



U.S. DEPARTMENT OF
ENERGY

OFFICE OF
**ENVIRONMENTAL
MANAGEMENT**

Agency Model Reviews: Department of Energy

Ming Zhu, Ph.D., PE, PMP

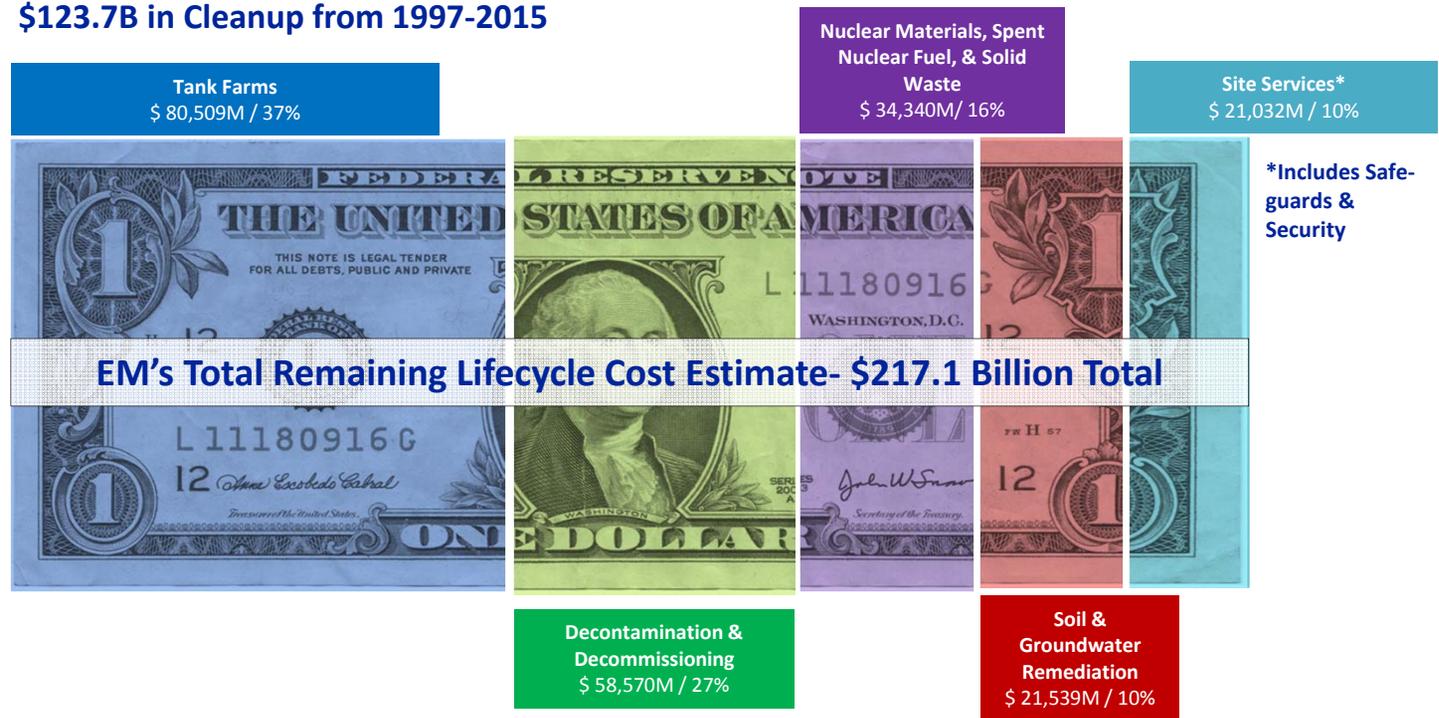
2016 ISCMEM Annual Public Meeting
National Science Foundation, Washington, DC
December 14, 2016

- **Complex-Wide and Hanford Site-Wide Risk Reviews**
- **Using ASCEM to Support Development of End-State and Long-Term Monitoring Program**
- **Predicting Performance of Cementitious Materials**
- **Evaluation of Porewater Pressures underneath the Oak Ridge Low level Waste Disposal Facility**
- **LANL Cliff Retreat Study**
- **Interagency Performance and Risk Assessment Community of Practice (P&RA CoP)**
- **EM Guidance on Modeling Development and Uses**
- **SC Multiscale Modeling of Watershed System; SBR**

DOE Environmental Cleanup Program

- Safeguards & security
- Tank waste stabilization, treatment, & disposal
- SNF & SNM disposition
- TRU & MLLW disposition
- Soil & groundwater remediation
- Facility D&D

\$123.7B in Cleanup from 1997-2015



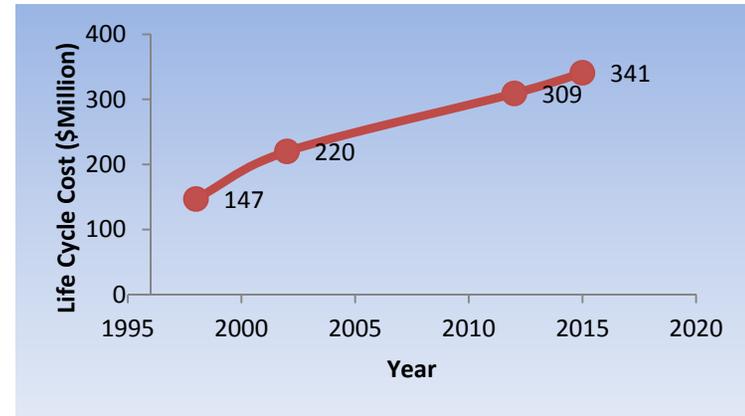
EM Accomplishments



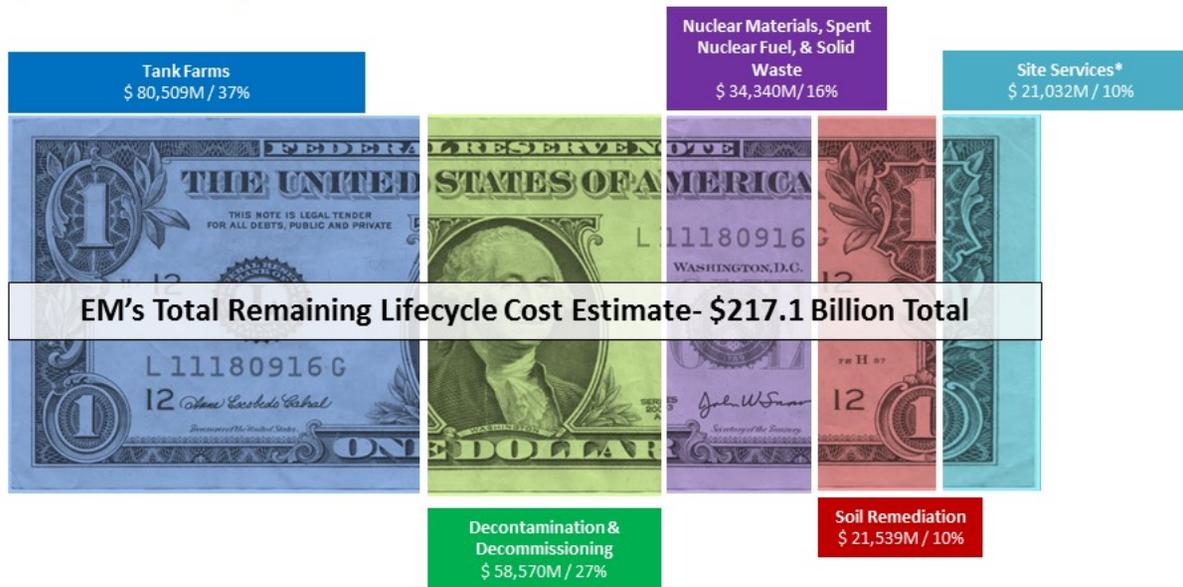
EM has significantly reduced risks to the public and environment

Life-Cycle Cost & Environmental Liability

Environmental Liabilities

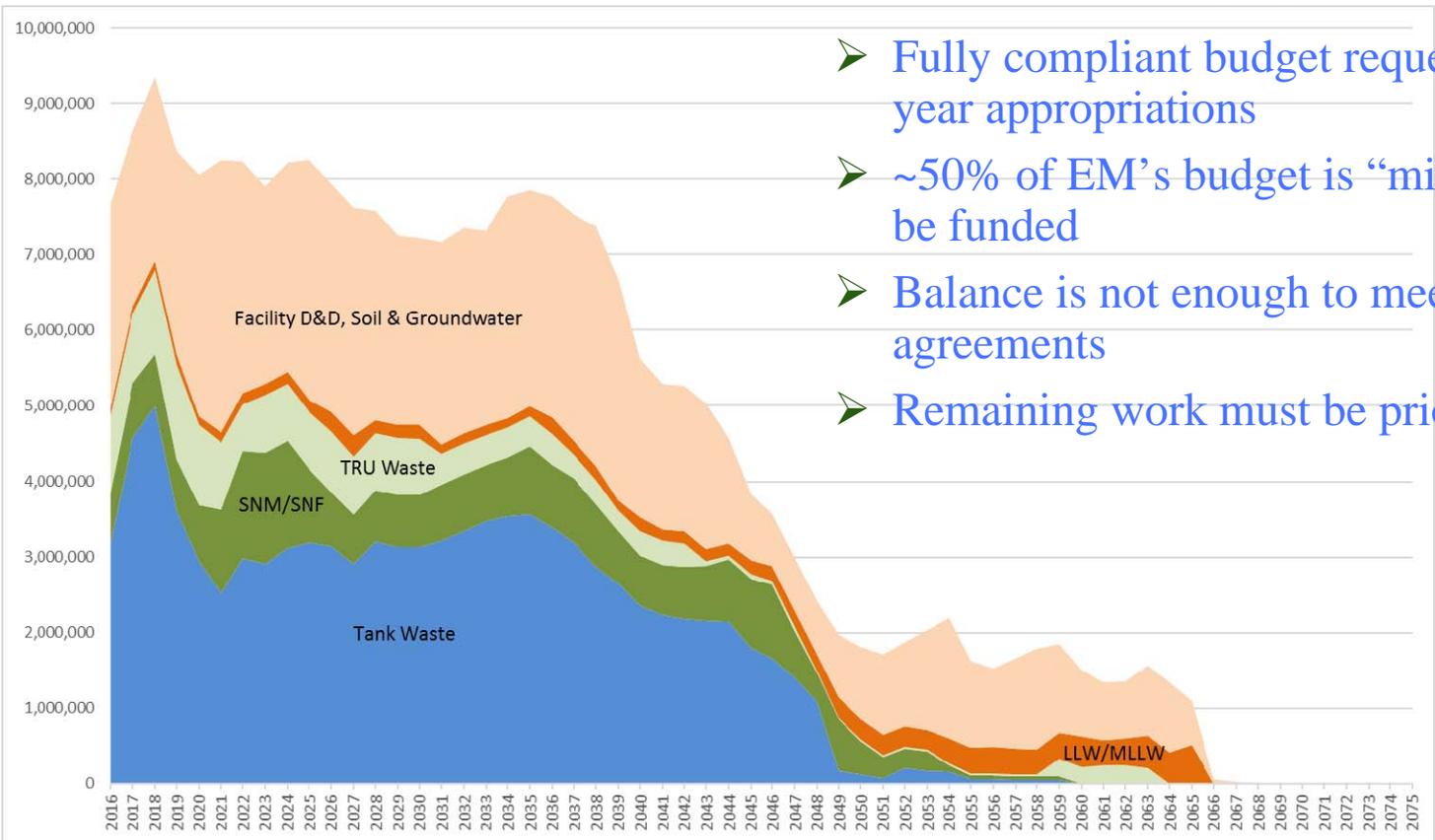


\$123.7B in Cleanup from 1997-2015



*Includes Safeguards & Security

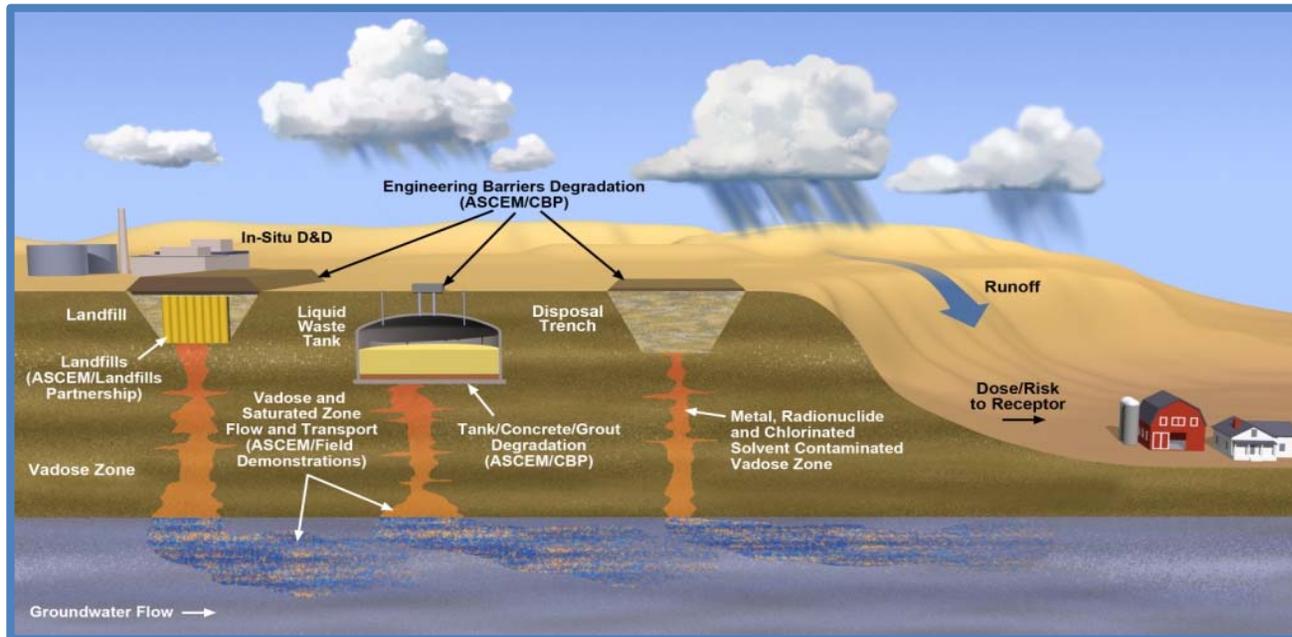
Need for Risk-Informed Prioritization



- Fully compliant budget requests exceed recent-year appropriations
- ~50% of EM’s budget is “min-safe”, which must be funded
- Balance is not enough to meet current cleanup agreements
- Remaining work must be prioritized



NAS Workshops for Risk-Informed Site Clean Up and Closure



- National Academies facilitated workshops at EM's request
- Topics discussed include:
 - ✓ Holistic approaches for remediation of sites
 - ✓ Effective post-closure controls
 - ✓ Assessing performance of site remedies and closures
 - ✓ Risk-informed decision-making

Complex-wide and Hanford Site-wide Risk Reviews

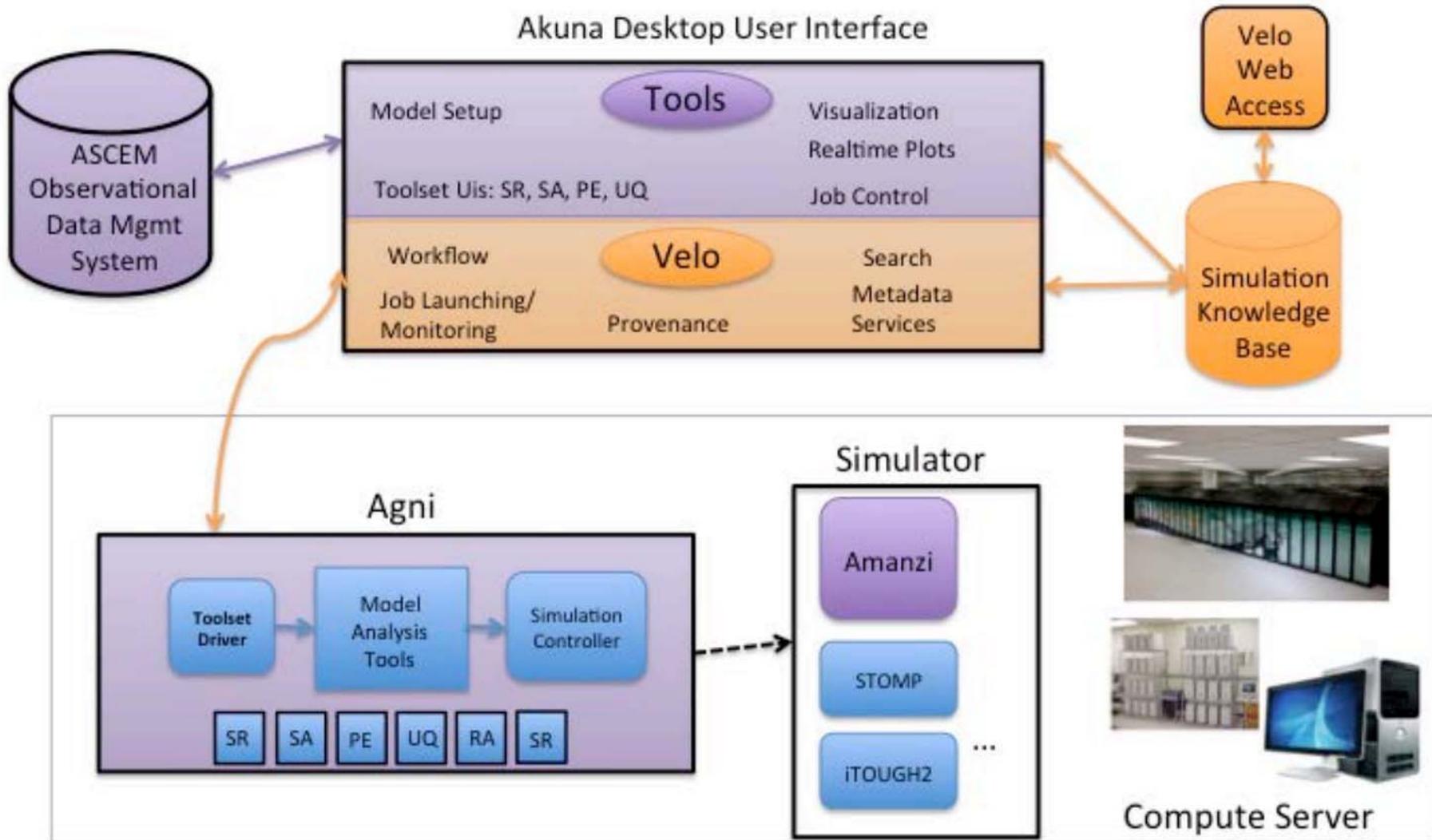
Omnibus Complex-Wide Risk Review

- Mandated in Fiscal Year 2014 “Omnibus” Appropriations Act
- Focuses on DOE and DNFSB’s identification and use of risk information pertaining to human health, environment, and nuclear safety
- Review *does not* evaluate risks posed by specific facilities or contaminants or compare risks between sites
- Led by the Consortium for Risk Evaluation with Stakeholder Participation (CRESP)
- Final report published in August 2015, with epilogue released in June 2016

Hanford Site-wide Risk Review

- Requested by DOE Deputy Under Secretary for Management
- Goal: Identify and characterize potential risks to the public, workers, groundwater, Columbia River, and ecological and cultural resources
- Led by CRESP with support from Pacific Northwest National Laboratory and a core team from DOE, EPA, & Washington State
- Methodology document published in 2015

Advanced Simulation Capability for Environmental Management (ASCEM)



New Paradigm of Long-Term Monitoring

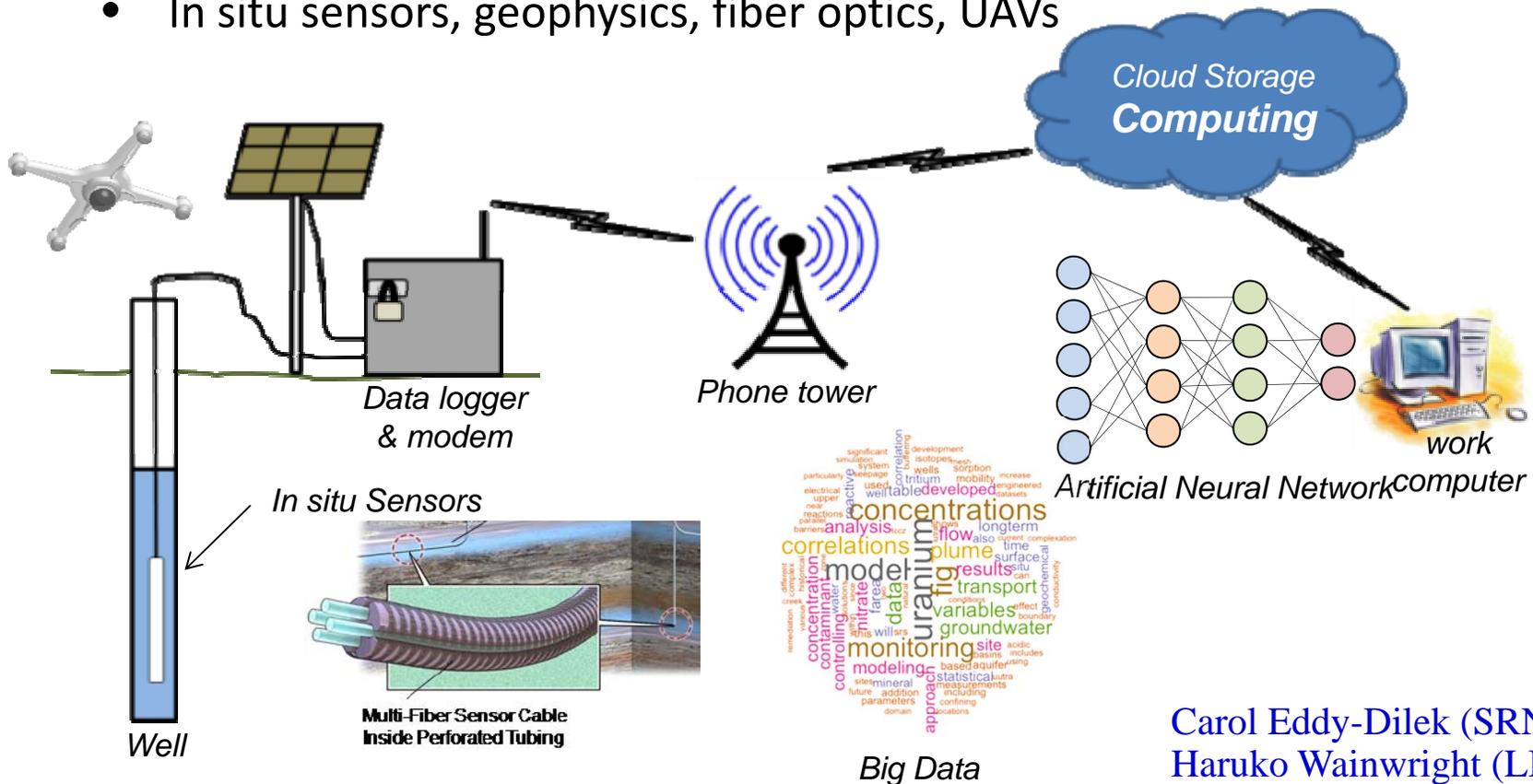
Big Data methods for real-time data analysis and early warning systems

- Data mining, machine learning (Kalman filters, artificial neural network)

Virtual Test Bed: ASCEM modeling tool for predicting long-term performance

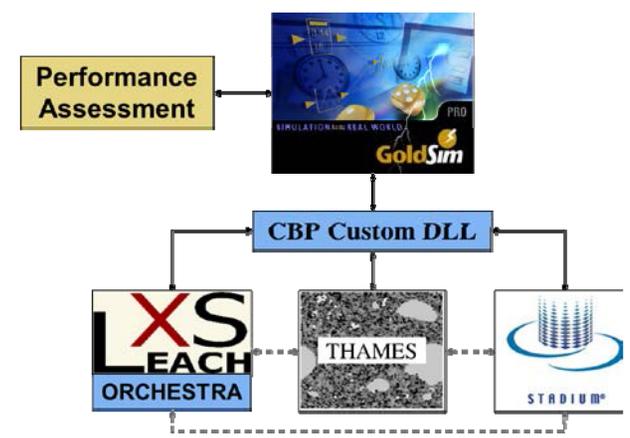
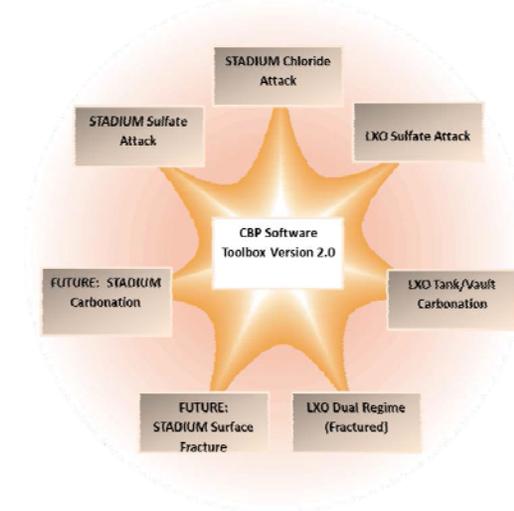
New sensing technologies for automated remote continuous monitoring

- In situ sensors, geophysics, fiber optics, UAVs



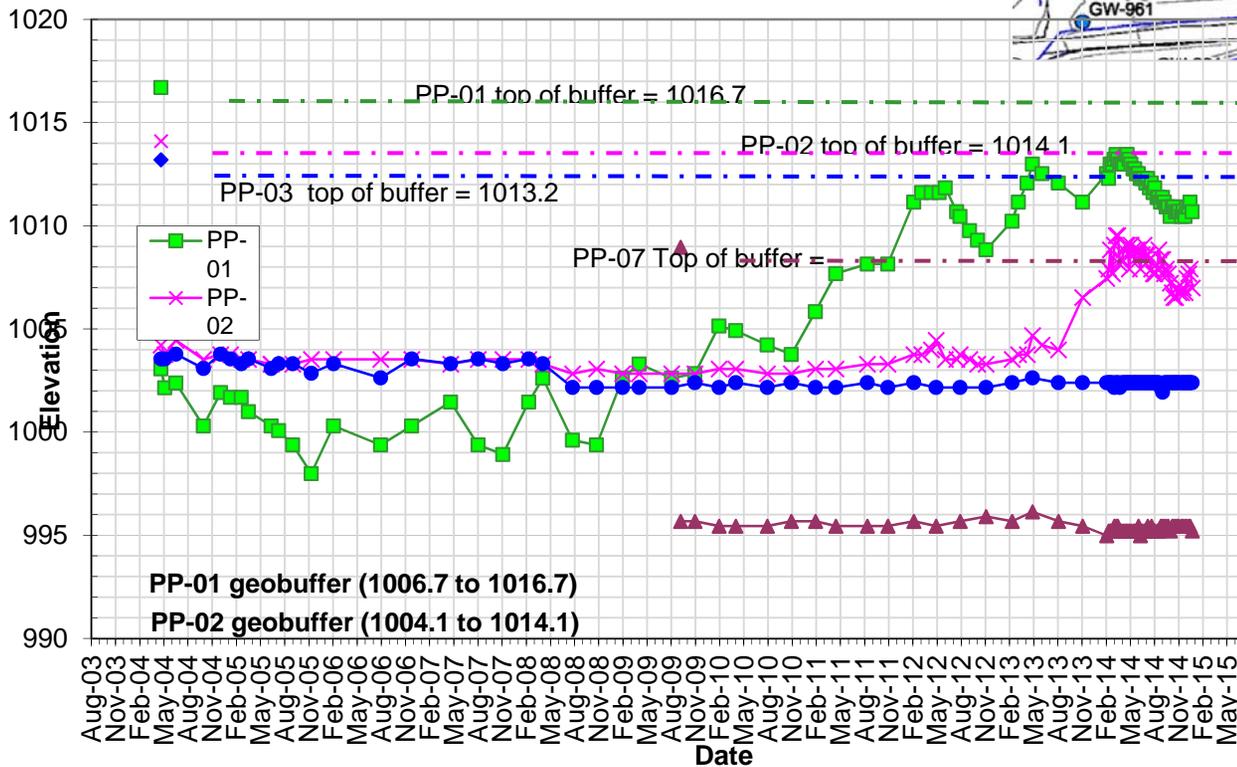
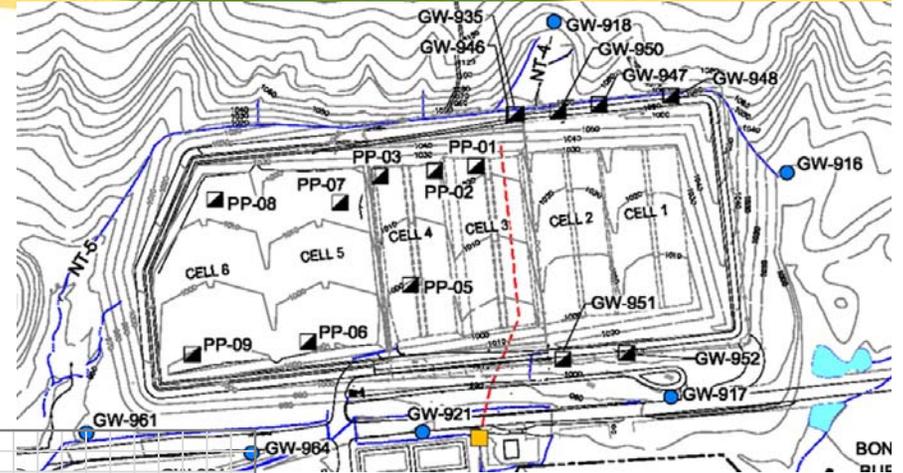
Carol Eddy-Dilek (SRNL) & Haruko Wainwright (LBNL)

- CBP Software Toolbox, Version 3.0 released to enable evaluation of the performance of cementitious barriers and waste forms over the long term (i.e., up to and > 1000 years)
- Four new CBP software modules have been added to the CBP Toolbox - Version 3.0 to increase confidence in performance assessment evaluations:
- STADIUM® Tank/Vault Carbonation – New software using STADIUM®
- STADIUM® Sulfate Attack & Chloride Attack – Significant update of Version 2.0
- STADIUM® Calcium Leaching - Models the damage due to Portlandite dissolution and C-S-H decalcification
- SRNL – FloXcel database tool to simulate fracture flow



<http://cementbarriers.org/>

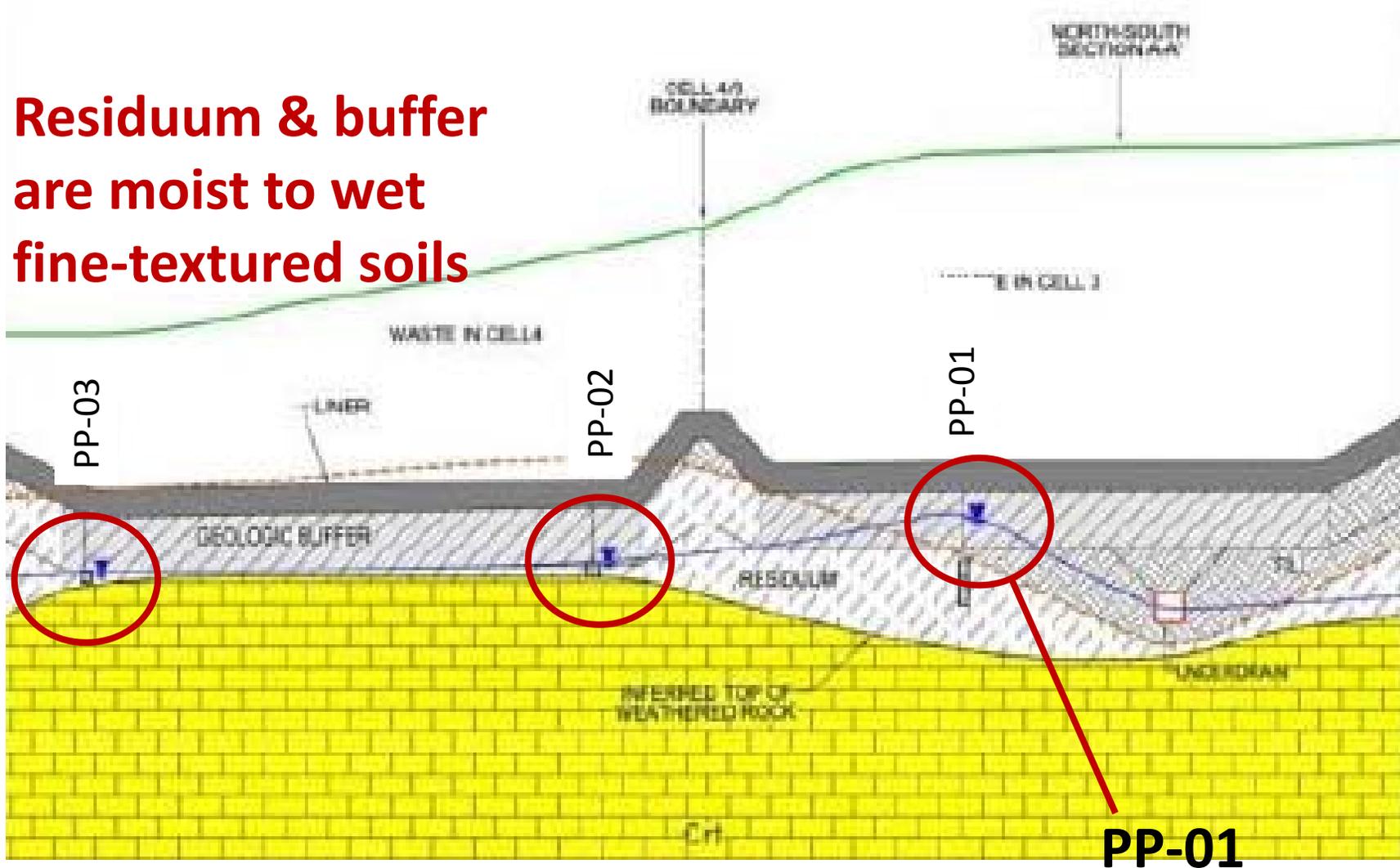
Oak Ridge LLW Disposal Facility



Oak Ridge LLW Disposal Facility: Cross Sections through Disposal Cells

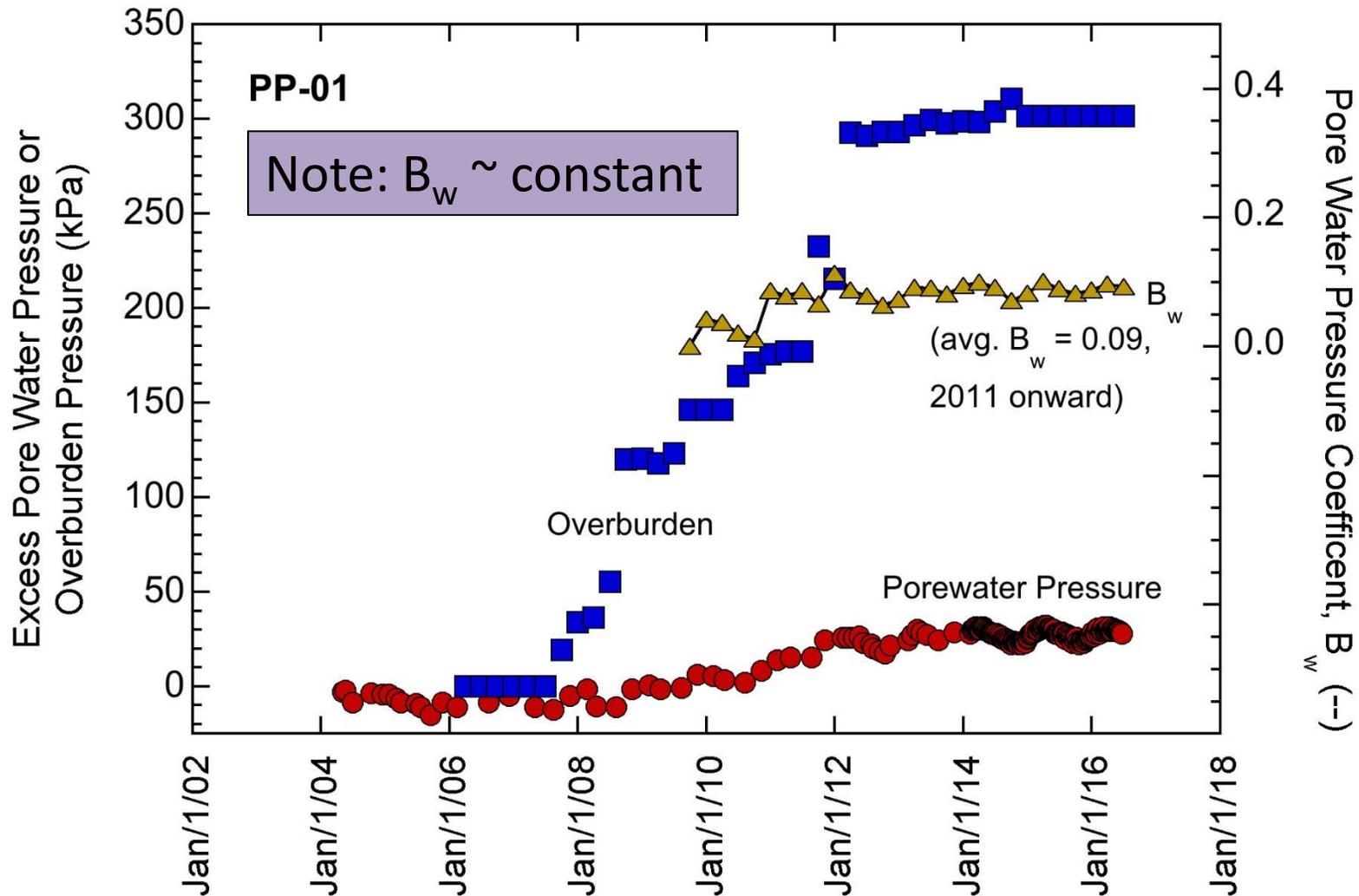
Craig Benson (U. Virginia)

**Residuum & buffer
are moist to wet
fine-textured soils**



Oak Ridge LLW Disposal Facility: Porewater Pressures at PP-01

Craig Benson (U. Virginia)



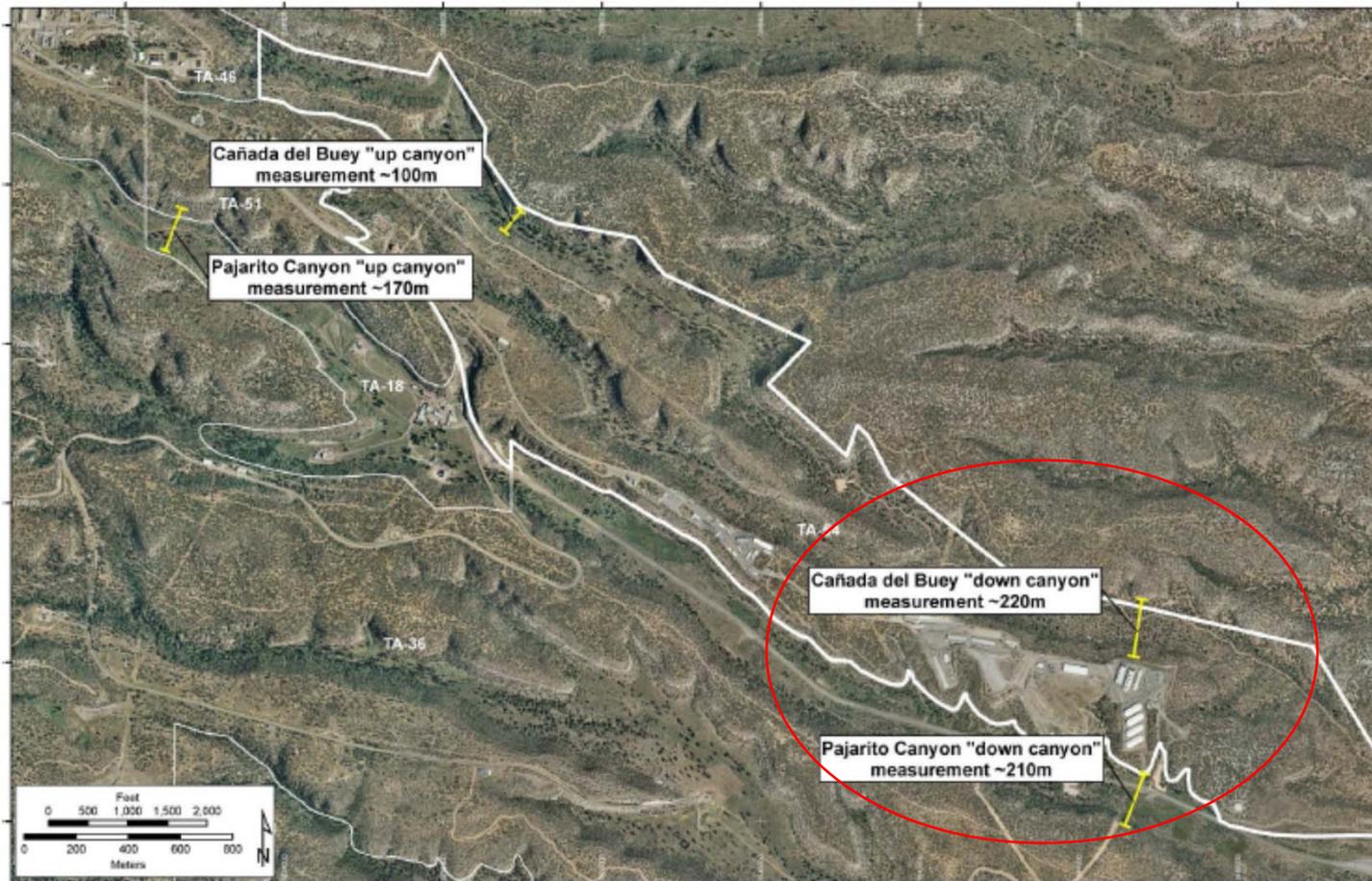
Oak Ridge LLW Disposal Facility: Results and Conclusion

Craig Benson (U. Virginia)

- Porewater pressures can be associated with factors other than groundwater rise -- excess porewater pressure from loading.
- $B_w = \Delta u / \Delta \sigma$ is constant despite changing $\Delta \sigma$ and Δu , indicating excess porewater pressure from loading.
- $B_w \ll 1$, indicating **un**saturated soil in residuum and buffer. Groundwater **cannot** be in residuum and buffer.

Elizabeth Miller, Richard Kelly & Emily Schultz-Fellenz
(LANL)

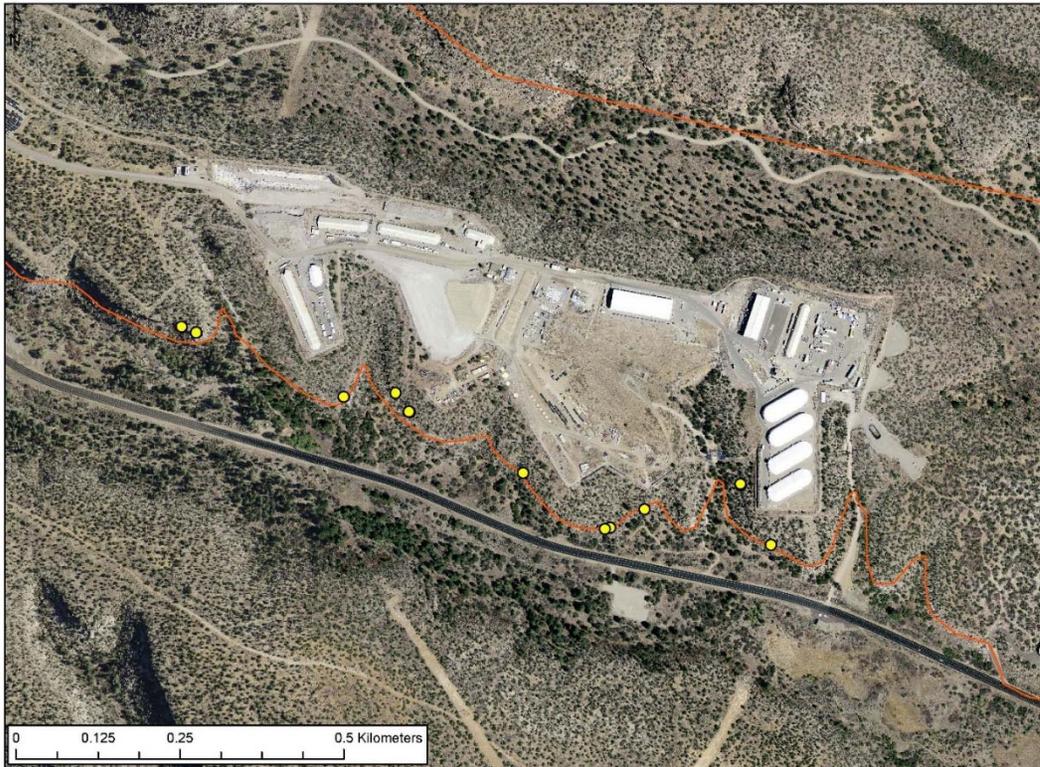
North side: 220m/1.256 Ma \approx 0.175 m/1,000 years



South side: 210m/1.256 Ma \approx 0.167m/1,000 years

LANL Cosmogenic Nuclide Dating

Elizabeth Miller, Richard Kelly & Emily Schultz-Fellenz
(LANL)

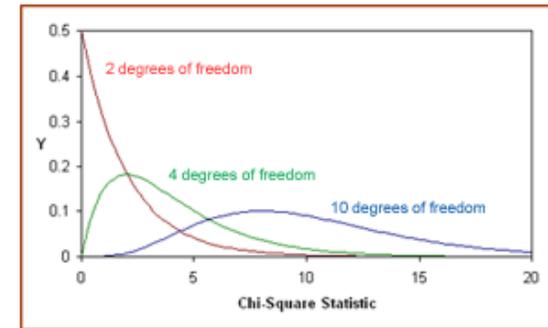


- *14 samples collected in 2016; 25-30 total samples planned*
- *2 results received so far: 3,300 years and 12,100 years since rock face exposed*

Elizabeth Miller, Richard Kelly & Emily Schultz-Fellenz
(LANL)

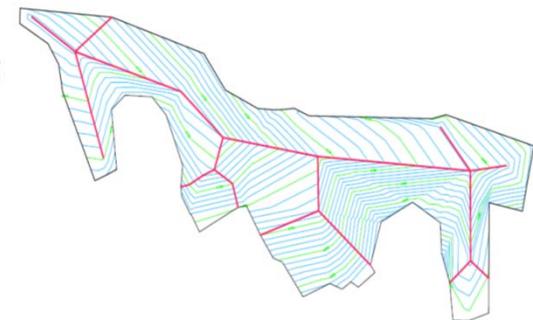
□ Statistical Approach:

- Cliff retreat rate distribution pattern
- Bootstrapping and simulations



□ Discrete Random Event Approach:

- New incision points from discrete random events, such as the fall of rock
- Eating back into the cover



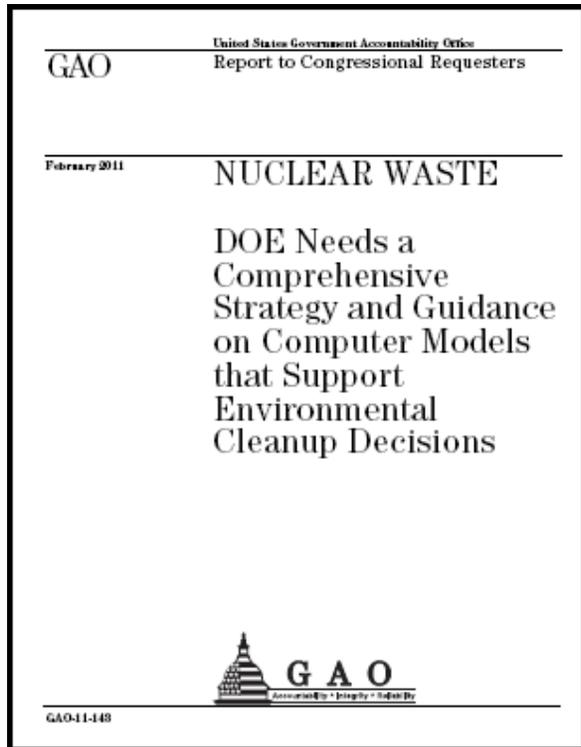
Performance and Risk Assessment Community of Practice

- DOE EM sponsored the Performance Assessment Community of Practice (PA CoP) in 2009, to:
 - a) provide means to address consistency early and throughout PA process;
 - b) foster early and sustained communication among CERCLA, NEPA, RCRA, and DOE Order 435.1 activities involving LLW, tank closure, and D&D;
 - c) provide a forum to share information regarding state of the art and specific models, data and approaches; and
 - d) serve as an enduring data and modeling resource to minimize duplication of effort across DOE and train future generation of PA professionals
- In 2013, the group was broadened as P&RA CoP to emphasize:
 - a) the need for an integrated regulatory framework when cleanup work at a given site is subject to overlapping environmental regulations (CERCLA, RCRA, NEPA, DOE Order 435.1 and NDAA Section 3116); and
 - b) the importance of risk assessments in non-DOE self-regulated cleanup activities
- Chartered Interagency Steering Committee
- 13 Public Webinars
- 6 Technical Exchange Meetings
- Guidance documents under preparation



<http://www.energy.gov/em/services/site-facility-restoration/performance-risk-assessment-community-practice-pra-cop>

EM Comprehensive Guidance for Modeling

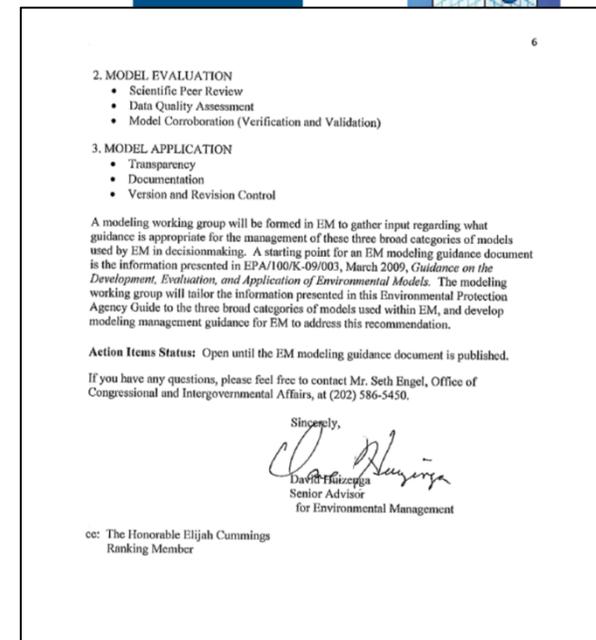
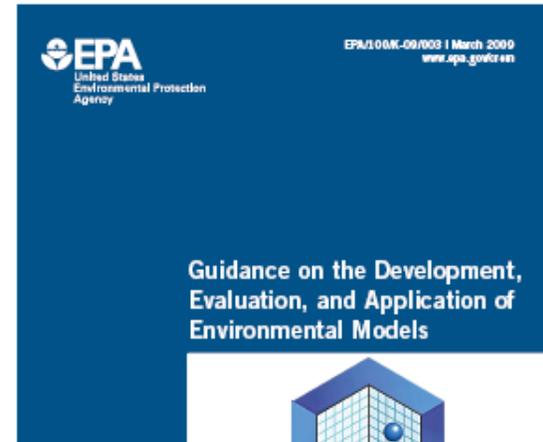


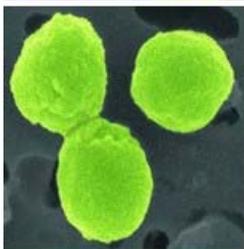
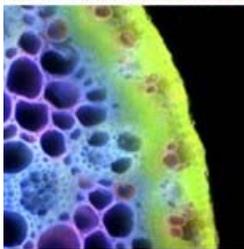
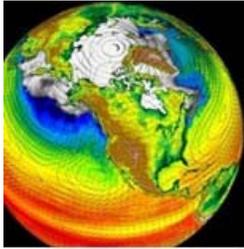
- Clarify specific quality assurance requirements for computer models used to analyze the potential effectiveness of cleanup alternatives, assess the performance of selected cleanup activities, and assist in planning and budgeting cleanups
- Ensure that the models are assessed for compliance with these requirements
- Develop a comprehensive strategy and guidance for the management of computer models to promote consistency, reduce duplication, and ensure sharing of lessons learned

EM Developing Comprehensive Guidance for Modeling

EM committed to developing Guidance for Models Used to Support Environmental Cleanup Decisions

- Form a modeling working group to gather input regarding what guidance is appropriate for the 3 broad categories of models used by EM
- Starting point is EPA/100/K-09/003, 2009, Guidance on the Development, Evaluation and Application of Environmental Models
- The modeling working group will tailor the EPA guidance to the 3 EM model categories
- Develop modeling management guidance for EM



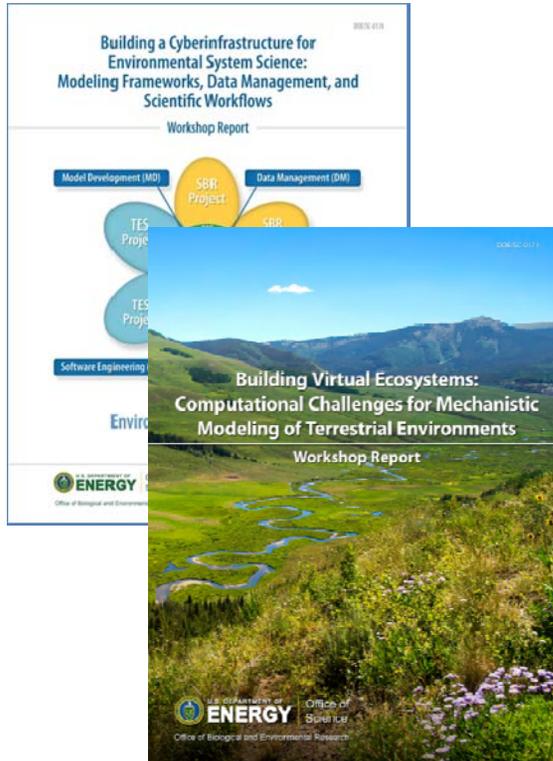


Multi-Scale Modeling of Watershed System Function and Dynamics

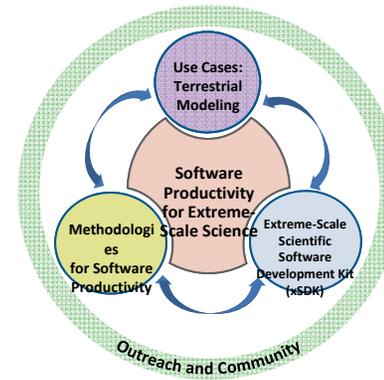
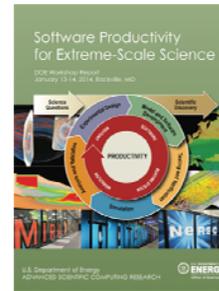
- David Lesmes (DOE) – Programmatic Context and Interagency Connections
- Tim Scheibe (PNNL) - The Multiscale Watershed Challenge and Overview of the IDEAS project
- Carl Steefel (LBNL) – Integrated Surface-Subsurface Hydrology and Biogeochemistry
- Laura Condon (Syracuse University) - Integrated Hydrological Modeling at the Continental Scale
- Q&A

*ISCMEM Working Group 4: Surface Water and Watershed Water Quality Modeling
DOE Webinar: July 27, 2016*

Building Community Infrastructure
 Frameworks: Modular, Interoperable, Extensible; Data Management; Workflows



ASCR/BER: Software Productivity



Research Watersheds & Use Cases

