

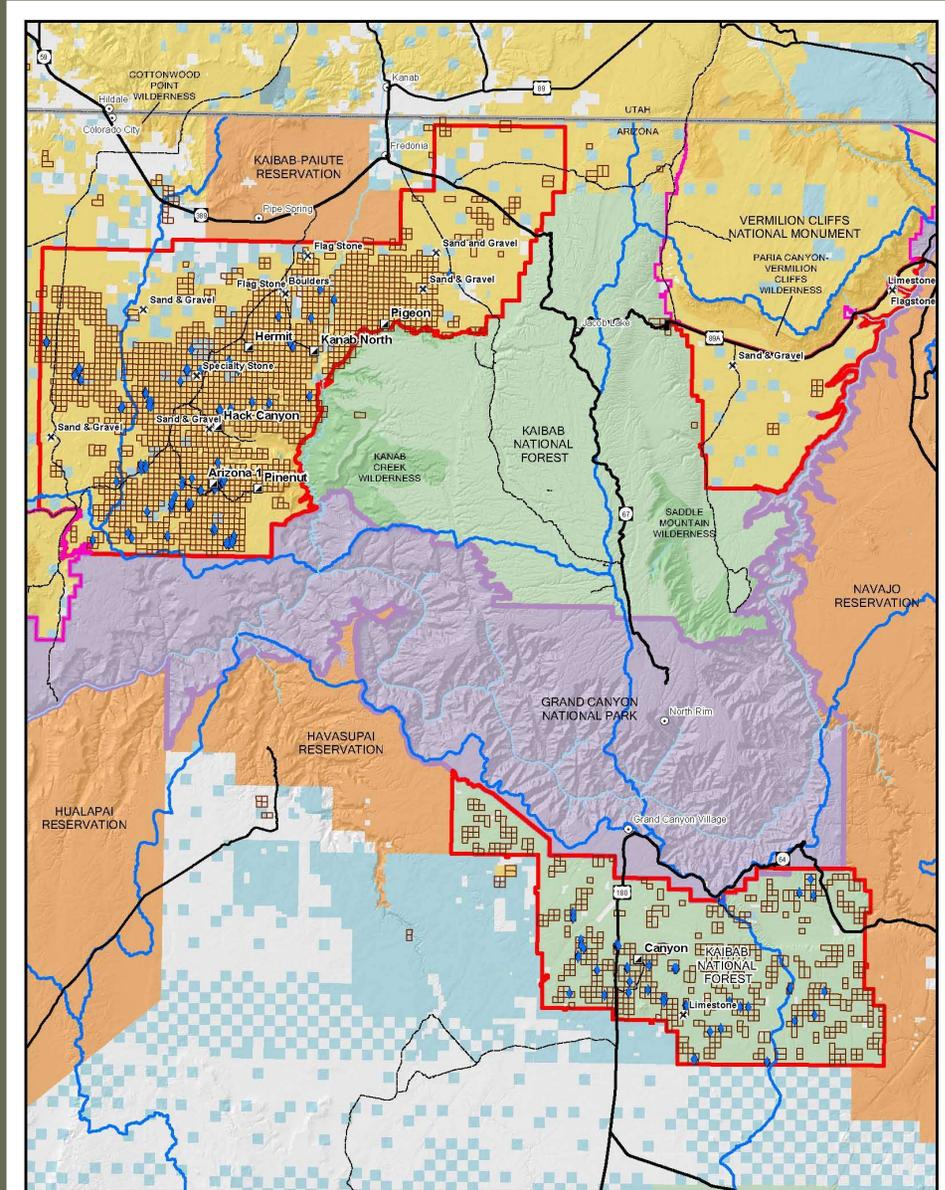
Impacts of Uranium Legacy Mining and Recent Mining Developments in Northern Arizona

By Donald J. Bills, Fred D Tillman, David W. Anning,
Ronald C. Antweiler, and Thomas F. Kraemer



Background

- Renewed uranium mining interest in Northern Arizona.
- Thousands of new claims files (squares)
- About 75 active exploration sites (blue diamonds)
- Current mines (developed in 1980's)
 - 2 south of the South Rim
 - 6 in the Kanab Creek Basin
 - 3 reclaimed
 - 2 standby
 - 1 active (Arizona 1; 12/09)

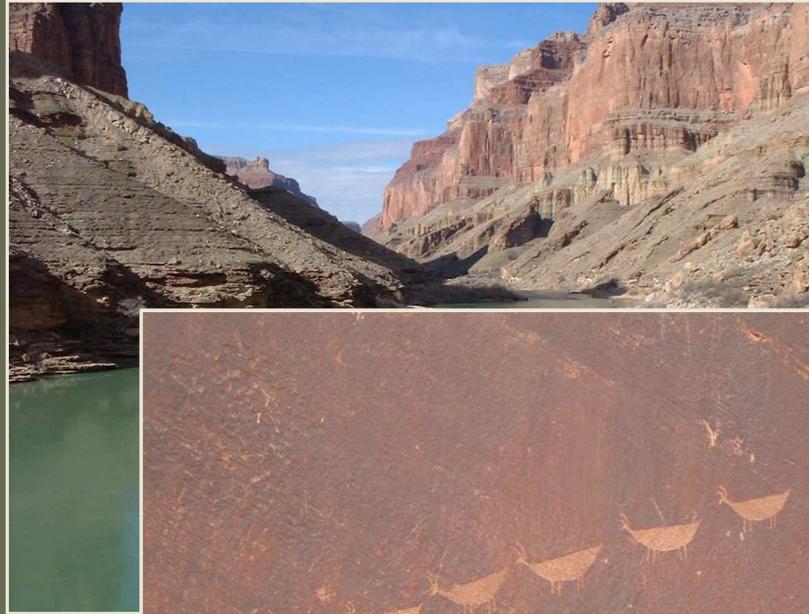


Regional Resource Issues

NPS Concerns

- Contamination of water (especially springs and seeps)
 - Fractionation of wildlife corridors
 - View and “soundscape” impacts
 - Traditional cultural properties
- Over a dozen Native American Tribes consider this area as sacred and most all oppose Uranium mining

Issue:
Balancing a national energy resource with protecting natural resources of the watershed of Grand Canyon National Park



On July 21th, 2009 the Secretary of the Interior temporarily withdrew about 1 million acres of lands from mineral entry in the Grand Canyon Region.



4 Components of the USGS Study

Study area and location of Segregated Lands

➤ Uranium resource assessment

➤ Impacts of past, current, and future mining

a) Surface

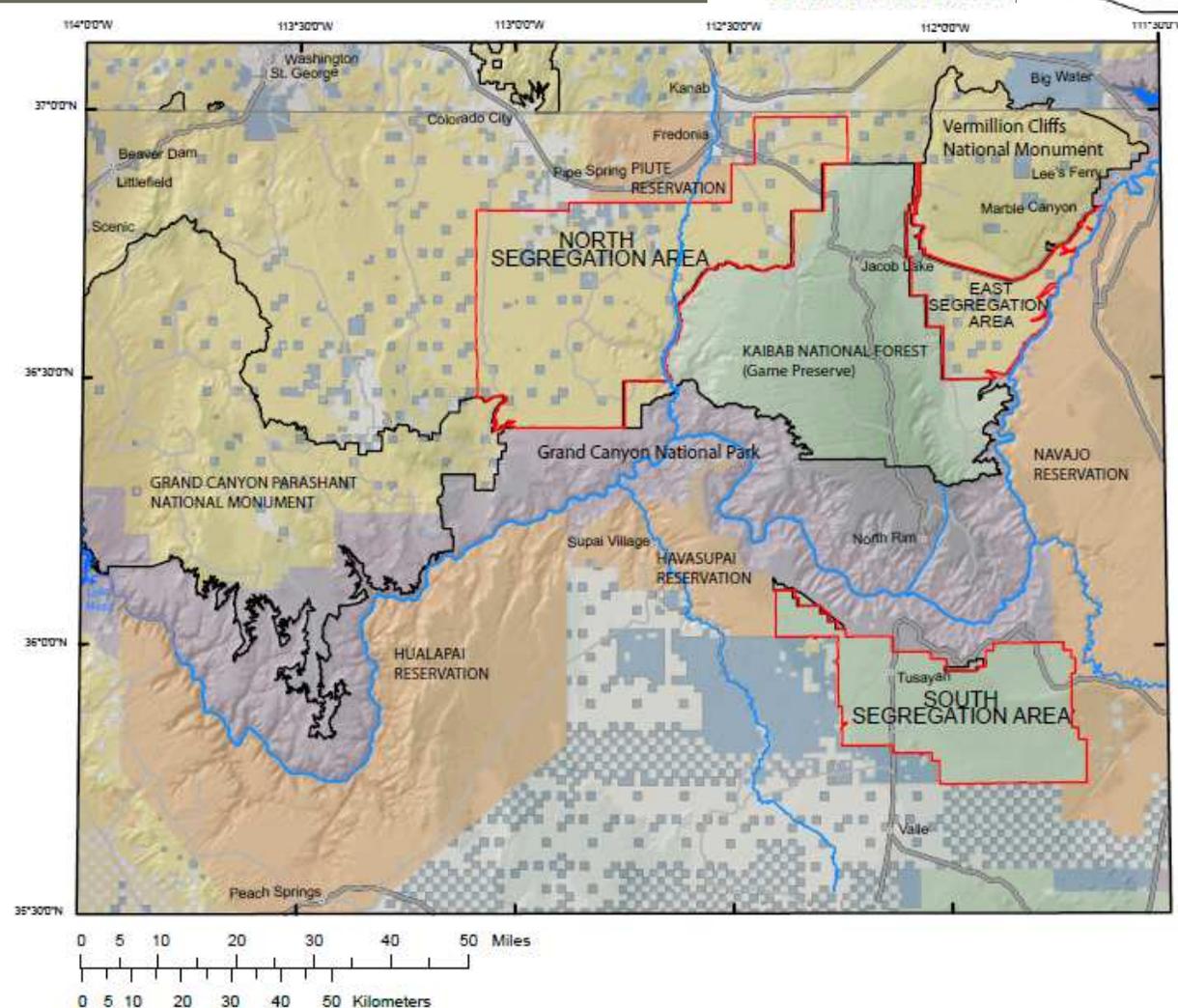
b) Biology

c) Hydrology



EXPLANATION

- BLM
- USFS
- Indian lands
- Private
- State
- Segregation Area
- National Monuments

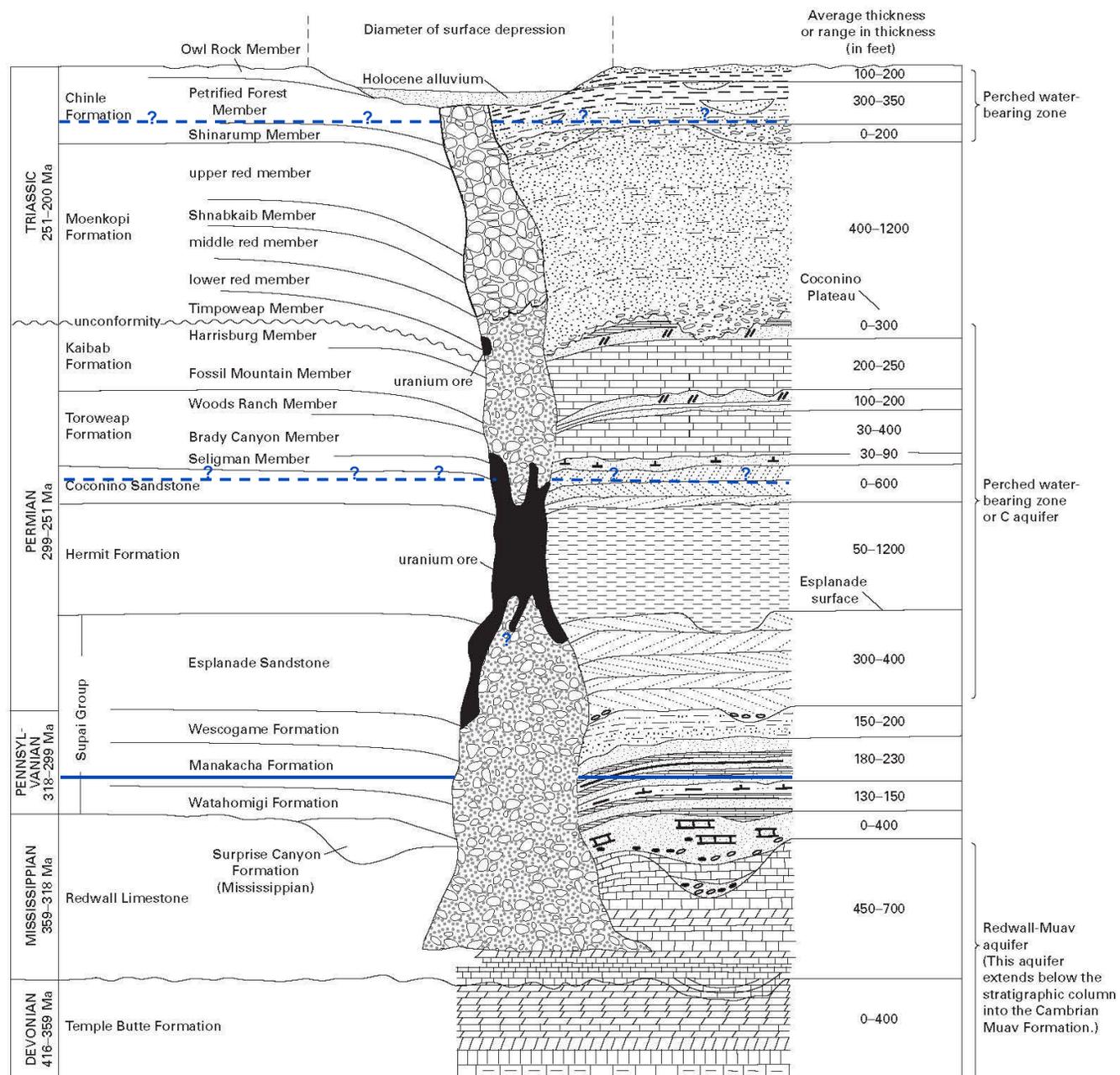


Generalized stratigraphic column of ore bearing breccia pipe

➤ 100's Ma old

➤ Developed from collapse of cave ceilings in the Redwall Limestone

➤ Ore precipitated from mineral rich GW either moving downward or upward



Water table or potentiometric surface, dashed where uncertain

Modified from Van Gosen and Wenrich, 1989

Collapse Feature and Exposed Breccia Pipe, in the Grand Canyon Region, Northern AZ

- Collapse features a few hundred up to a mile in diameter.
- Not all collapse features collocated with breccia pipes.
- Not all pipes reach the surface.
- Not all pipes mineralized.



Grand Canyon pipe,
USGS photo

Bat Cave breccia pipe,
western Grand Canyon,
photo by George Billingsley,
USGS



Estimated Uranium Reserve in Northern Arizona

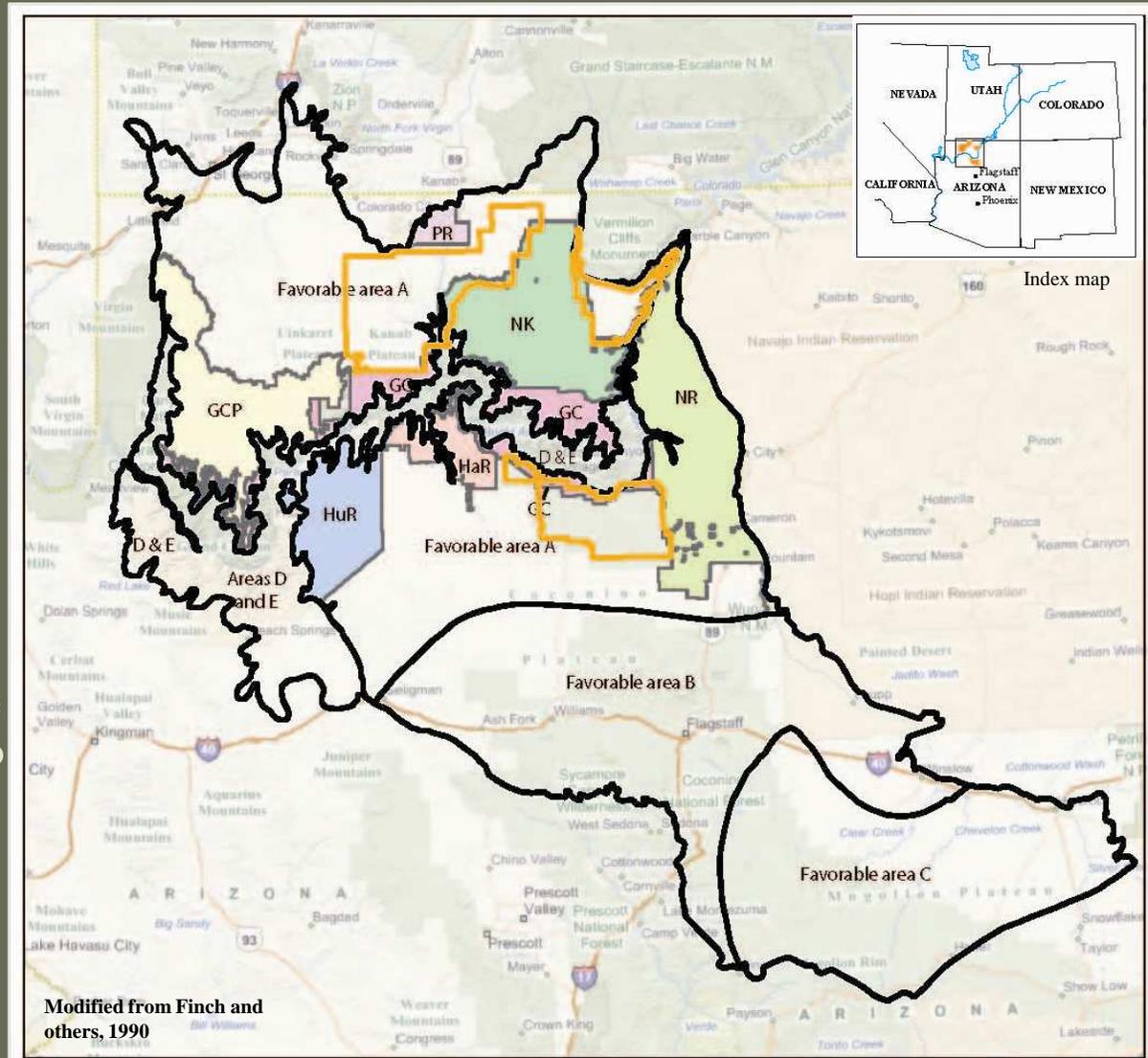
➤ Total estimate of undiscovered uranium in NAZ about 1.3 Million tons (2.6 billion pounds)

➤ Favorable area A = 910,000 tons

➤ Already withdrawn from mining: 466,834 tons (about 35 percent; Nat. Parks, game reserves, and Indian Res.)

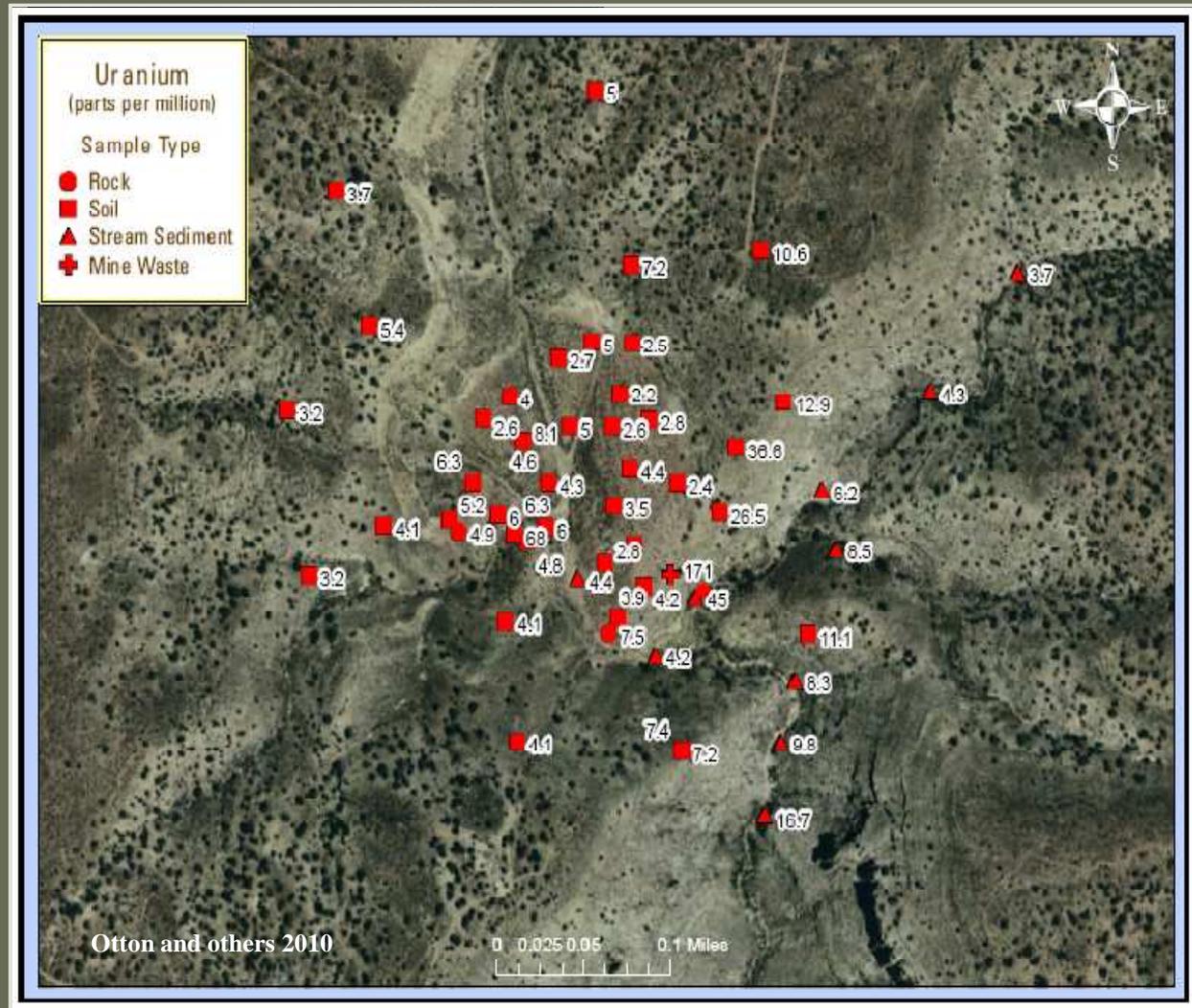
➤ 162,964 tons (about 12 percent) total in the three segregated areas

➤ The uranium resource for the entire “favorable area” in AZ is estimated to be 40% of U.S. reserves



Surface Impacts of Past, Current, and Future Mining

- Elevated radioactivity is evident at all sites (except the Jumpup Canyon).
- Radioactivity rapidly decreases outside the footprint of the mine.
- This material can be moved by wind and flash flood events.



Biological Issues Related to Mining

➤ T&E species and other species of concern in the segregation areas

➤ Routes of exposure linked to atmospheric dispersion, water, soil, sediment, and food-chain pathways

➤ Little to no scientific information on biological effects of uranium toxicity and radioactivity for plants and animals of concern

• 6 plants, 1 invertebrate, 2 fish, and 4 birds

• Over 50 additional plants and animals designated as species of concern

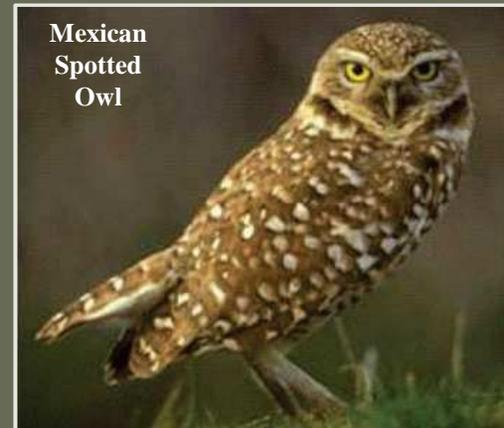
• Uranium and other radionuclides can affect survival, growth, and reproduction of plants and animals (toxicity and radiation)

• subterranean habitats (burrows) of particular concern

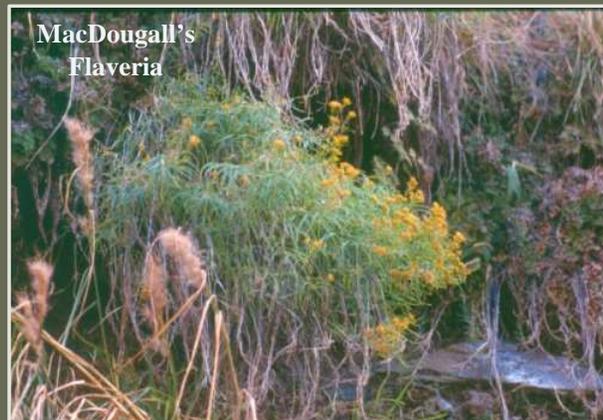
Humpback Chub



Mexican Spotted Owl

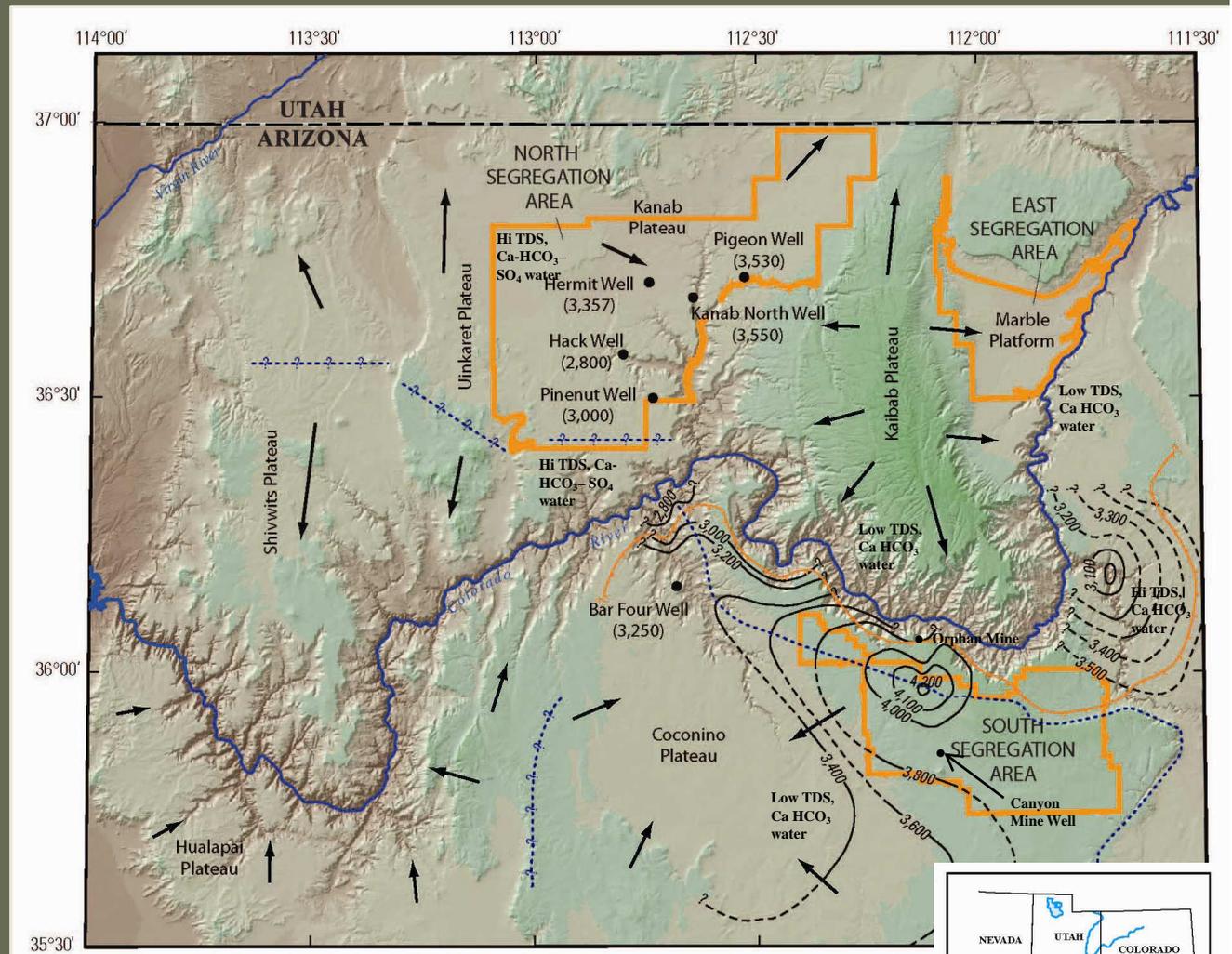


MacDougall's Flaveria

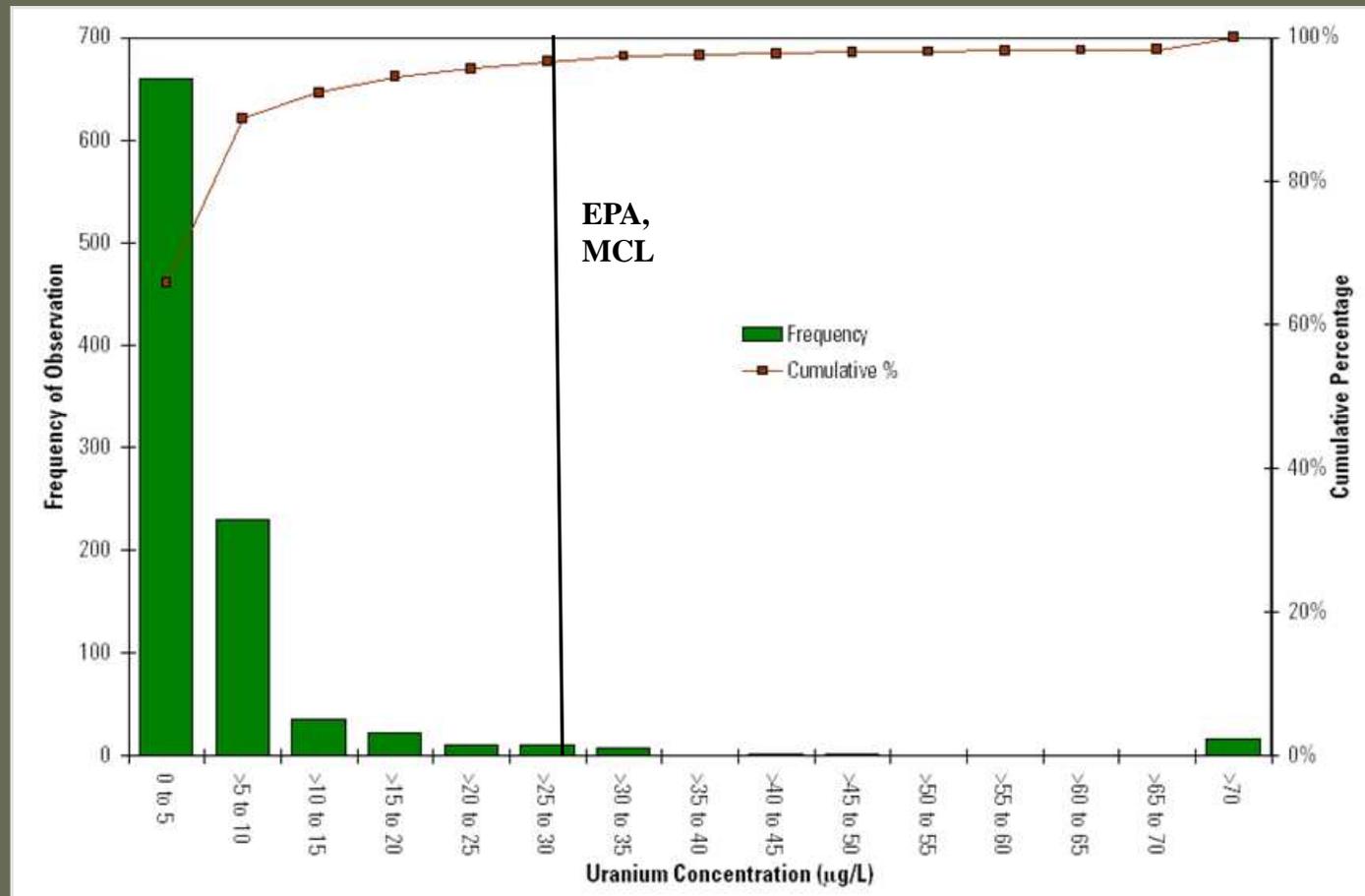


Impacts of Past, Current, and Future Mining on Springs, Wells, and Streams

- Significant water quality differences north and south of the Colorado River.
- Significant water quality differences in perched water bearing zones and the Redwall-Muav aquifer.
- No water samples collected from a runoff event.



Frequency and cumulative distribution of uranium concentrations for spring, stream, and well locations in dataset.



Based on 1,014 samples from about 428 sites.

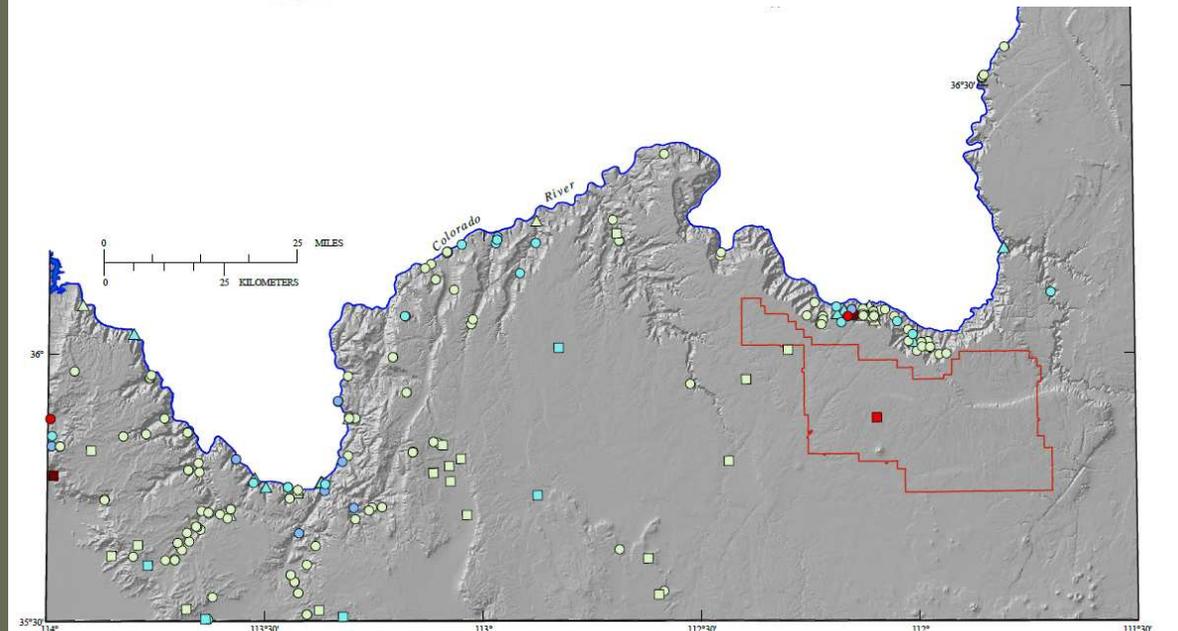
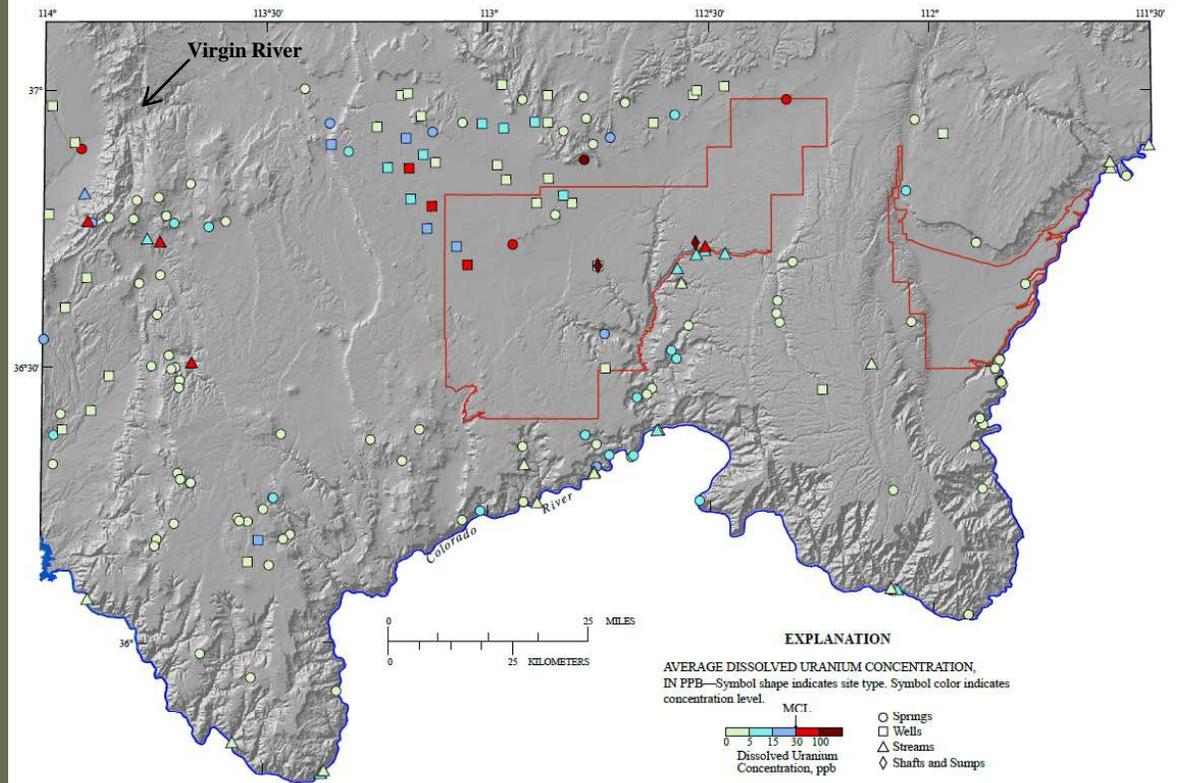
EPA drinking water standard – 30 ug/L



Spatial Distribution and Concentrations of Historic Dissolved Uranium

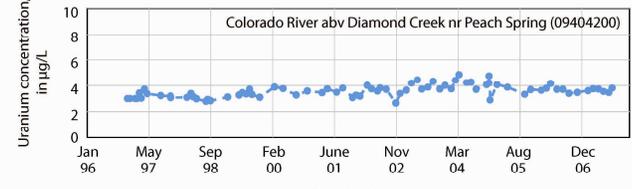
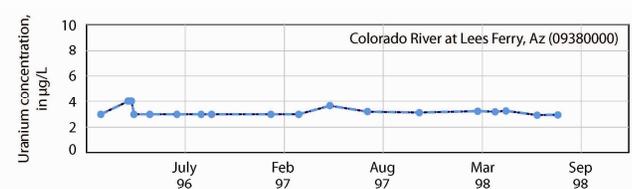
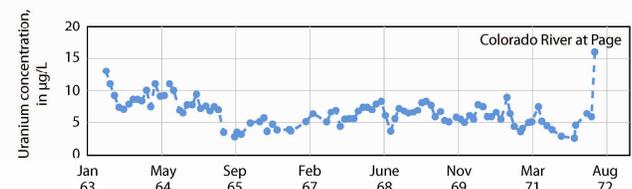
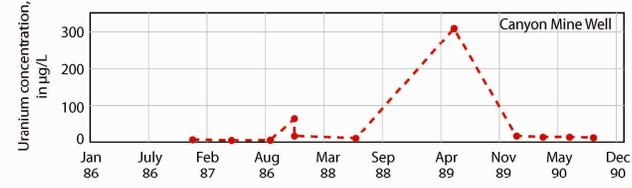
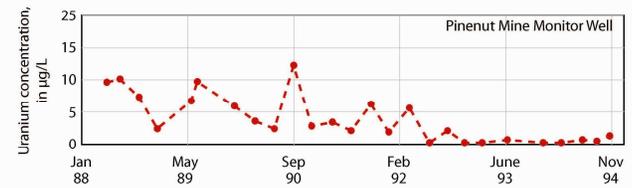
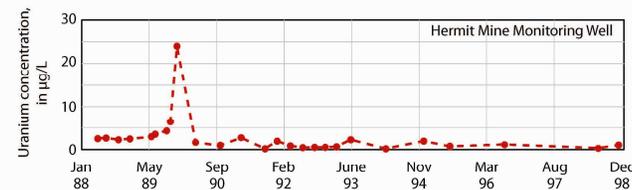
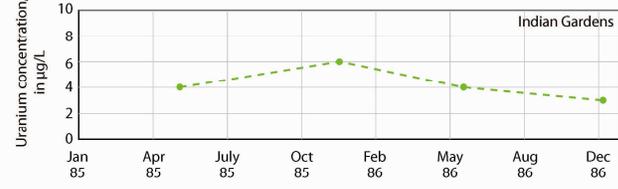
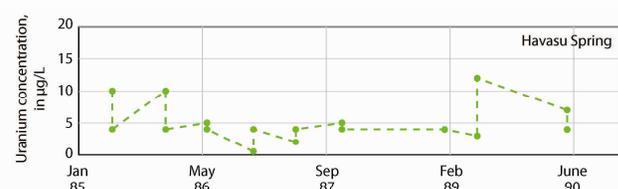
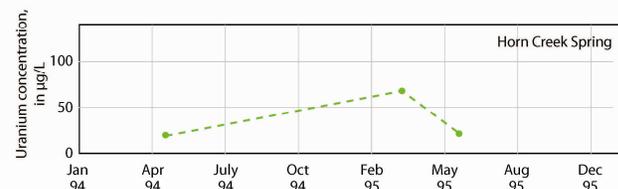
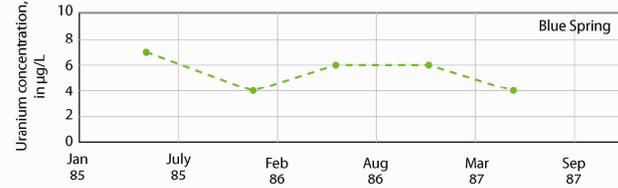
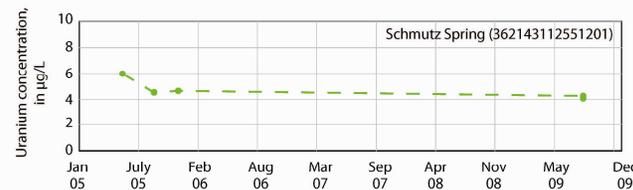
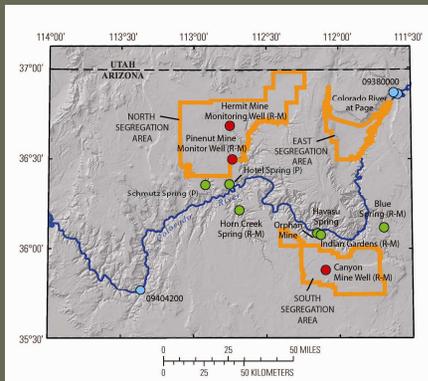
➤ 120 springs and 32 streams in the region contained dissolved uranium concentrations greater than 5 $\mu\text{g/L}$ but less than 30 $\mu\text{g/L}$

➤ 15 springs and 5 wells in the region contained dissolved uranium concentrations greater than 30 $\mu\text{g/L}$



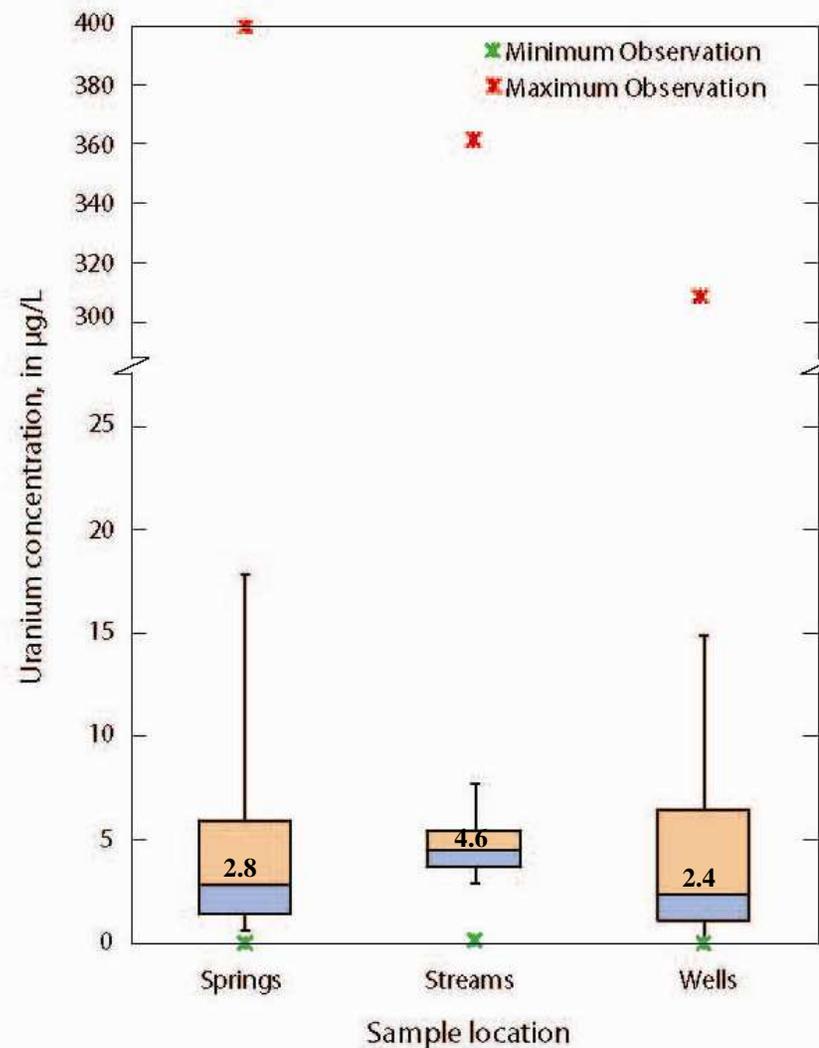
Temporal variability of Dissolved Uranium

- Dissolved uranium spikes possibly correlate to recharge related to wet years.
- Colorado River data consistently low with time.
- Additional data for these and other sites are being evaluated.



Comparison of Dissolved Uranium Concentrations for Springs, Streams, and Wells

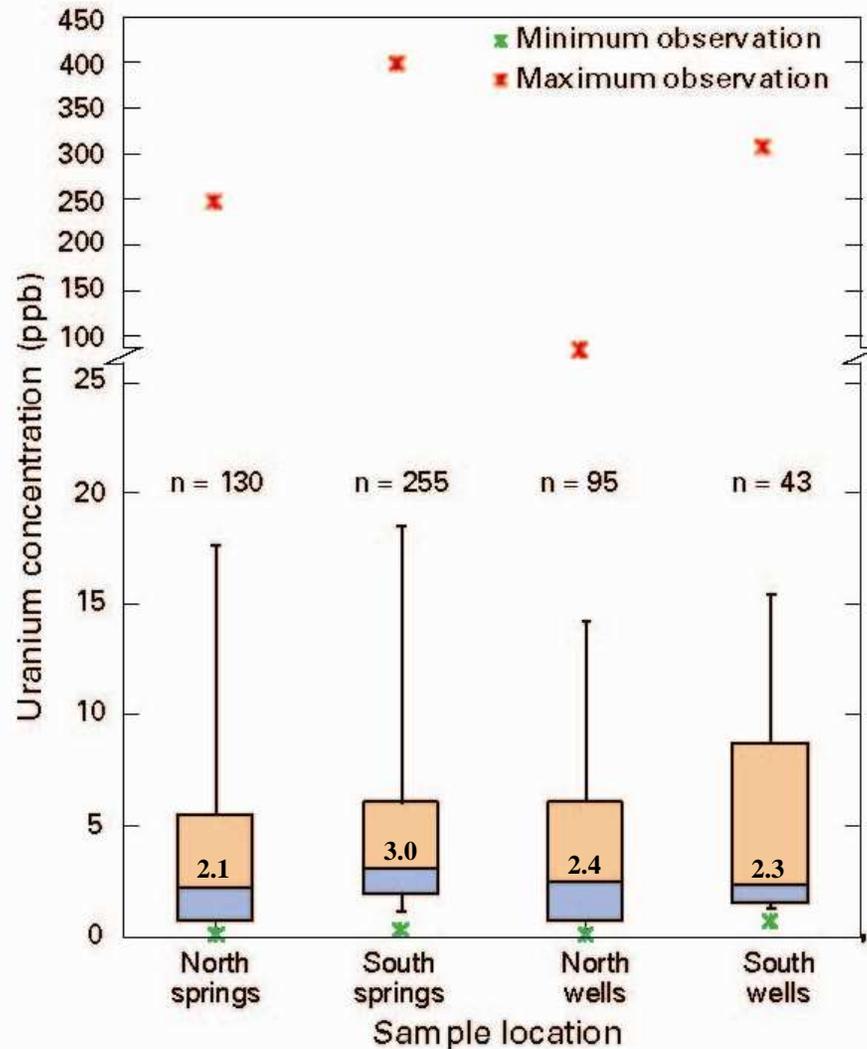
➤ Median uranium concentrations similar for springs, streams, and wells.



Comparison of Dissolved Uranium, Continued

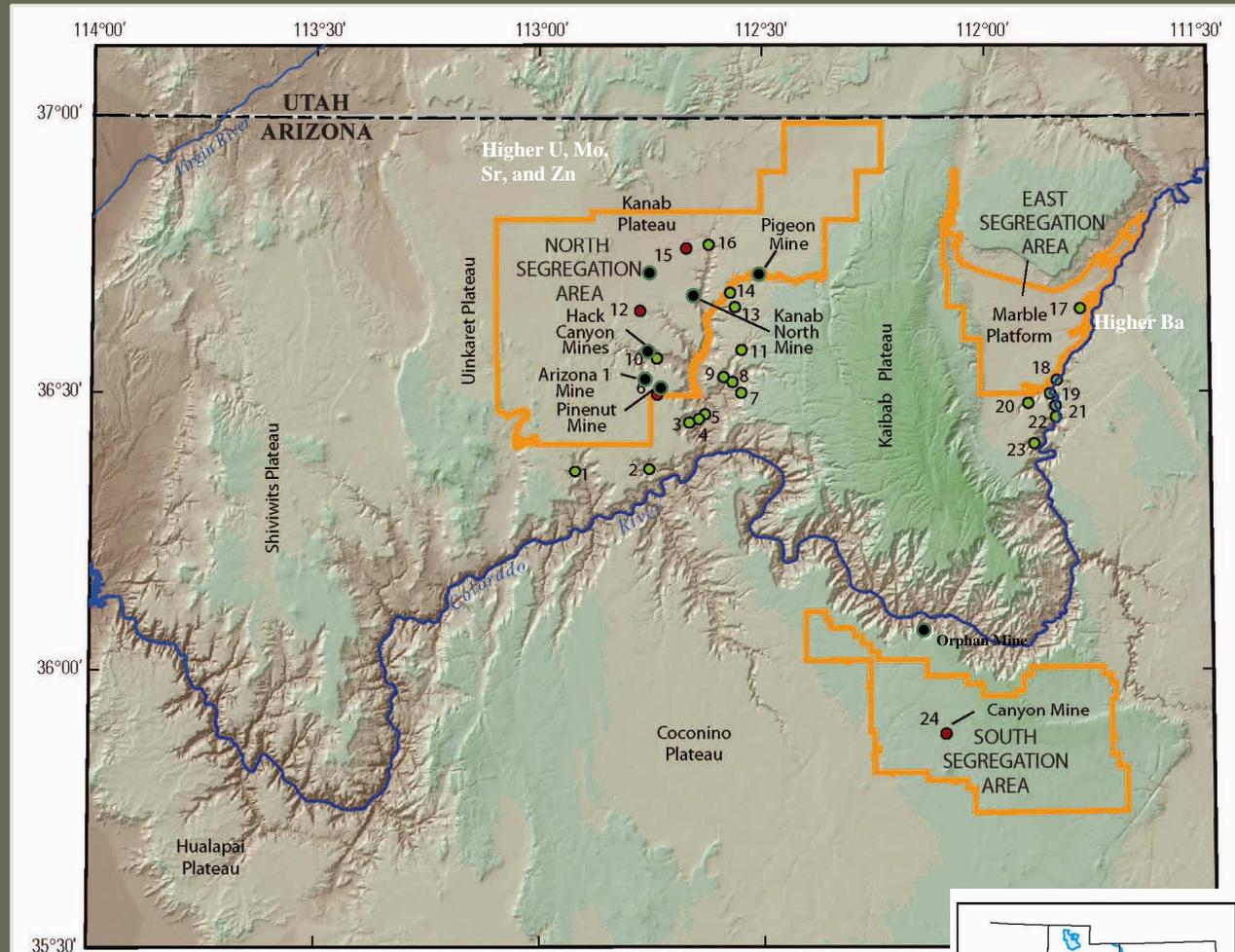
➤ Median uranium concentrations similar for springs and wells north and south of the river.

Maximum concentrations greater for springs and wells south of the river.



Comparison of Dissolved Uranium Concentrations for Samples Collected August and September 2009

- Sampled 20 springs, 4 wells.
- No mining – 0.57 – 20.6 µg/L
- Mining – 2.14 – 19.5 µg/L
- Dissolved uranium and some trace metal concentrations are generally higher in groundwater from perched water-bearing zones near ore bodies.
- we could not distinguish natural vs mining impacts.



EXPLANATION

- Segregation area—Boundary
- Spring sampled
- Well sampled

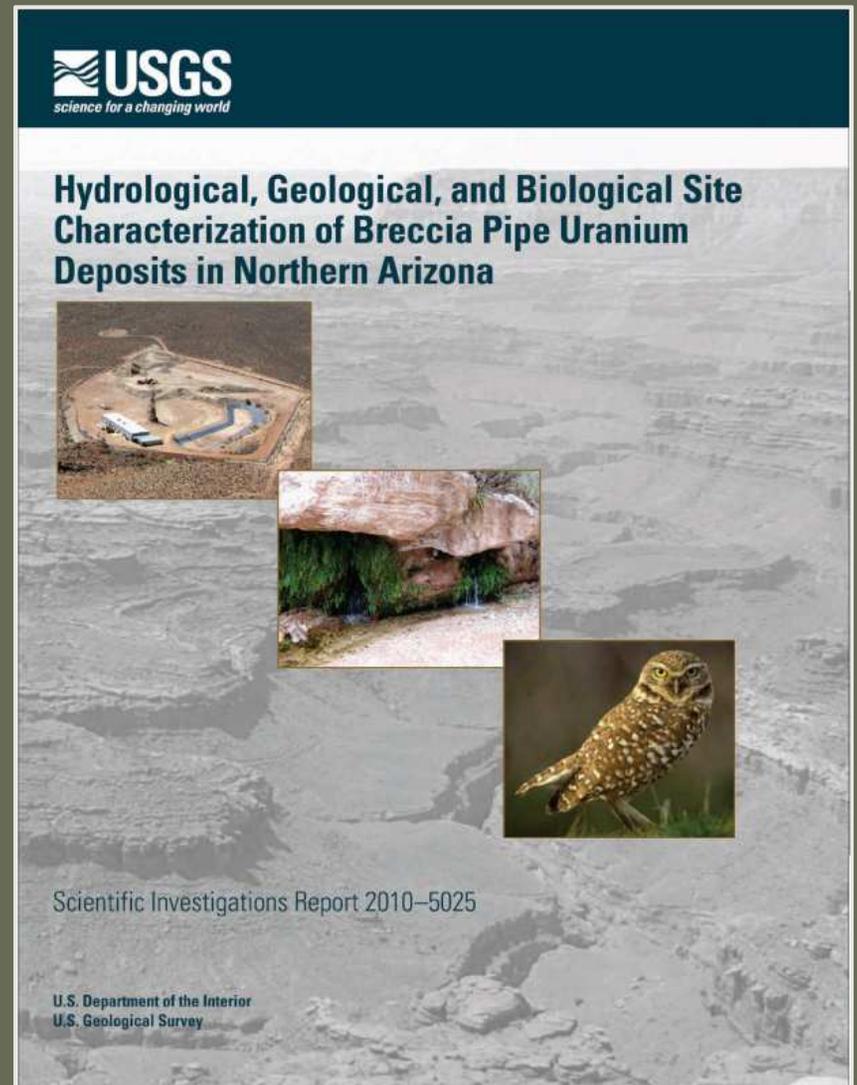


Index map



Current status and next steps

- Report released online February 18, 2010:
 - <http://pubs.usgs.gov/sir/2010/5025/>
- 2010 – USGS:
 - Continues role helping BLM interpreting our findings.
 - Develops plans for future study and monitoring.
- BLM and Federal Agency Team: Draft EIS by June 2010. Final EIS by December 2010.
- July 2011 – SOI makes decision – “permanently” withdraw all, some, or none of the identified areas



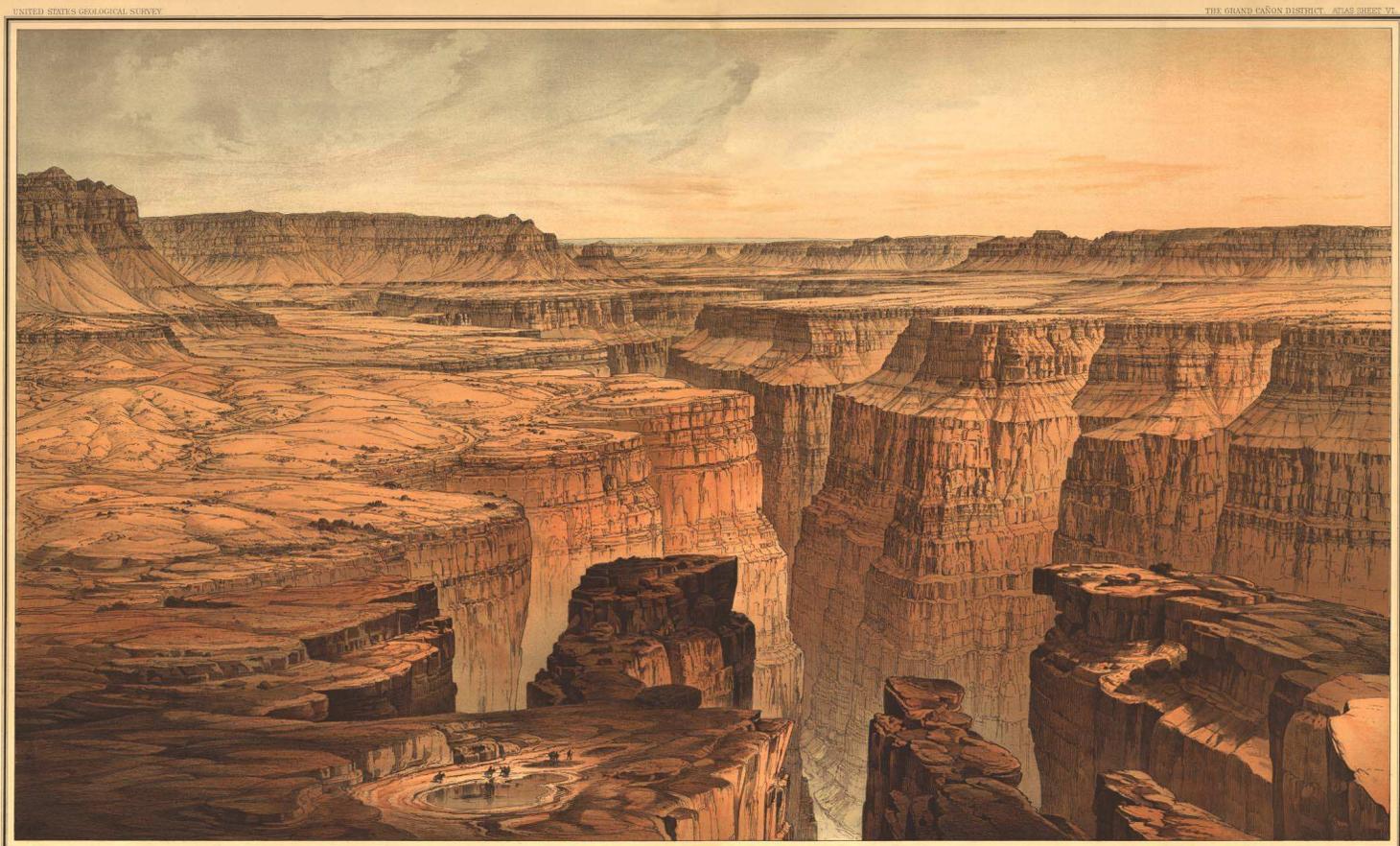
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Questions?

**Donald Bills, USGS
Ph: 928-556-7142
E-mail: djbills@usgs.gov**



THE GRAND CAÑON AT THE FOOT OF THE TOROWEAP-LOOKING EAST