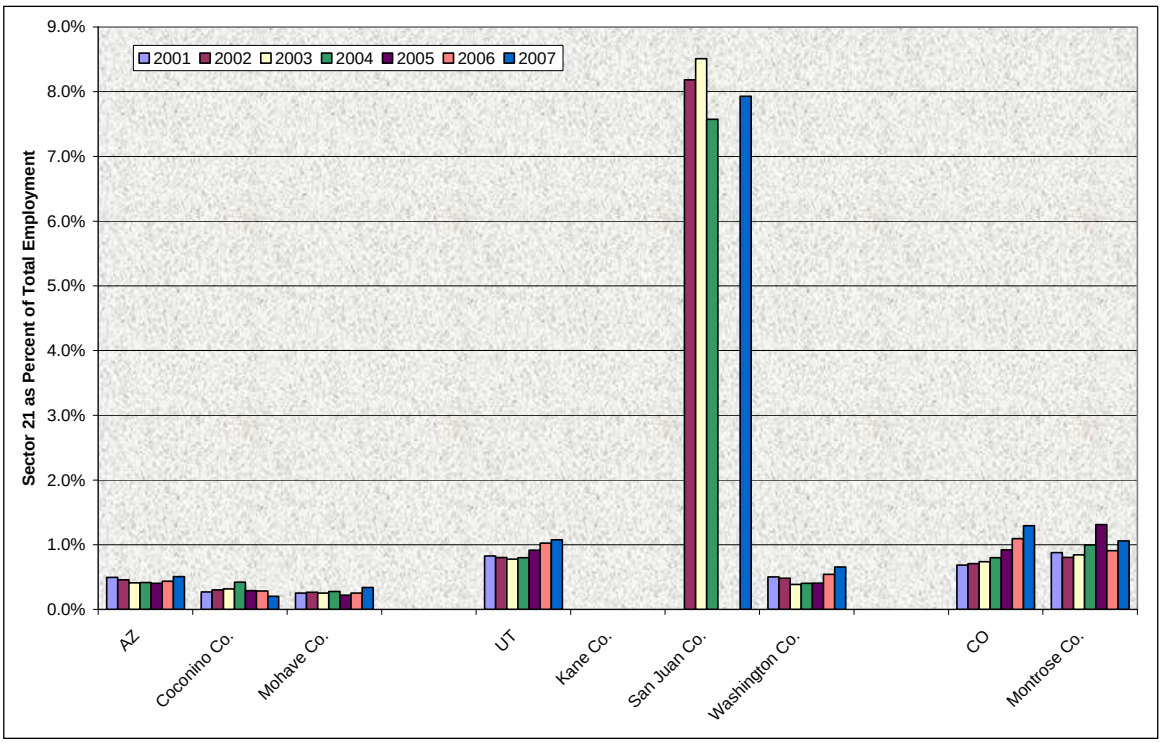


Figure A-7. Sector 21, Mining, as Percent of Total Private-Sector Employment, 2001-2007

Note: This chart is based on the location of the job, regardless of where the worker lives.

Source: BLS 2009b

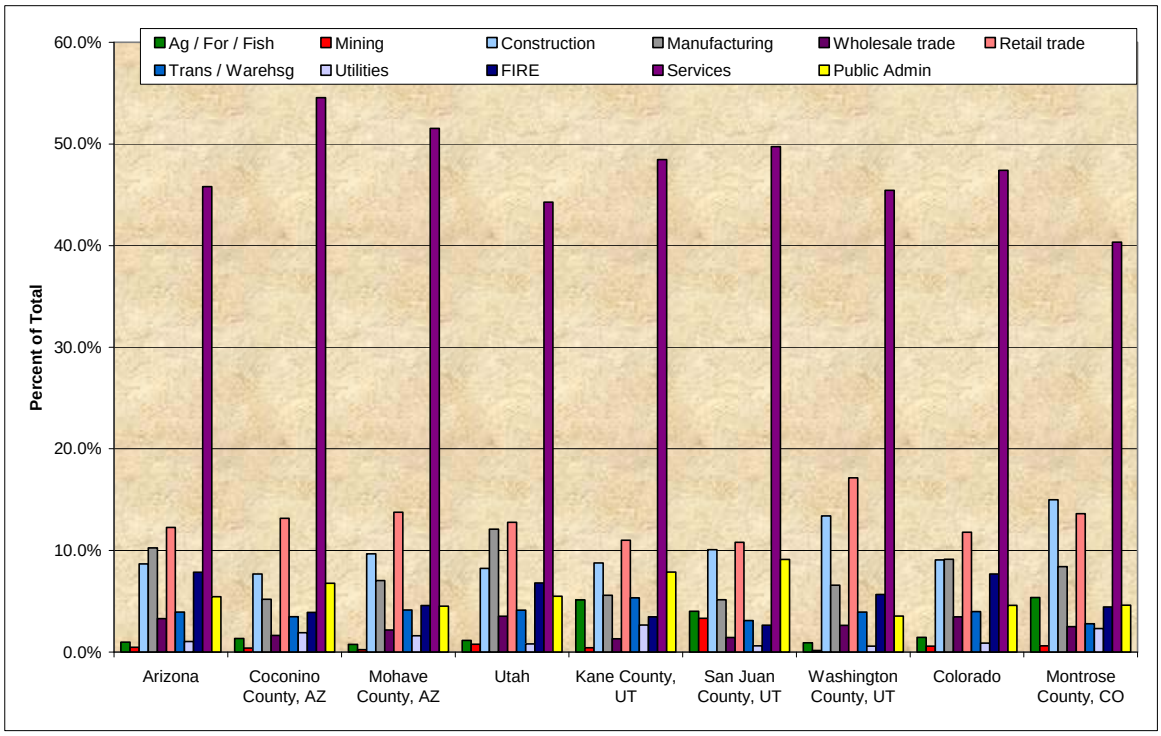


Figure A-8. Sector Employment by Residence, 2000

Note: This chart is based on the residence of the worker, regardless of the location of the job. Later data are not available.

Source: USCB 2000b

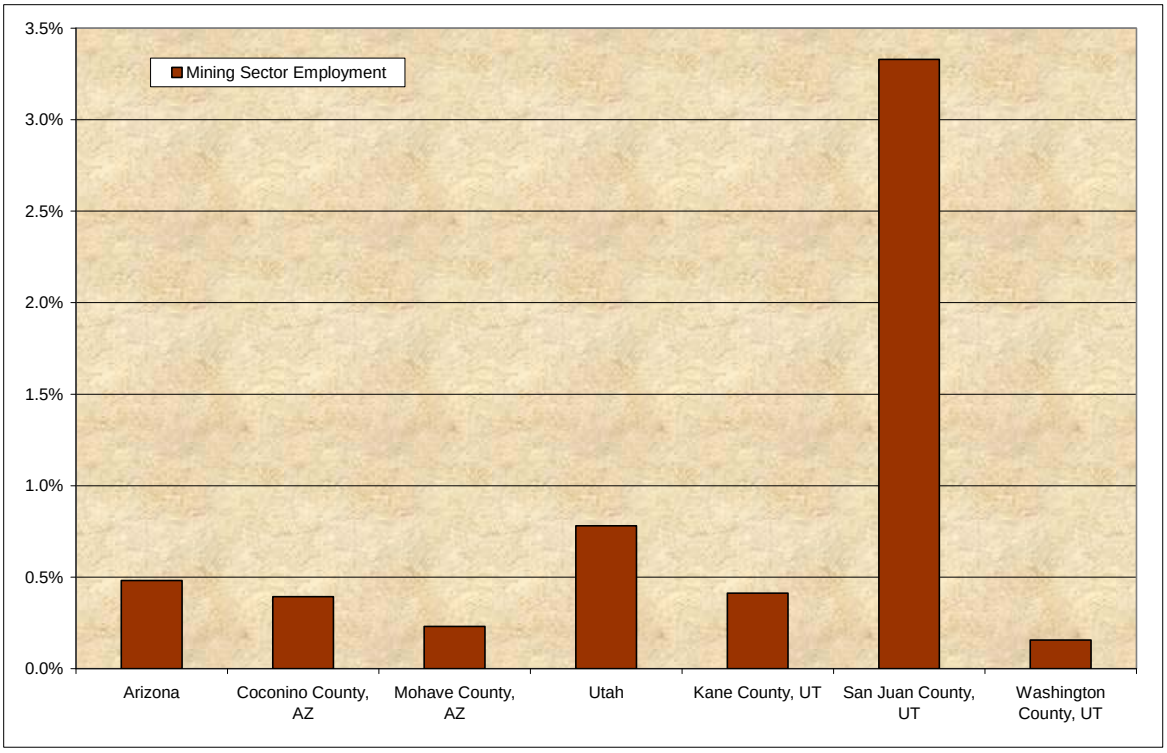


Figure A-9. Mining Sector Employment by Residence, 2000

Note: This chart is based on the residence of the worker, regardless of the location of the job. Later data are not available.

Source: USCB 2000b

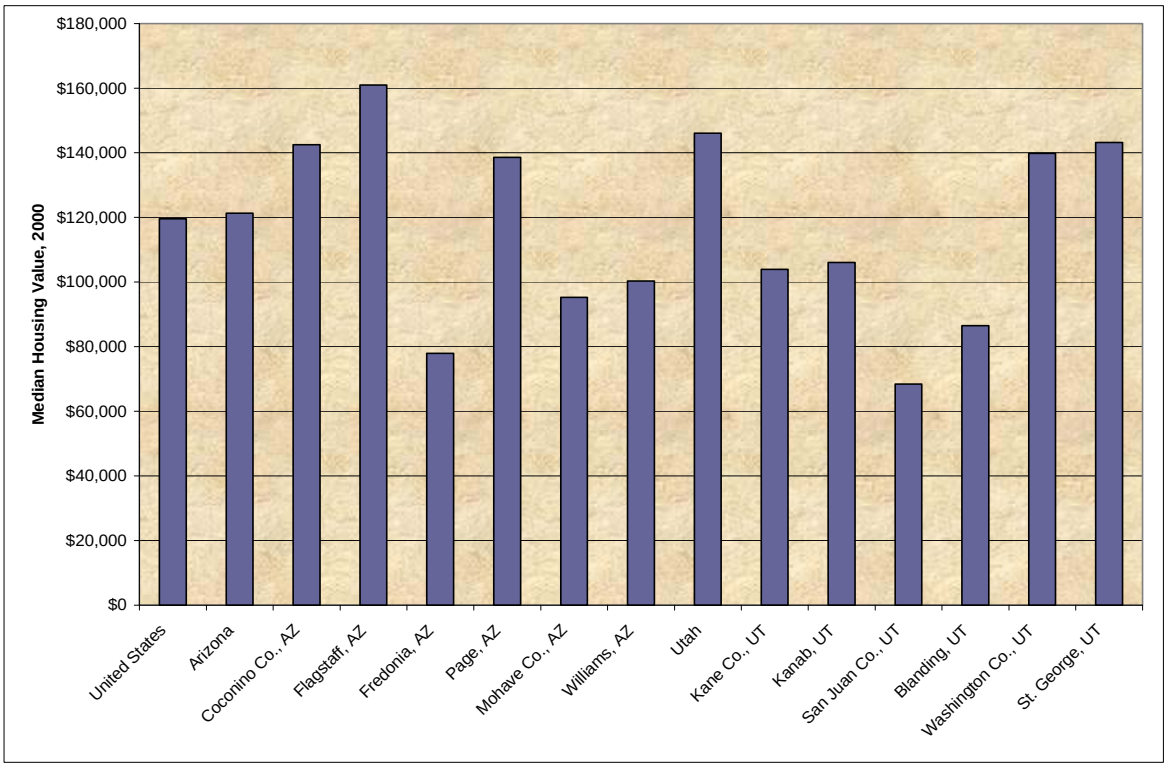


Figure A-10. Median Housing Value, 2000, Project Area and Comparison Regions

Source: USCB 2000b

This page intentionally left blank.