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April 11, 2008

The Hon. Raul Grijalva, Chairman
Subcommittee on National Parks, Forests and Public Lands
1333 Longworth House Office Building
U.S. House of Representatives
Washington, DC 20515

Re: Supplemental Information for the Record of the Joint Oversight Field Hearing on "Community Impacts of Proposed Uranium Mining Near Grand Canyon National Park" at Flagstaff, Arizona, on March 28, 2008

Dear Congressman Grijalva,

I appreciated the opportunity to testimony at the March 28 field hearing on uranium mining impacts in and around the Grand Canyon.

In response to the Subcommittee's invitation to submit post-hearing comments, I am providing this letter and its contents as a supplemental statement. My additional comments are focused in two areas: (1) Analysis of water quality data to emphasize the importance of determining and protecting water quality in springs and aquifers around the Grand Canyon, and (2) review of historical concerns about the impacts of uranium mining on the Arizona Strip north of Grand Canyon National Park.

Water Quality Issues

In my written and oral testimonies, I noted there is evidence of mining-related impacts on water quality in two springs-creeks on the South Rim, Horn Creek and Salt Creek. Studies by Fitzgerald, et al., 1997, and Monroe, et al., 2004 showed elevated concentrations of uranium in these creeks adjacent to and downstream of the Orphan Mine. Orphan Mine consists of an upper level located on the South Rim between Maricopa and Powell points, and a lower level, located on the South Rim slope, about 1,100 feet below the Rim. The lower level includes abandoned mining workings and the highly visible "Glory Hole." Fitzgerald reported a maximum uranium concentration in Horn Creek in 1995 of 92.7 micrograms per liter (ug/l), or more than 3 times the USEPA drinking water standard of 30 ug/l. Monroe, et al. (2004), reported uranium levels between 8.6 and 29 ug/l (average of 15.6 ug/l) in Horn Creek and between 29 and 31 ug/l (average of 30 ug/l) in Salt Creek in sampling conducted in 2000 and 2001.

To assess whether these uranium levels could be attributed to variations in natural conditions and not to anthropogenic sources, I examined and analyzed the data in the Monroe study (USGS Scientific Investigations Report 2004-5146, Table 8, page 52) using standard statistical methods in Microsoft Excel 2003. First, I created a chart showing all reported uranium values for 19 of the 20 springs, seeps and creeks sampled by Monroe and colleagues. **Figure 1** graphically depicts these data, clearly showing that the Horn Creek and Salt Creek uranium levels are much higher than the maximum levels recorded in any of the other springs, seeps and creeks sampled.

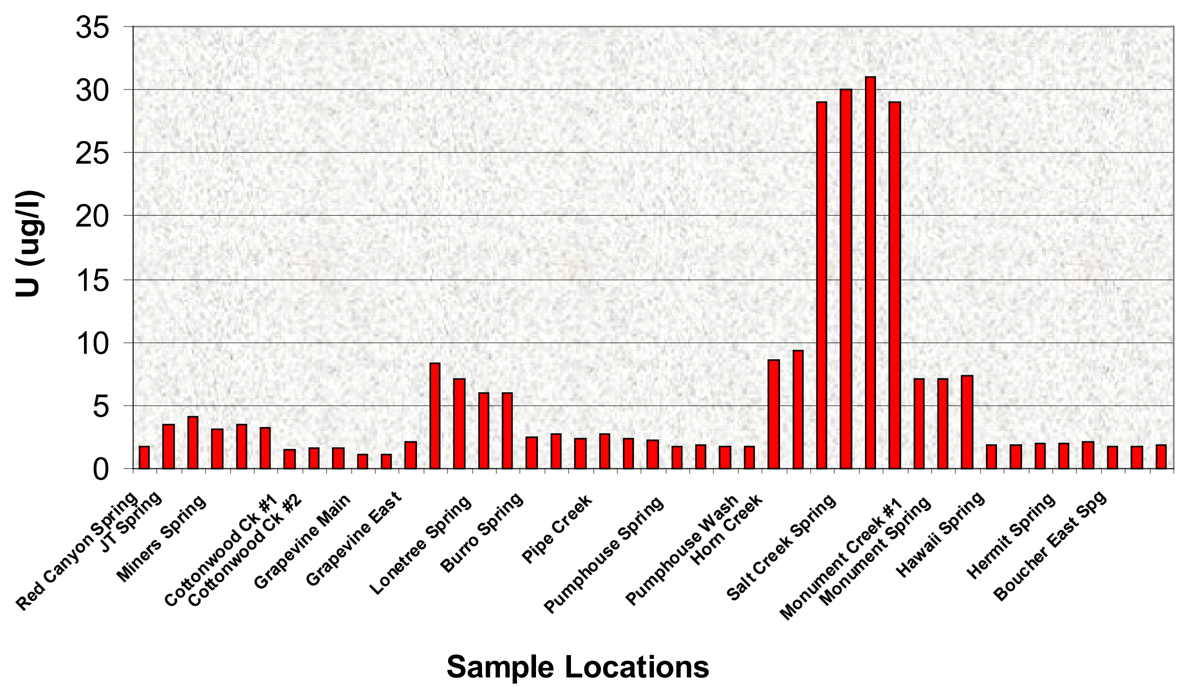

Figure 1. Uranium Concentrations in South Rim Springs, Seeps, Creeks: 2000-2001
(Source: USGS 2004-5146)

Next, I assessed whether the Horn Creek and Salt Creek uranium values are outside of the normal distribution of water quality data from the 19 water sources. I compared means, medians, standard deviations, sample variances, kurtosis and skewness of the 43 uranium data points for all 19 sample locations (which I call "Data Set A") against a subset of uranium values from which the Horn Creek and Salt Creek data were omitted (which I call "Data Set B"). These data are summarized in **Table 1** below.

Results of the statistical analysis show that the uranium levels in Horn Creek and Salt Creek are significantly higher than the rest of the uranium values from the other 17 springs and seeps. As such, these values can and should be treated as statistical outliers. All three measures of variance — sample variance, kurtosis and skewness — are closer to zero in Data Set B, the one that omits

Table 1.
Statistical Analysis of Uranium Values in South Rim Seeps, Springs and Creeks
(Data Source: Monroe, et al., 2004)

***Data Set A**: All sample data/sites*	
Mean	5.848837
Standard Error	1.231006
Median	2.4
Mode	1.9
Standard Deviation	8.072244
Sample Variance	65.16113
Kurtosis	5.323016
Skewness	2.529172
Range	29.9
Minimum	1.1
Maximum	31
Sum	251.5
Count	43
Confidence Level(95.0%)	2.48427

***Data Set B**: Horn Creek and Salt Creek samples omitted*	
Mean	3.097297
Standard Error	0.33485
Median	2.1
Mode	1.9
Standard Deviation	2.036812
Sample Variance	4.148604
Kurtosis	0.623373
Skewness	1.400626
Range	7.2
Minimum	1.1
Maximum	8.3
Sum	114.6
Count	37
Confidence Level(95.0%)	0.679107

the Horn and Salt data, than in Data Set A, the one that includes the Horn and Salt data. The mean uranium value of Data Set B is 3.1 ± 2.0 has less error than the mean value of Data Set A (5.8 ± 8.1 ug/l), while the median of Data Set B, 2.1 ug/l, is much closer to the mean of 3.1 ug/l than is the median of Data Set A. All of these statistics indicate that the data in Data Set B is normally distributed, and therefore, more accurately reflects natural conditions.

I conducted this exercise to demonstrate that natural uranium levels in springs, seeps and creeks in the Grand Canyon are quite low and vary little across the large expanse of the South Rim. The uranium levels in Horn and Salt creeks are likely influenced by ongoing releases of contaminants from the Orphan Mine, especially around its lower level 1,100 feet below the South Rim. At the lower location, the Glory Hole (**Figure 2**) may act as a conduit for contaminated mine water to reach Horn Creek. At the upper level, runoff from rain and snowmelt facilitates movement of contaminants from the contaminated mine yard next to the headframe (**Figure 3**).

Review of Historical Concerns About Uranium Mining on the Arizona Strip

Public concerns about cumulative impacts of uranium mining on the Arizona Strip, and its potential for adverse impacts to the Grand Canyon ecosystem and Colorado River, date to the early 1980s when new mining was first proposed and new mines opened in the Kanab Creek watershed between 1981 and 1992. During that time, I provided comments on site-specific mine plans and regional environmental assessments to the U.S. Bureau of Land Management (BLM) in collaboration with community groups and conservation organizations. (SRIC, 1984) Since the March 28 hearing, I have reviewed documentation from that era, and provide the following comments that benefit from the passage of nearly two decades.

Figure 2. "Glory Hole" at the lower level of Orphan Mine, South Rim of Grand Canyon National Park near Horn Creek. (Photo by C. Shuey, 3-27-08)

Figure 3. Orphan Mine headframe and mine yard, South Rim Grand Canyon National Park. Snow on slope melts, facilitating release of contaminants to Horn Creek below. (Photo by C. Shuey, 3-27-08)

Whether or not land in the Kanab Creek drainage on Kanab Plateau is withdrawn from mineral entry as currently proposed in H.R. 5583, my professional opinion is that a thorough assessment of the impacts of past uranium mining in the area is needed to determine (1) permanent changes in the landscape and drainages, (2) the extent to which these changes resulted in shifts in use of the public lands of the area, (3) effectiveness of reclamation of at least eight uranium mines that were developed and operated between 1981 and 1992, and (4) chemical and radiological characteristics of soils and surface water upstream and downstream of mine sites. A comprehensive assessment is warranted by the fact that Kanab Creek and its tributaries, including Hack Canyon, is a major tributary of the Colorado River in the Grand Canyon.

Changes in the landscape and in the use of public lands in the region were noted by conservation organizations monitoring uranium development in the 1980s. By 1986, six mines had disturbed more than 100 acres inside the mine yards alone, adding 31 miles of new powerlines and 25 miles of new or expanded ore haul roads. (Whalen, 1986) The mine sites, plus many more exploration sites, "scarred once pristine vistas and mesa tops." (Norton, et al, 1987) "No trespassing" signs were erected on public lands near the mining operations, denying access to wilderness areas, and ore hauling increased traffic and dust on what were "backcountry jeep trails." (Norton, et al, 1987). By 1988, eight mines were in operation in the Kanab Creek drainage, and production continued into 1992 before all operating mines were closed permanently or placed in "stand-by" mode for future mining. (ADGF, 2007)

In her written statement dated March 25, 2008 (pages 7-8), Dr. Karen Wenrich showed before-and-after photos of reclamation at the Hack #1 Mine and Pigeon Mine to assert, "[t]here was NO negative impact to water, land, vegetation, air, or humans." Without supporting environmental monitoring data, these photos do not substantiate Dr. Wenrich's assertion of zero impact. Radiological and chemical assessments of the mine sites are needed to determine any residual effects of mining operations, ore handling and spills, and waste disposal.

Post-mining and post-reclamation environmental monitoring is particularly important at the Hack mines complex (Hack #1, #2 and #3) in Hack Canyon, a tributary of Kanab Creek. According to several accounts in the media and academic literature, a flashflood in Hack Canyon in 1984 washed four tons of uranium ore from the Energy Fuels Nuclear (EFN) Hack Canyon #1 mine, a few miles upstream from its confluence with Kanab Creek. (Gilles, et al, 1990b; Schmidt, 1993) EFN reportedly removed 1,500 tons of contaminated soils following the spill, but did not conduct radiological monitoring downstream (Gilles, et al., 1990a, citing comments by an EFN official). At an average grade of 0.65 percent U_3O_8 equivalent (or, about 13 pounds of uranium per ton of ore) (ADGF, 2007), the ore would have had a uranium concentration of *2,000 to 3,000 times greater than the average uranium level in natural soils not impacted by uranium mining*. As I discussed in my March 25 written testimony, we demonstrated from environmental monitoring conducted in the Church Rock Uranium District in New Mexico in 2003-2005 that the radiological and chemical fingerprints of uranium mining are observable more than 25 years after mining ended. (Shuey Written Testimony, 2008, pages 2-3; Shuey, 2007)

Reclamation effectiveness can and should be assessed, especially since 15 to 20 years have elapsed since the mines in the Kanab Creek drainage were reclaimed. A BLM landscape architect noted in a 1982 memorandum that the topsoil in the Arizona Strip is too thin to be used for reclamation cover, that revegetation does not last because of low rainfall and intrusion by invader species, and that access roads to mine sites are unlikely to be abandoned. (Ray, 1982)

I have personally observed the deterioration of a soil cover that was applied to the mine site and waste dump in the early 1990s at the former Kerr-McGee Corp. Church Rock 1 Mine in Coyote Canyon Chapter of the Navajo Nation, about 12 miles northeast of Gallup, New Mexico. Today, the cover is replete with gullies measuring 3 to 4 feet deep, possibly exposing contaminated wastes beneath. The topography and climate of this mine site is quite similar to that of conditions in the Kanab Creek area — elevations between 6,500 and 7,000 feet above sea level and rainfall between 10 and 12 inches annually.

As a general matter, exposure of mine wastes to water and wind erosion increases the chances that radioactive materials and heavy metals will be released to surrounding lands and water systems. Removal of high-grade ore from the breccia pipes in the Arizona Strip does not, by itself, eliminate, or even substantially mitigate, the potential for contaminant releases from abandoned and reclaimed mines. Indeed, the USEPA's 2006 report on radiological characteristics of wastes at open-pit and underground uranium mines in New Mexico, Utah and Wyoming showed that uranium and other heavy metals, including arsenic and lead, are enriched in all categories of mine waste[1] compared with background levels of these contaminants. (USEPA, 2006; Tables 3.10, 3.11 and 3.12) In the Churchrock area, we showed that the radiological signature of mining – elevated gamma radiation levels and levels of radium-226 and natural uranium in soils — is still observable today in soils along ore haul roads and near Navajo homes located in close proximity to mine waste dumps. (Shuey, 2007; attached as Appendix A.)

Conclusions

The additional data and analyses provided in this supplemental written testimony support the principal conclusion that I and other witnesses at the March 28 hearing reached, namely, that renewed and expanded uranium mining around the Grand Canyon has a reasonable likelihood of adversely impacting the Canyon's water and cultural resources and creating long-lasting changes in the region's ecosystem. Furthermore, extensive regional uranium development of a magnitude projected from current activities — more than 4,000 new mining claims and widespread exploration by at least a half-dozen different companies — is likely to place the health of the Canyon's indigenous and permanent populations at increased risk from cumulative and chronic exposures. As a public health and environmental professional, I believe that withdrawal of public lands from mineral entry on both sides of the Grand Canyon is prudent policy.

Sincerely,

Chris Shuey, MPH
Southwest Research and Information Center

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[1] "Mine waste" typically onsists of topsoils and overburden from the mine site, waste piles derived from underground mining, and "protore," or "subore," rocks and dirt that have elevated concentrations of uranium but not high enough to warrant economic recovery. Some abandoned mines still have ore piles that were never shipped for processing.

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