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Learning from Nature's Full Scale Experiments: Event Driven Monitoring for Long-Term Stewardship

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Track 1.1 General LTS Practices

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The case for event driven monitoring

- The objectives of post-closure monitoring by the DOE Office of Legacy Management usually is focused on compliance to assess whether the public and the environmental continued to be protected.
- Example for groundwater monitoring:
  - If groundwater treatment is being done, are contaminant concentrations decreasing?
  - If supplemental standards have been applied to water resources, are contaminant concentrations staying below action levels?
- However, remedies are changing too because of natural process. Will they continue to be protective?
- Examples of changes on cells and landfills:
  - Formation of soils, even in arid and semi-arid regions, at much faster rates that once predicted.
  - Vegetation establishment and succession.
  - Erosion that is below the surface (subgrade).

The case for event driven monitoring

- Many remedies were designed with only projections of response to severe events. Little basis for calibrating models for rare events.
  - Rare events did not occur during the period of time when a site was being characterized and remedies being selected and implemented.
  - Rare events may have been observed in the past, but before the need to collect data for long term stewardship (LTS) was needed.
- Consequences: less confidence how remedies will respond to rare events.
- Good news!: for sites that will be in LTS for hundreds or even thousands of years, we will likely witness these events.
- Two examples are provided where the objectives of event driven monitoring were met.

Event Driven Monitoring Examples and What We Learned: June 2010 Flood at the Riverton, Wyoming Uranium Mill Tailings Site

Riverton Baseflow and Flood Conditions on Little Wind River

Event Driven Monitoring Examples and What We Learned:
June 2010 Flood at the Riverton, Wyoming Uranium Mill Tailings Site

- Tailings were removed at the former uranium mill site in Riverton, WY

- Periodic flooding of rivers created transient contaminant increases. During 2010 flood, contaminant concentrations increased, not decreased as predicted.

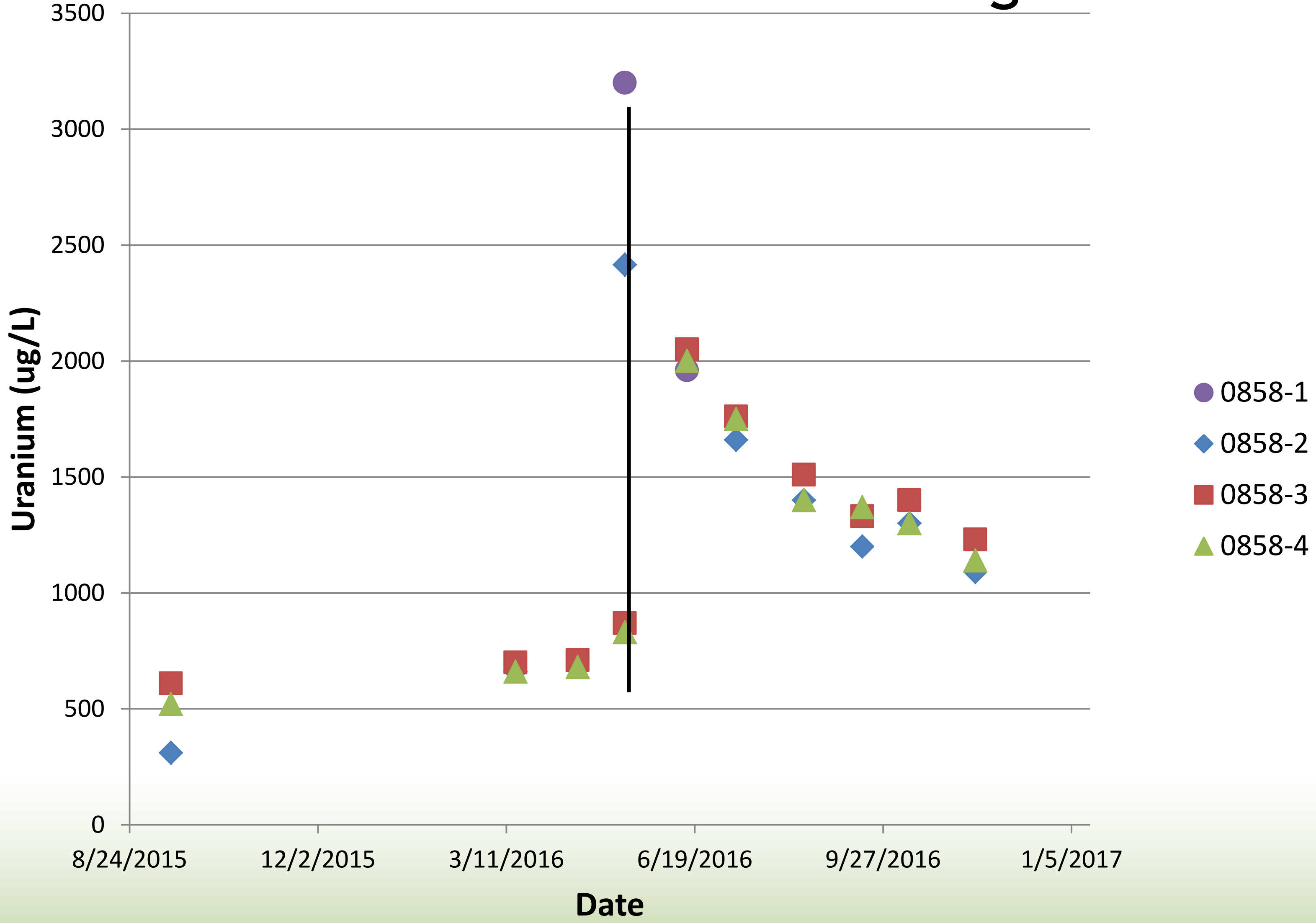
- Additional solid phase sampling and multilevel groundwater sampling has led to a new conceptual model.

  - Contaminants, including uranium in the unsaturated zone. When water level rises during a flood, these contaminants were mobilized.
  - Evaporites and naturally reduced zones that can influence groundwater quality, especially after flooding events.

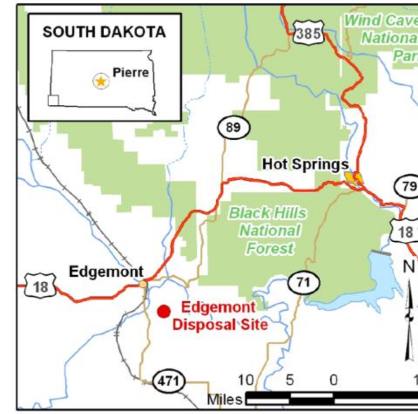
- Continue conceptual model updates with science integration, including “biohydrogeochemistry” and revised environmental risk assessments

- Joint project: LM, Savannah River Natl. Lab, Stanford Linear Accelerator Center, USGS, Argonne Natl. Lab, and Northern Arapaho Tribe.

Uranium in multilevel well 0858 during 2016 flood



Event Driven Monitoring Examples and What We Learned: Edgemont, South Dakota Uranium Mill Tailings Site



Event:
July 19, 2016
Indian Canyon Wild Fire

Continued- What We Learned Edgemont, South Dakota Uranium Mill Tailings Site:

Jerry Sterns, Site Grazing Lessee, 2017

Right after the fire

Three months after

Climate trends are making some types of “events” more common and we need to understand how remedies will respond.

- **Southwest USA**
  - Droughts more intense, overall precipitation decrease, but more intense precipitation events when they do occur.
  - Lower annual snowpacks, earlier melting, & sometimes higher peak runoff.
  - Higher fire frequency and longer fire seasons.
  - Reduced vegetation cover and higher dust generation and deposition.
- **Rocky Mountains and Great Plains**
  - Lower annual snowpacks, snow melting earlier, peak flows occurring earlier.
  - More frequent intense precipitation events.
- **Upper Midwest**
  - Higher annual precipitation.
  - More intense precipitation and associated flooding.
- **Northeast USA**
  - Higher annual precipitation.
  - Significantly more high intensity precipitation events.

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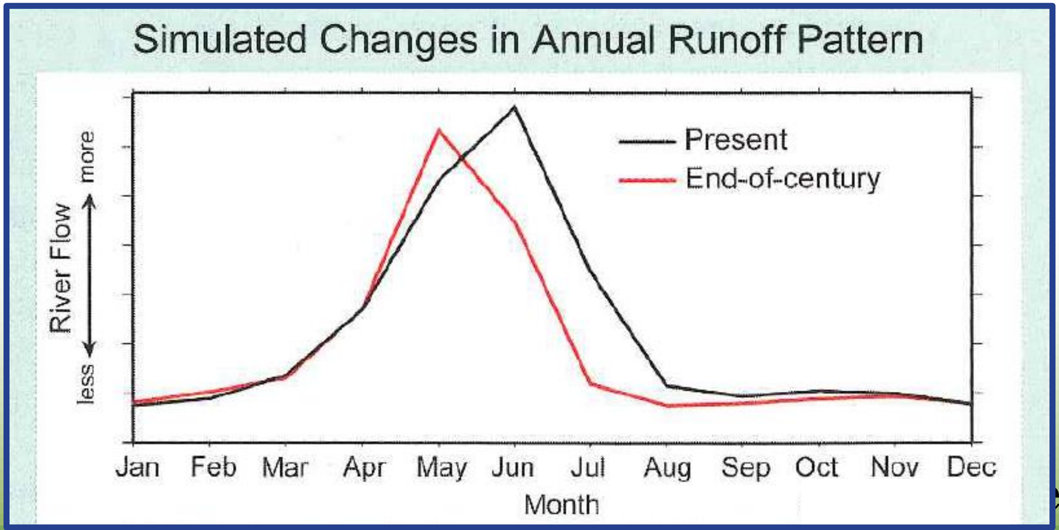

Data from the Green River, Utah. However, this same trend is already occurring at Riverton, WY.

U.S. Global Change Research Program 2009 Report
Christensen et al., 2004

Changes in events and their effects do not occur in isolation. New conceptual scenarios can be envisioned for sites in LTS.

L-Bar Site, New Mexico

Management Approaches for Event Driven Monitoring

- Contingency funds identified that can be used for initiating monitoring/data collection at sites on short notice.
- Risk profiles for sites can help us know what types of events we want to be prepared for.
- *De facto* teams identified who have expertise in different phenomena who can develop data quality objectives and be deployed quickly.

We cannot be everywhere. What are some alternatives or ways to supplement event driven monitoring at an LTS site?

- Collecting data on rare events in environments similar to where LTS sites are located-analog approach.

- Using analog sites that show collective impacts of a process.
    - Aeolian deposition and soil development on cells and landfills in the western U.S.

- Extrapolating results from rare events at one LTS site to others in the same region.

    - This approach is being used by DOE Legacy Management at the Monticello, Utah site to study climate resiliency of sites in the southwest USA.

- Expanding the network of SOARS (System Operation and Analysis at Remote Sites) stations, especially to collect data on precipitation intensity.

Conclusions

- Given the timeframes that LTS sites will remain a risk to public health and the environment, we will experience rare events.
- Having a rare event at an LTS site is not a failure; it is a chance to better understand the durability of remedies and whether we have an accurate conceptual model.
  - Riverton, Wyoming: our conceptual model of the site was incomplete. Other sites similar to it are or need to be investigated as well.
  - Edgemont, South Dakota: site was protective for what is likely to be a uncommon, but regular disturbance event.
  - L-Bar, New Mexico: A possible scenario of site changes in response to coupled changes in rare event frequency and intensity because of climate trends.