U.S. DEPARTMENT
of ENERGY

Office of Legacy Management

Building Efficiencies into Groundwater Compliance Strategies Under UMTRCA by Integrating Adaptive Site Management Principles

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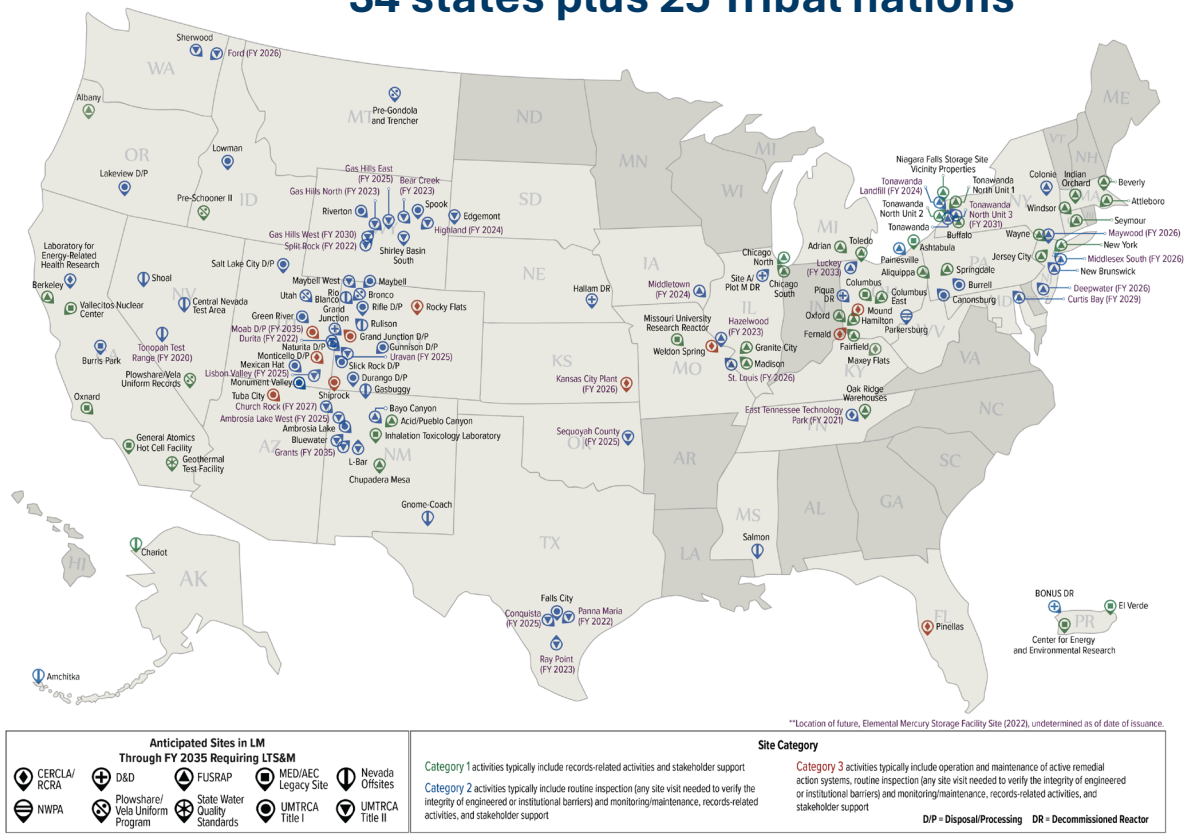
Presenter:
Anthony Farinacci – RSI EnTech, LLC.

Contributing Authors:
Meghann Hurt – Department of Energy Office of Legacy Management
Mary Young – Department of Energy Office of Legacy Management
Al Laase – RSI EnTech, LLC.
Jennifer Nyman – Geosyntec

History & Mission

- The Office of Legacy Management (LM) was created in December 2003
- It's a dedicated office responsible for the long-term care of 103 sites from various regulatory programs
- The number of sites will nearly double the portfolio over time

34 states plus 25 Tribal nations



Anticipated Sites in LM Through FY 2035 Requiring LTS&M

CERCLA/RCRA · D&D · FUSRAP · MED/AEC Legacy Site · Nevada Offsites · NWPA · Plowshare/Vela Uniform Program · State Water Quality Standards · UMTRCA Title I · UMTRCA Title II

Site Category

Category 1 activities typically include records-related activities and stakeholder support

Category 2 activities typically include routine inspection (any site visit needed to verify the integrity of engineered or institutional barriers) and monitoring/maintenance, records-related activities, and stakeholder support

Category 3 activities typically include operation and maintenance of active remedial action systems, routine inspection (any site visit needed to verify the integrity of engineered or institutional barriers) and monitoring/maintenance, records-related activities, and stakeholder support

D/P = Disposal/Processing DR = Decommissioned Reactor

**Location of future, Elemental Mercury Storage Facility Site (2022), undetermined as of date of issuance.

Mission: ***fulfill the Department of Energy's post-closure responsibilities and ensure the future protection of human health and the environment.***

What Does LM Do?

Environmental Monitoring

Groundwater | Soil conditions
Plant communities

Institutional Controls

Long-Term Surveillance

Annual inspections

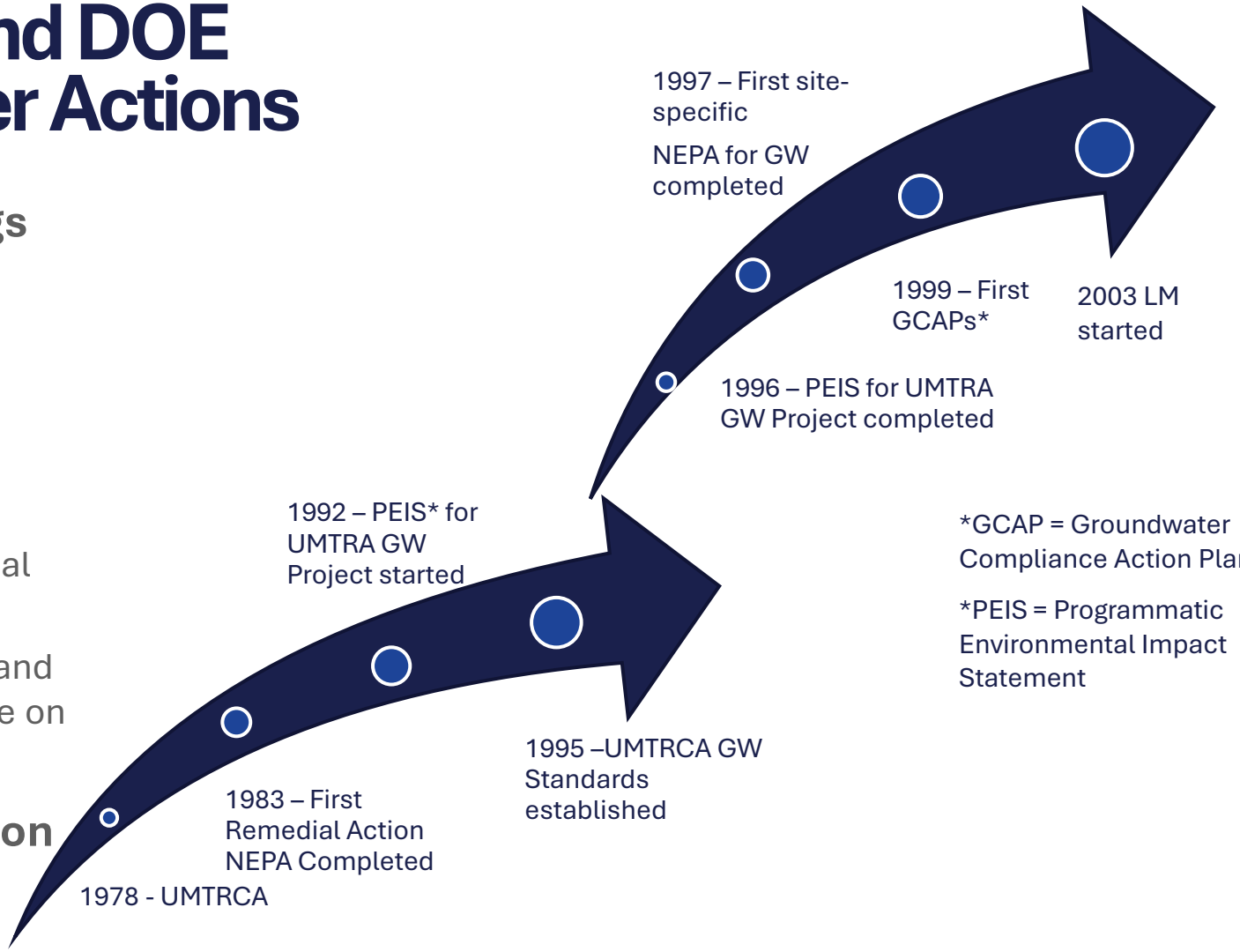
Cell performance

High-resolution lidar imaging
Groundwater protection

Rifle Disposal Site in Colorado

Uranium Mill Tailings Radiation Control Act and DOE Initiation of Groundwater Actions

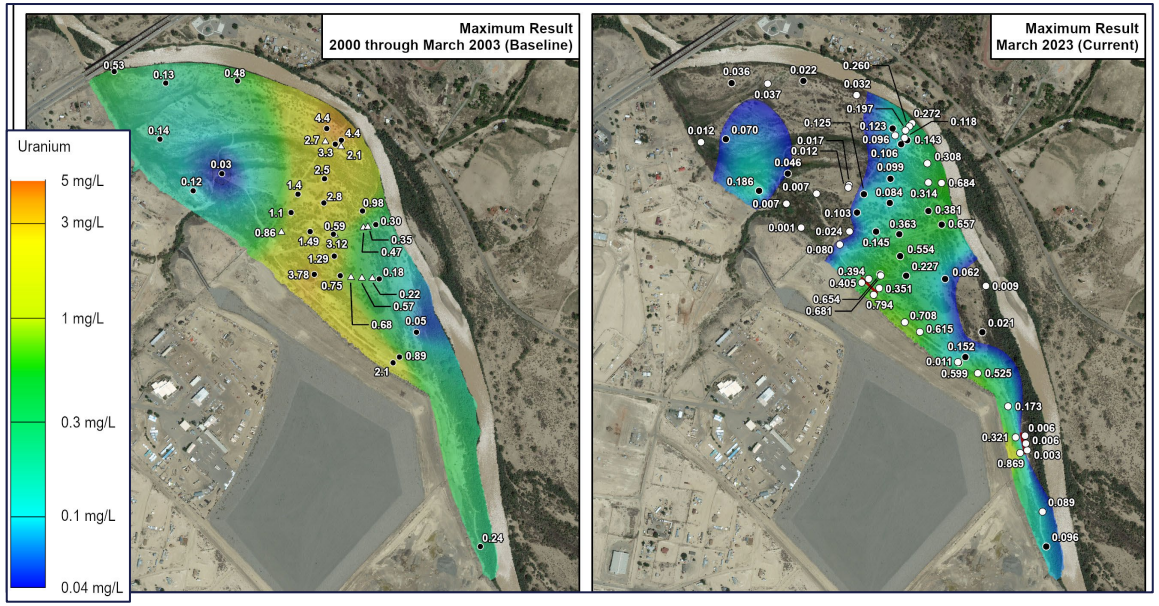
- **The regulations issued under the authority of the Uranium Mill Tailings Radiation Control Act (UMTRCA) of 1978**
  - Title I and Title II
  - Designates NRC as lead regulator
- **Title I**
  - DOE is responsible for performing remedial action
  - Requires NRC in consultation with Tribal and state governments to provide concurrence on remedial actions
- **Uranium Mill Tailings Remedial Action (UMTRA) Ground Water Project –**
  - Initial programmatic approach



Groundwater Compliance

- **What is a Groundwater Compliance Action Plan (GCAP)?**
- **UMTRCA Groundwater Compliance Strategies**
  - No remediation
  - Natural flushing
  - Active remediation
  - Active remediation with natural flushing
- **UMTRCA Standards**
  - Supplemental standards
  - Alternate Concentration Limits

Uranium plume enhanced natural flushing progress



Water Treatment Units for Pump and Treat Systems

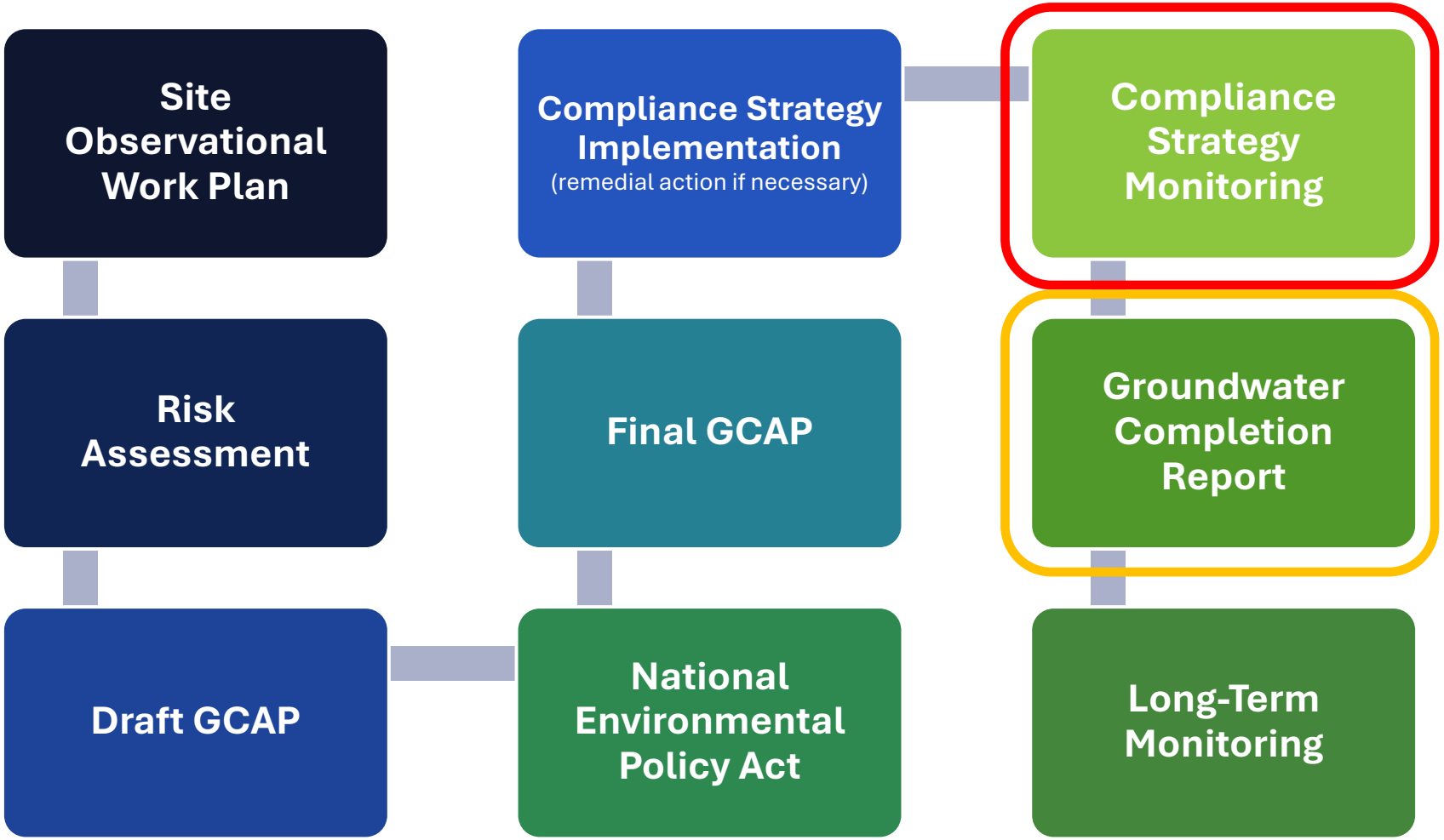
Modular evaporation pond

Title I GCAP Summary Status

- **LM is responsible for groundwater compliance at 24 abandoned processing sites**
  - 12 sites - no further action (supplemental standards or no groundwater) –
  - 4 site - passive (ACLs and natural flushing)
  - 1 site - active remediation
  - 1 site - active remediation and natural flushing
  - 5 site - no compliance strategy
- **LM has 10 sites with GCAPs being revised and updated**
  - Programmatic approach was established in 2023

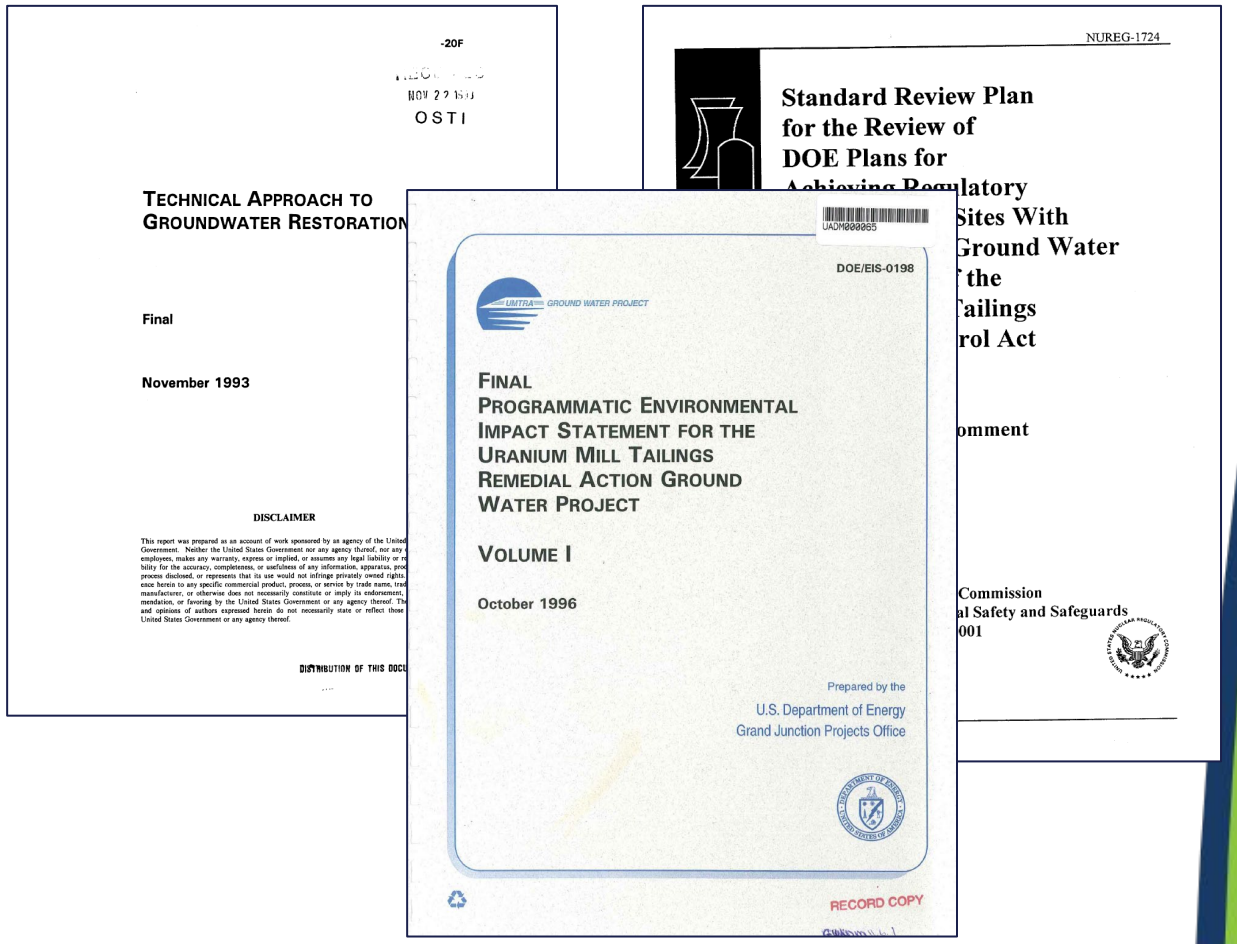
Phytoremediation pilot study plantings

Historical Compliance Strategy Development Process



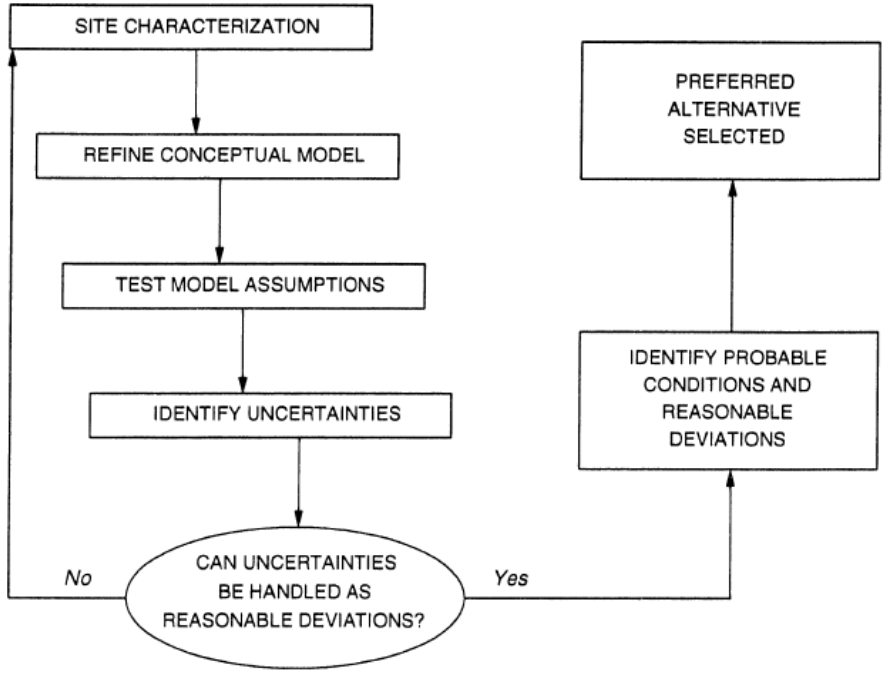
UMTRCA Groundwater Compliance Guidance and Planning

- **NRC**:
  - NUREG-1724 – *Standard Review Plan for the Review of DOE Plans for Achieving Regulatory Compliance at Sites with Contaminated Ground Water Under Title I of the Uranium Mill Tailings Radiation Control Act* (2000)
- **DOE**:
  - PEIS – *Final Programmatic Environmental Impact Statement for the Uranium Mill Tailings Remedial Action Groundwater Project* (1996)
  - ***Technical Approach to Groundwater Restoration (TAGR) (1993)***



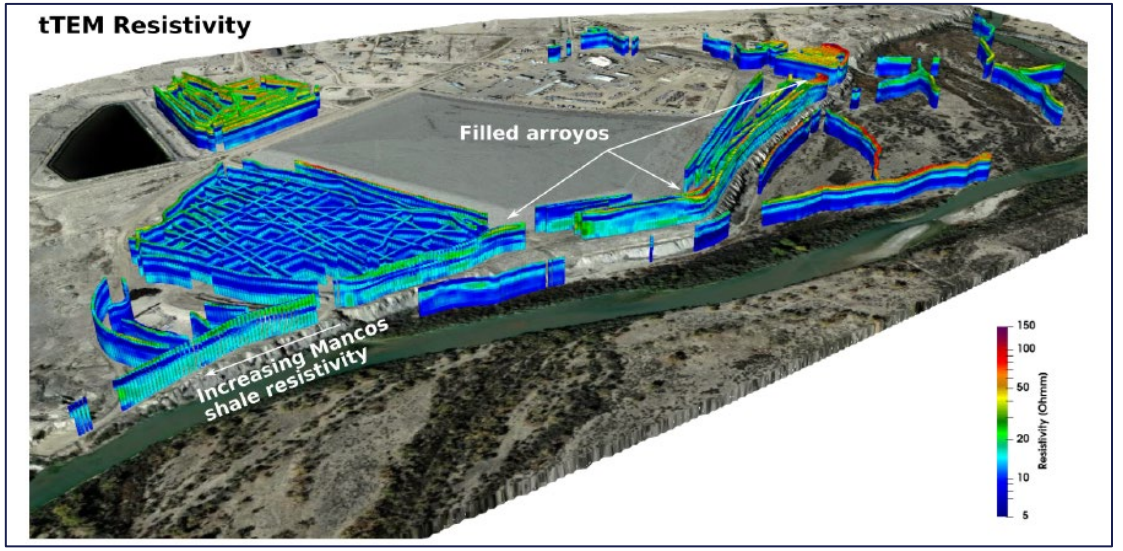
Current Implementation and Management Strategy for Groundwater

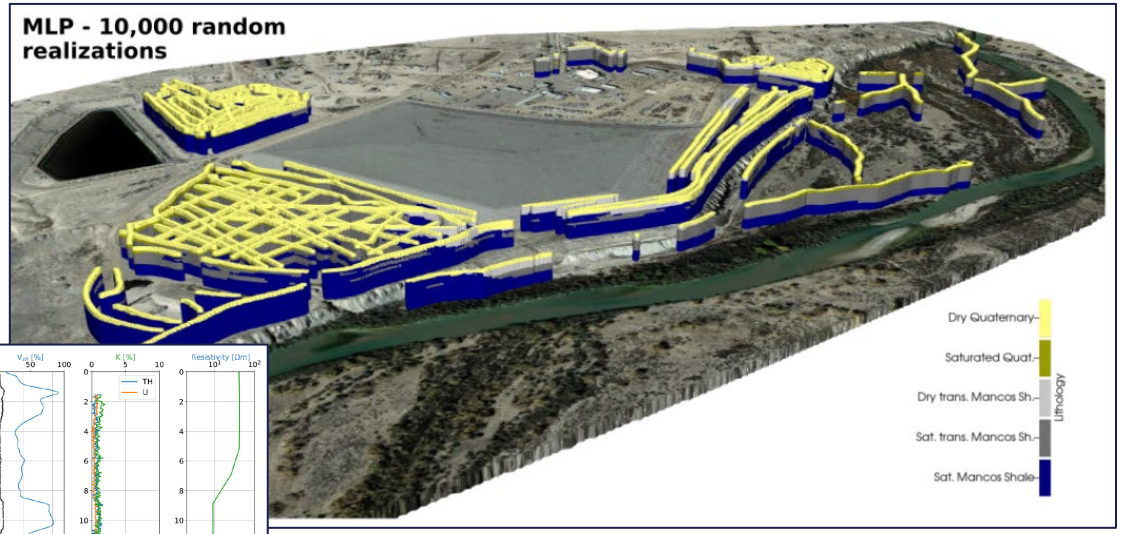
- Observational approach
  - Presented in the Technical Approach for Groundwater Restoration (DOE 1993)
- The observational approach is based on the following ideas:
  - Uncertainties are inherent in remediation projects
  - Less characterization – more action
- Approach has bias for remedial action implementation, and may risk unnecessary remedy implementation

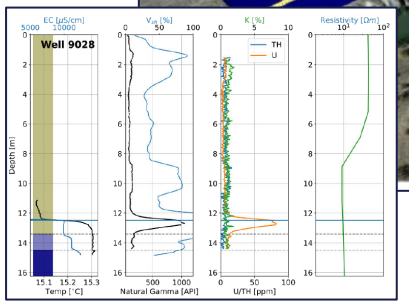


Challenges Along the Way

- Key data-gaps still exist resulting in incomplete Conceptual Site Models
- Changing site conditions
- Working towards stronger regulatory alignment
- Limited resources
  - Prioritization is required
- Prescriptive remedies without prescriptive adaptations







Geophysical survey conducted to fill key data gap of transport pathways

What is Adaptive Site Management (ASM)

- ASM = flexible, performance-based decision-making
- Core elements:
  - Trigger-based actions
  - Iterative remedy evaluation
  - Interim objectives
  - Stakeholder engagement
  - Data-informed optimization

Reference: ITRC (Interstate Technology & Regulatory Council). 2017. Remediation Management of Complex Sites. RMCS-1. Washington, D.C.: Interstate Technology & Regulatory Council, Remediation Management of Complex Sites Team.

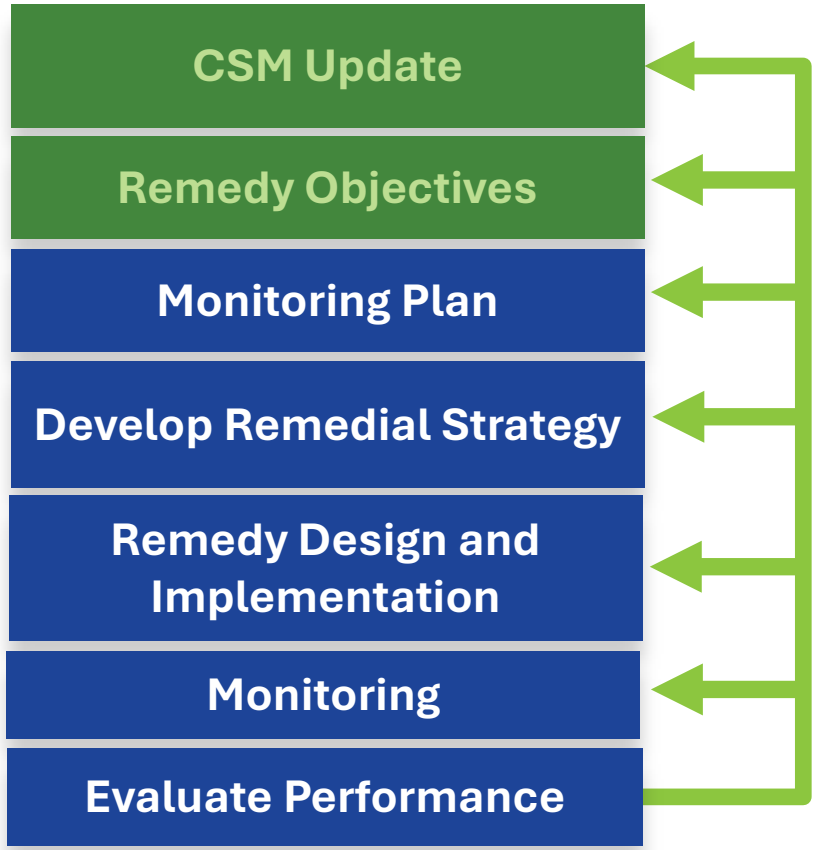


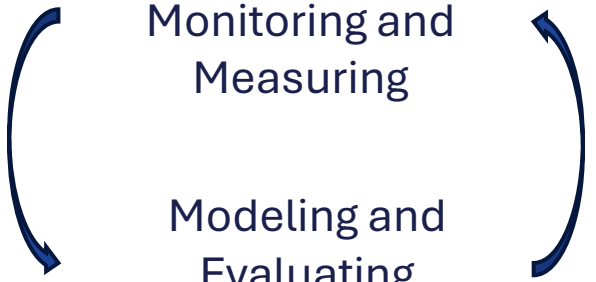
Figure Modified from ITRC 2017 – Adaptive Site Management Framework

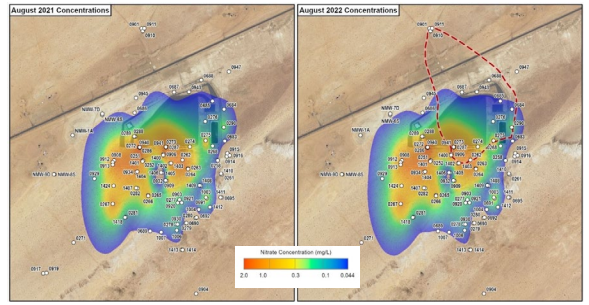
Key Applications of ASM in UMTRCA Groundwater Programs

- CSMs are revisited
- Prescriptive timeframes for revisiting performance
- Iterative risk-based decision making
- Performance-based remedy adjustments
- Optimization of monitoring networks
  - Monitoring is targeted
- Institutional Controls (ICs) and land use
- Stakeholder and regulator engagement

Integrating ASM with GCAPs

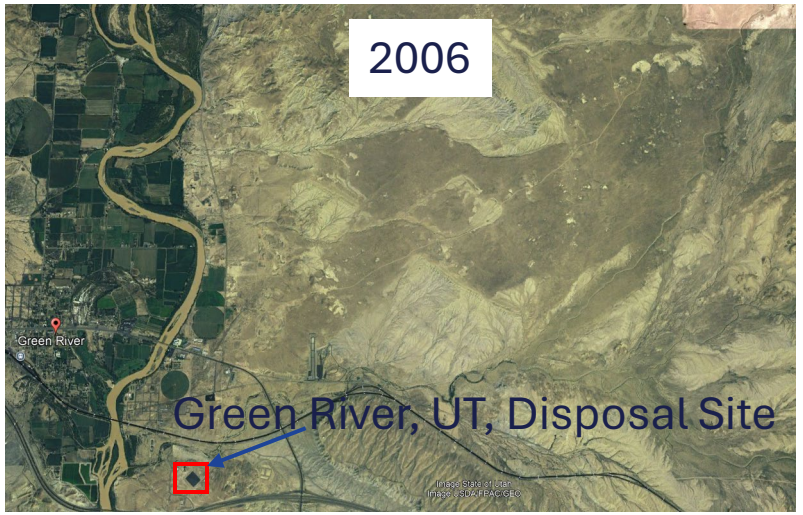
- Framework can be presented in a Revised TAGR
- Implementation Depends on the compliance strategy
  - No remediation and Natural flushing
    - Long-term monitoring – Changes are likely and actively identifying and managing risk is the key
    - Monitoring is targeted
  - Active remediation
    - ASM - Adjustments are likely and optimization is key
    - Ensures remedies are right sized and efficient
- Guidance is optional

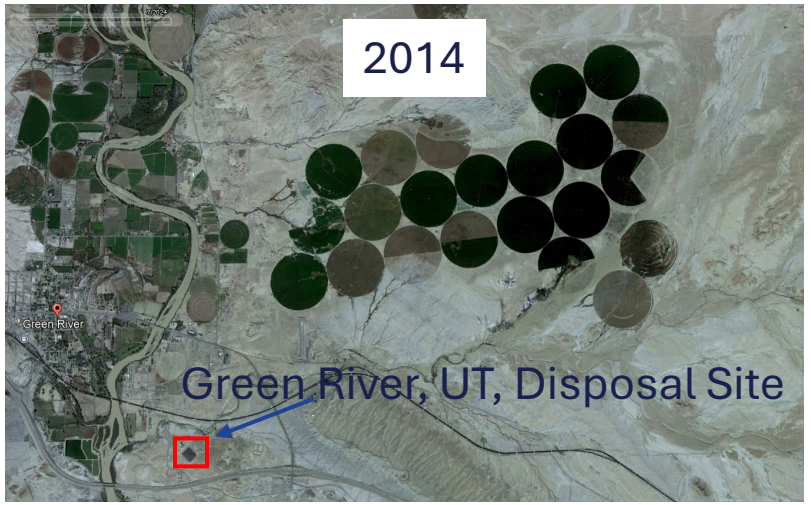




Why ASM

- Updated framework is needed
- We cannot look 1,000 years down the road
- Things are going to change
  - Regulations, weather, land use
- CSMs will need to evolve
  - Sites are complex
  - New data gaps will emerge
  - Our data record will continue to grow
- Compliance strategies will need revisited
  - We will not have a 100% solution
  - Assumptions are not always accurate
- Framework can help bridge the gap between the present and future site personnel
- Risk will always need managed; maintain protectiveness
- Uncertainties will always exist, and need monitored
- Provides the regulators assurance that we are not walking away





Aerial Photos Demonstrating Type of Land Use Change Near an LM Site

Thank You!

Historical Photo, Handling Material