DOE-EM Soil and Water Assistance Team

Technical Support to Complex Sites

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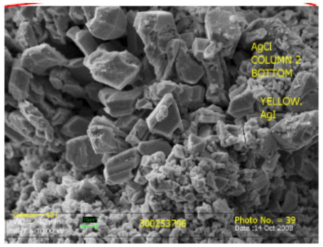

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Presentation Outline

Introduction

Overview of the EM SWAT Program

Lessons Learned

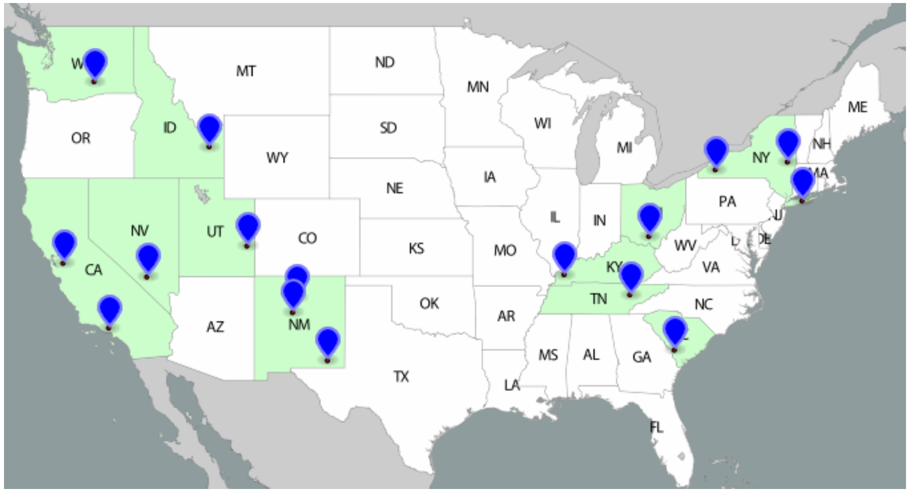
- Basic vs. Applied Science Approach
- Development of Overarching Frameworks
- Careful Matching of Technologies to Site-Specific Attributes and Issues

Examples

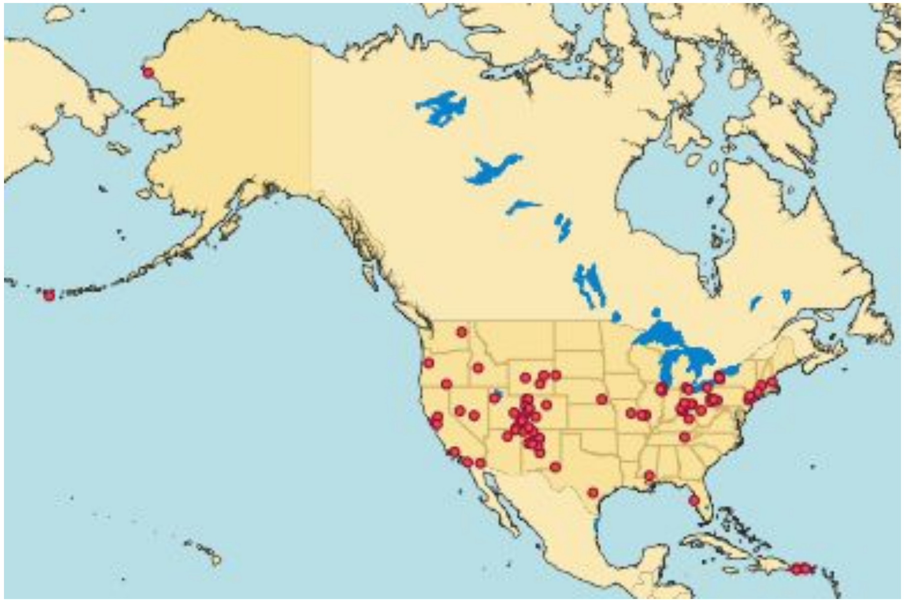
- Oak Ridge Mercury Challenge
- FY18 Activities

Conclusions

U.S. Department of Energy Environmental Challenge



DOE EM Sites
350 Million L of waste in 270 tanks
6.5 trillion L of contaminated groundwater
40 million cu m of contaminated soil and debris
Projected lifecycle cost $202 billion over 70 years



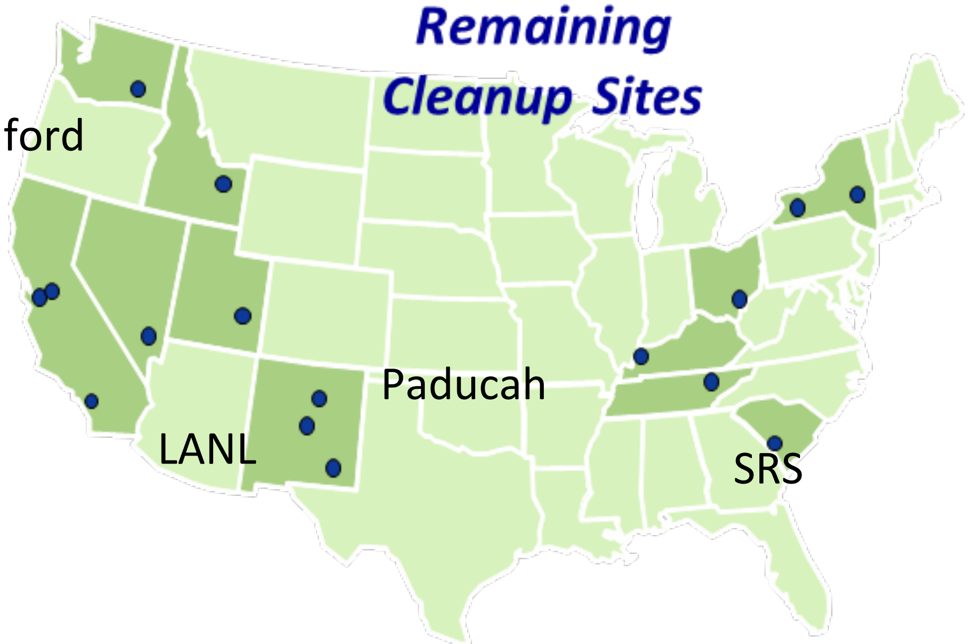
DOE LM Sites
Defense related mining, milling and processing sites and sites transitioned from EM
Includes stabilized mill tailings
Several redevelopment and reuse successes
90 sites and growing

Wide variety of contaminants including radionuclides (tritium, strontium, uranium, technetium, iodine, etc.), metals (mercury, lead, nickel, etc.), organics, and mixtures found in very diverse scenarios and settings

Groundwater and Soils Today

Large complex groundwater plumes remain at Hanford (Central Plateau, River Corridor), SR (F-area, M-area), Paducah and Los Alamos after 30 years of EM activities. Mercury in soils and surface water at Oak Ridge

Remediation costs for these plumes consume >90% of EM SGW estimated life cycle cost of $22B



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SRNL-EM Technical Assistance Program

Overall Objectives:
•Improve the effectiveness of DOE's environmental activities
•Facilitate incorporation of science into the cleanup program

Process:
•Multi-disciplinary teams of scientists and engineers provide recommendations for focused solutions to complex technical challenges that balance cost, regulatory standards, stakeholder issues, and risk

Team Objectives:
•Provide recommendations for viable technically-based solution strategies that address specific technical challenges
•Develop innovative characterization and cleanup methods by focusing on site specific conditions and the unique challenges and opportunities.
•Focused on matching effective and efficient solutions to site specific conditions
•Careful matching of technologies to real-world problems is key to implementation of transformational environmental remediation solutions

SRNL-EM Technical Assistance Program

Since 2000, the Technical Assistance program has focused on providing support to the larger DOE complex.

•Sponsored by DOE Offices of Environmental and Legacy Management

•Focus is complex or seemingly 'intractable' problems

•Over 50 teams visited 11 DOE sites (Lawrence Livermore, Los Alamos, Oak Ridge, Paducah, Portsmouth, SLAC, Kansas City Plant, SPRU, Pinellas, Pantex, and West Valley) and LM sites (Ashtabula, Columbus, Fernald, Mound, Tuba City, Gunnison, Bluewater, Riverton)

•Recommendations yielded an estimated cost savings of $100M to DOE

Paducah Gaseous Diffusion Plant

Portsmouth Gaseous Diffusion Plant

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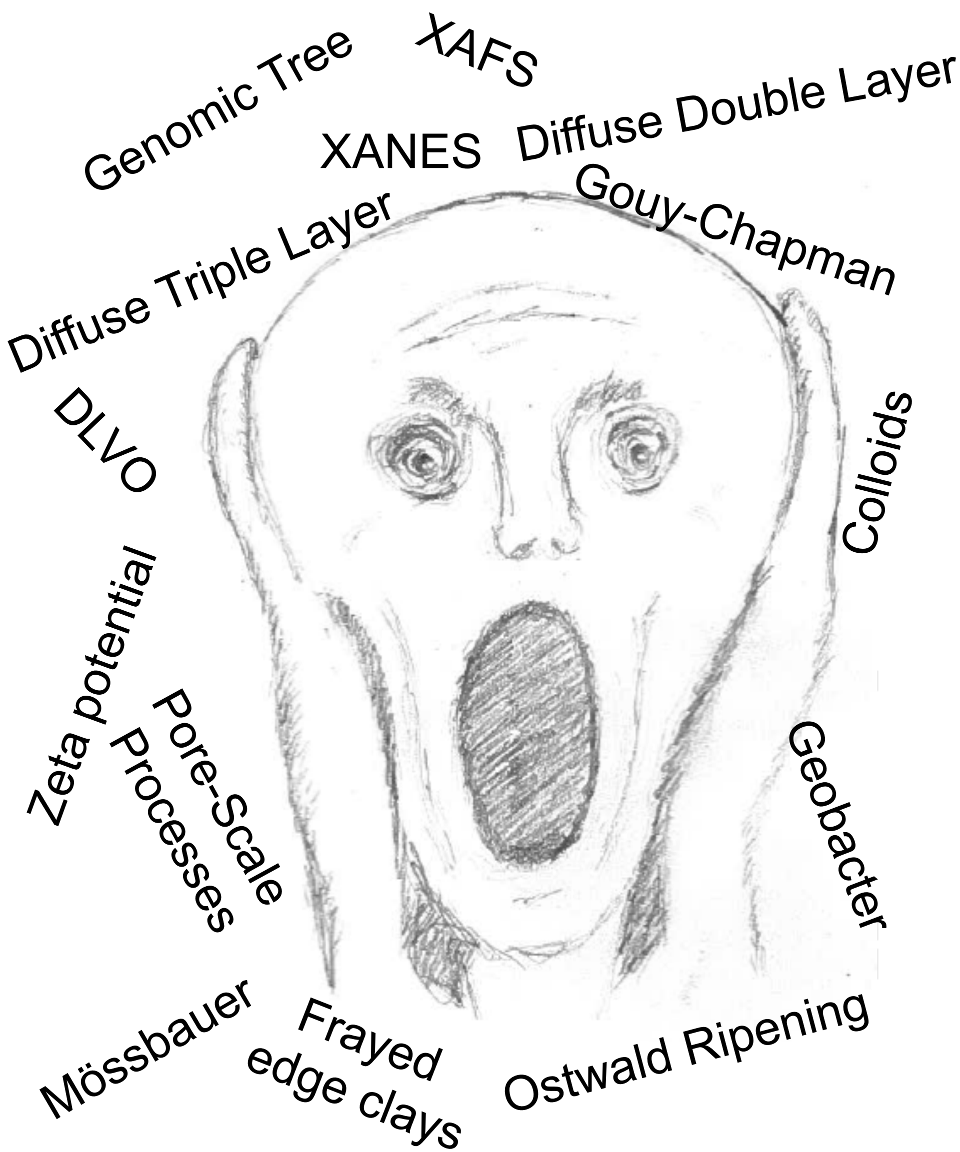
Lessons Learned

For complex sites, governing approach is the development of site-specific conceptual site model that supports decision making through the life of the project.

1. Avoid Paralysis by Perceived Complexity – Basic vs. Applied Science Approach
   - Decisions are limited to the available technology toolbox
   - Begin with what you know about the geology, chemistry, microbiology of the site and contaminant, site history
   - Identify the critical uncertainties that will impact decisions

Avoid Paralysis by Perceived Complexity



Begin With What You Know

- Nature of source
- Distribution of contaminants
- Bio-Geo-Chemical conditions of plume
- Background Bio-Geo-Chemical conditions
- Geologic and Hydrologic system
- General contaminant chemistry

We often know 90% of what we need to know for Environmental Management Success

Development of Technical Frameworks

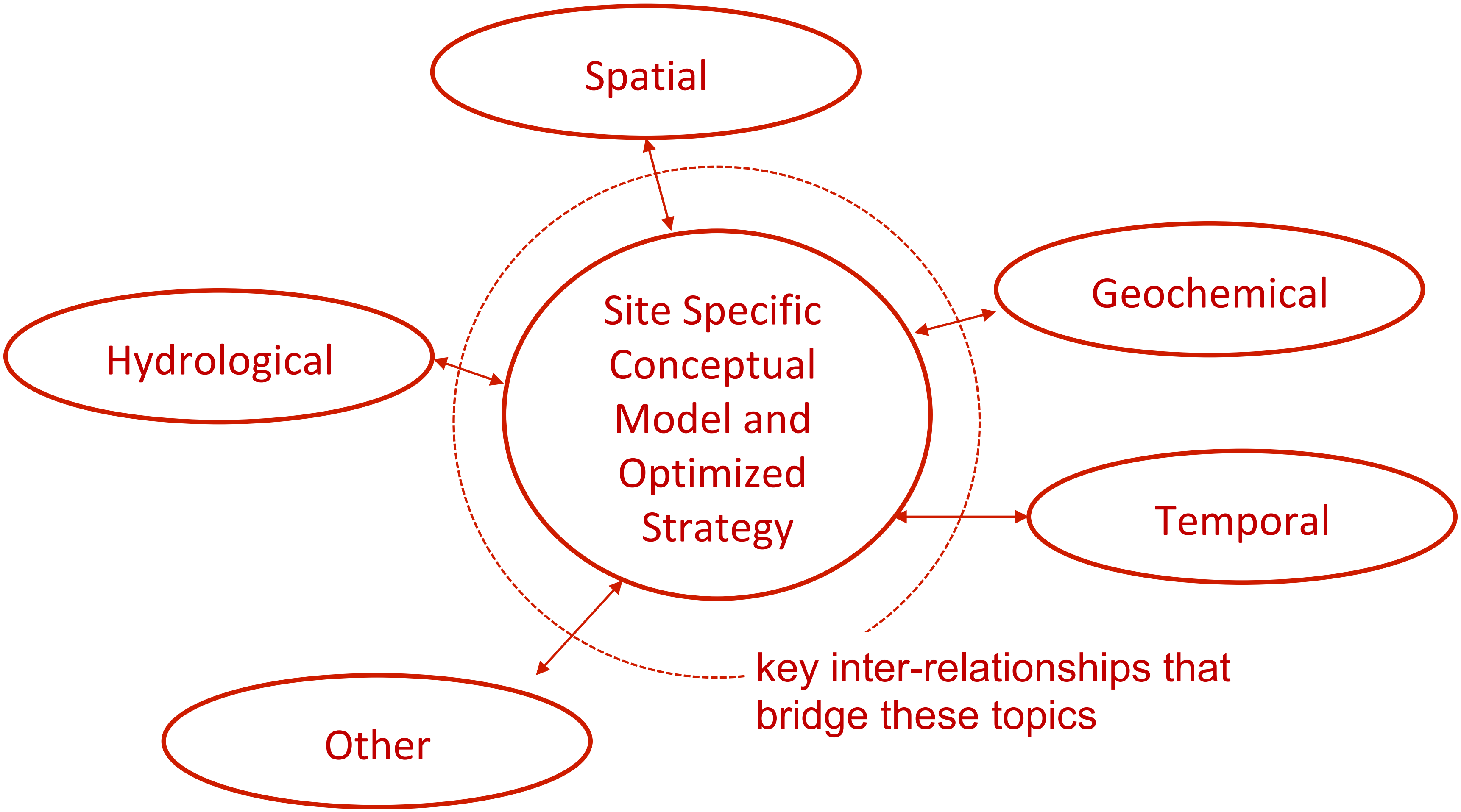
A framework is a useful simplification of a complicated system

- Captures key features in an intuitive and understandable manner
- Captures the key factors that provide practical and actionable understanding to support clear identifiable objective(s).

In evaluating data, challenges and opportunities, the technical team uses overarching set of frameworks

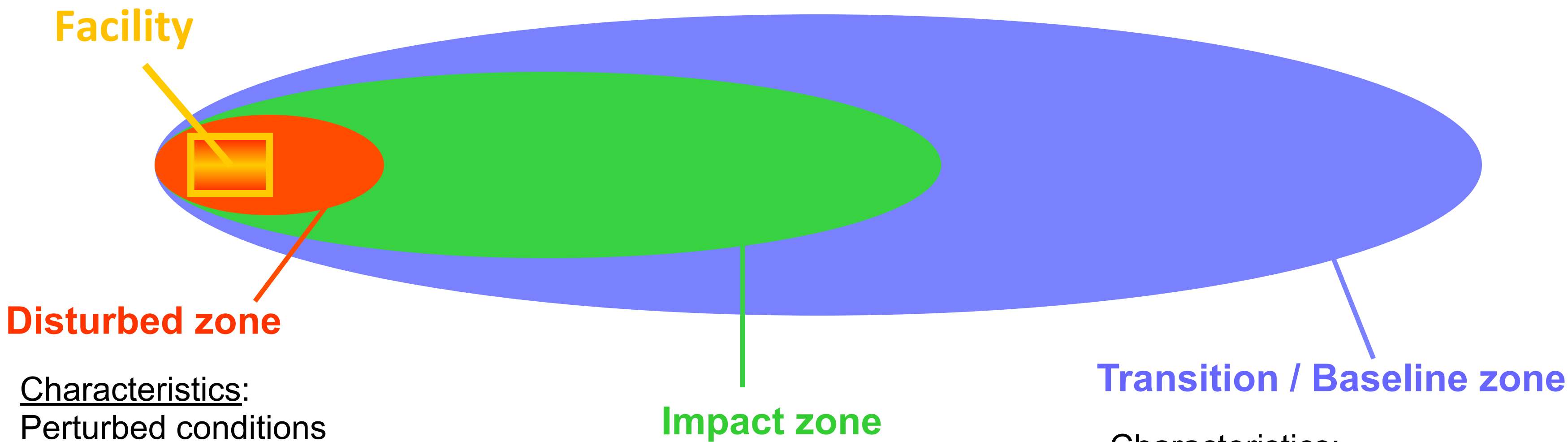
- Frameworks provide a consistent way of organizing and interpreting complex data in a manner that supports environmental decision making
- Frameworks support and dovetail with existing conceptual models/approaches for contaminated sites
- The objective is to identify scientific and technical areas of opportunity based on site-specific conditions.

Technical frameworks…



Example of a Spatial Framework

Anatomy of an impacted site



Disturbed zone

<u>Characteristics</u>:
Perturbed conditions (chemistry, solids, etc.)

<u>Need:</u>
Eliminate or mitigate disturbance by active engineered solution or improved design

Impact zone

<u>Characteristics:</u>
Area with observable and easily detectable facility impacts

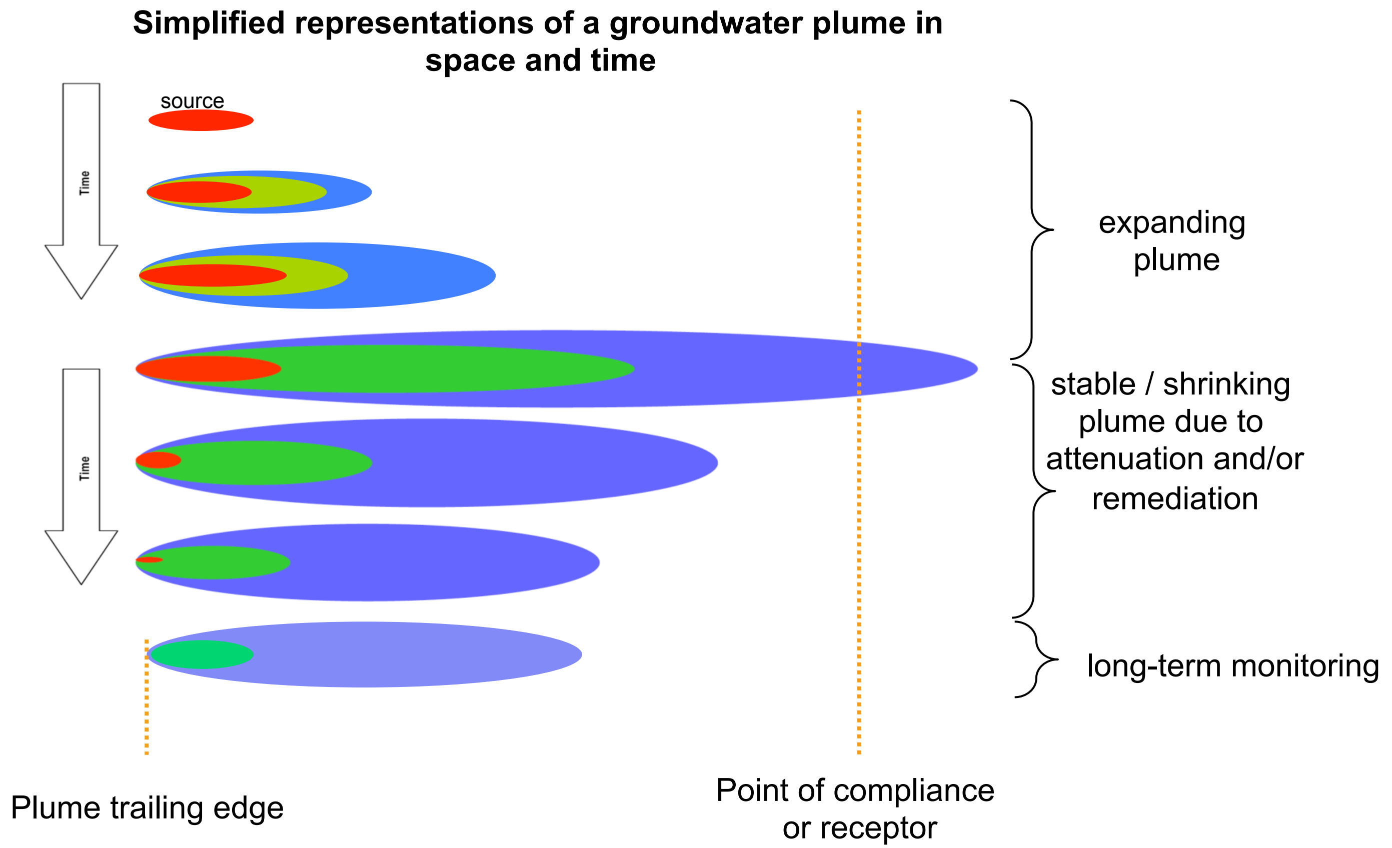
<u>Need:</u>
Characterization data to quantify potential impacts and mitigation activities, as needed, to provide environmental protection

Transition / Baseline zone

<u>Characteristics:</u>
Area where impacts are minimal or undetectable and conditions are similar to unimpacted settings

<u>Need:</u>
Careful characterization to provide a baseline for understanding impacts, development. Application of sensitive methods and early warning tools.

Integration of Spatial and Temporal Framework



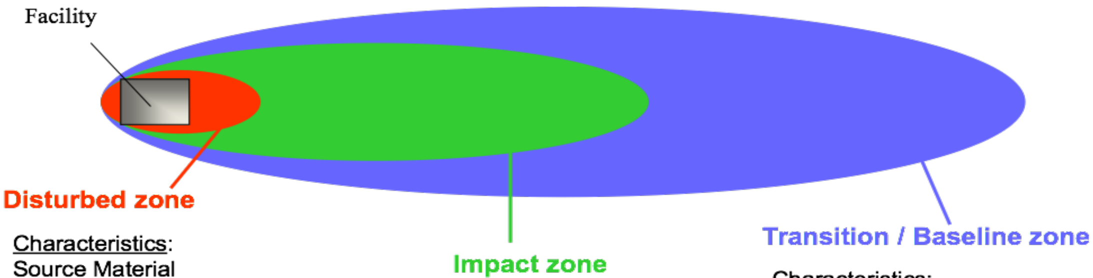
Applied science needed in near-term by SRS to complete clean-up

- Other sites will need the same science at some point

Current research program is focused on applied science needed to reach end-point

- Attenuation-based remedies
- Well understood plume, need to identify deviations from predicted behavior
- Long-term monitoring of attenuation based remedies

30 Year History of SRS Groundwater Clean-up



Disturbed zone

Characteristics:
Source Material
Perturbed conditions (geochemistry, etc.)

Need:
Eliminate or mitigate disturbance by active engineered solution or improved design

Impact zone

Characteristics:
Area with observable and easily detectable impacts

Need:
Characterization data to quantify potential impacts and mitigation activities (active or attenuation based remedies), as needed, to provide environmental protection

Transition / Baseline zone

Characteristics:
Area where impacts are minimal and conditions are similar to unimpacted settings

Need:
Careful characterization to provide a baseline for understanding impacts, development. Attenuation based remedies.

1990 — 2000 — 2014

Applied Research (SRNL)	Disturbed zone characterization and remediation technologies	Impact zone characterization and remediation technologies	Enhanced attenuation of chlorinated solvents	Attenuation-based remedies for metals and radionuclides
EM HQ Program	Integrated Demo	SubCon Focus Area	Alternative Projects	Applied Field Research Initiatives
SRS Clean-up Program	Pump-and-treat to capture plumes	Disturbed zone clean-up	Active to passive transition	

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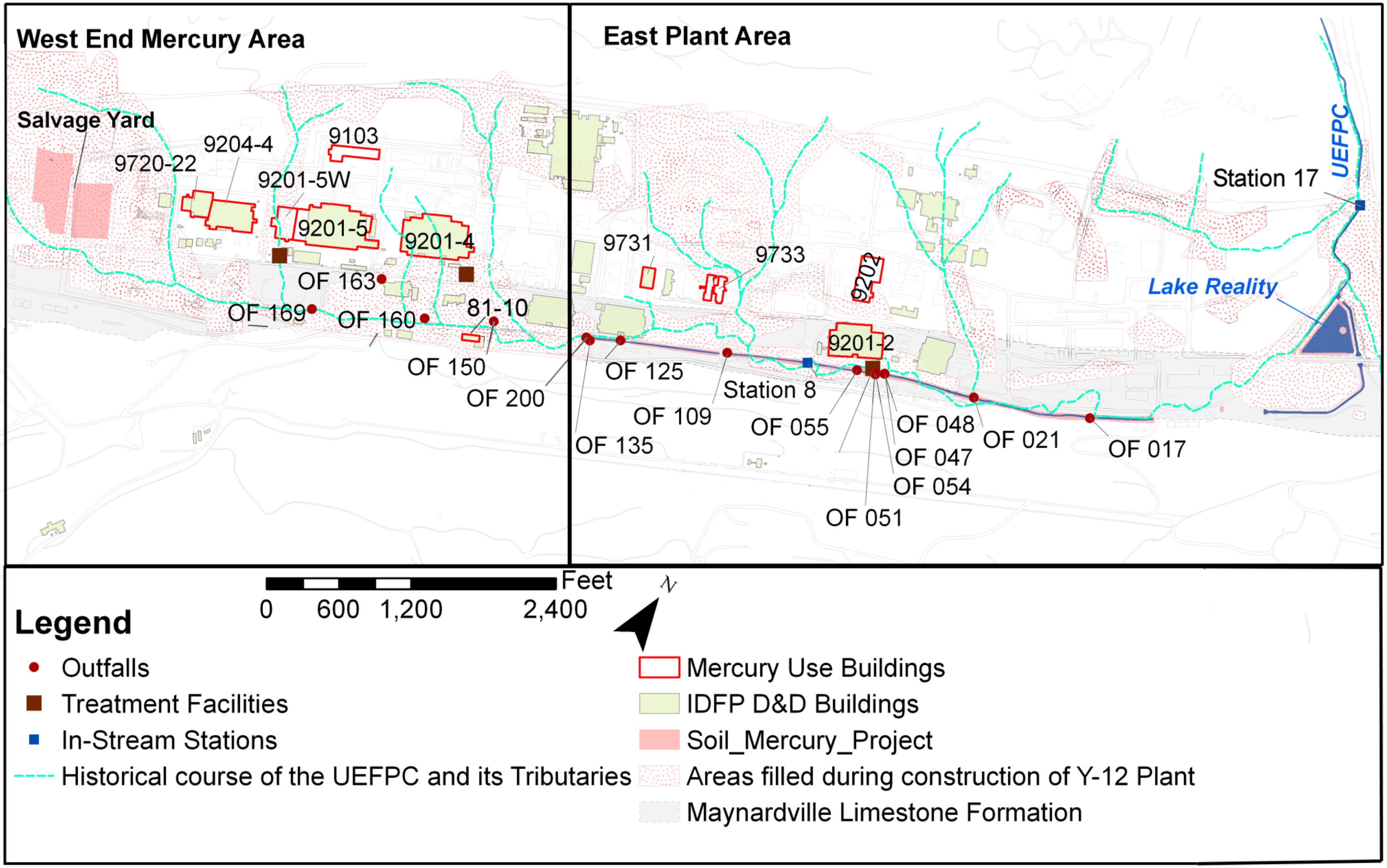
U.S. DOE Interest in Elemental Mercury

In the 1950's and early 1960's over 20 million pounds of elemental mercury were used at Oak Ridge.

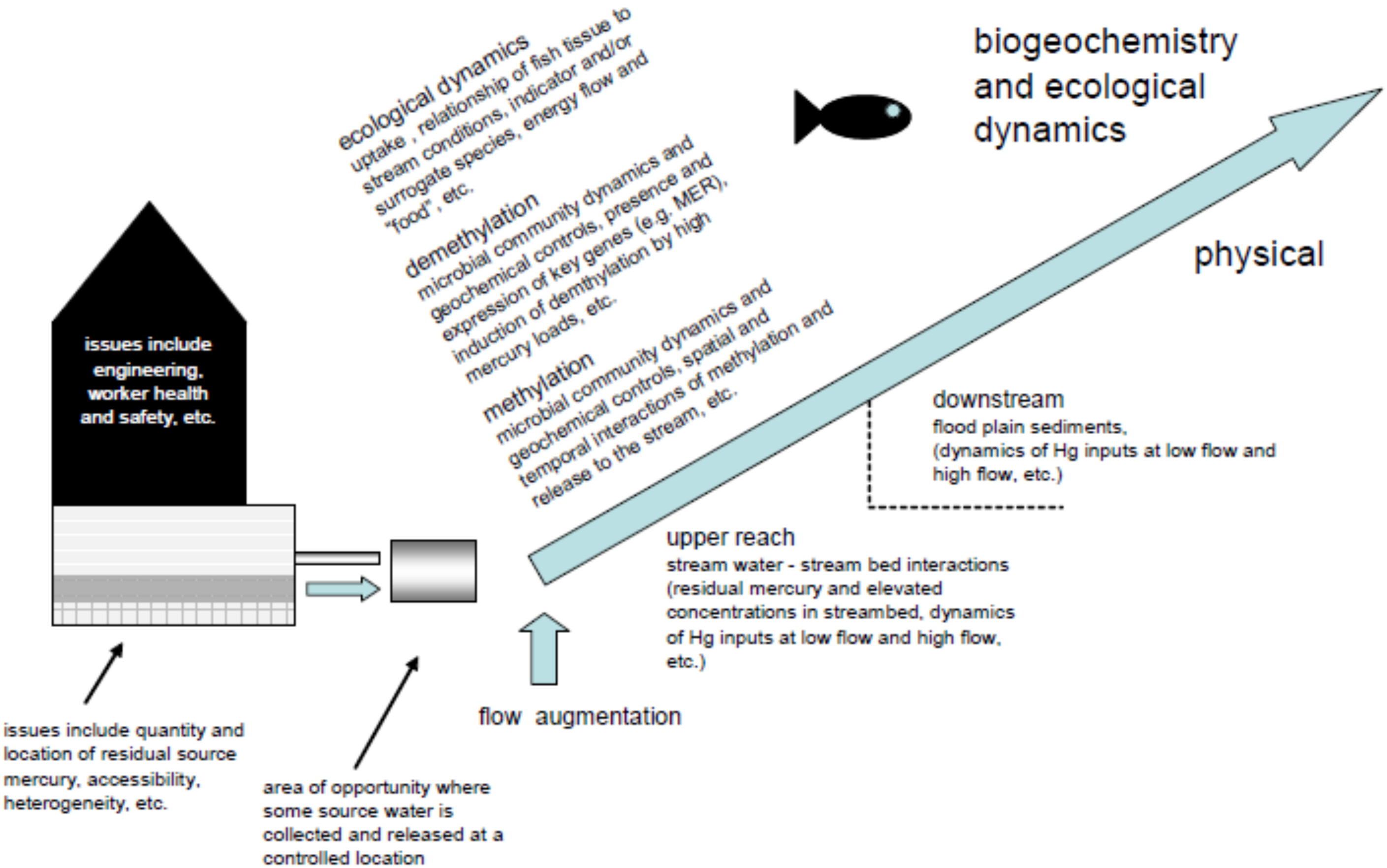
(Oak Ridge Photo Achieve ORO-55-7623)

1955 - Workers emptying flasks at the Y-12 mercury unloading dumping station. Pipelines carried mercury to process buildings

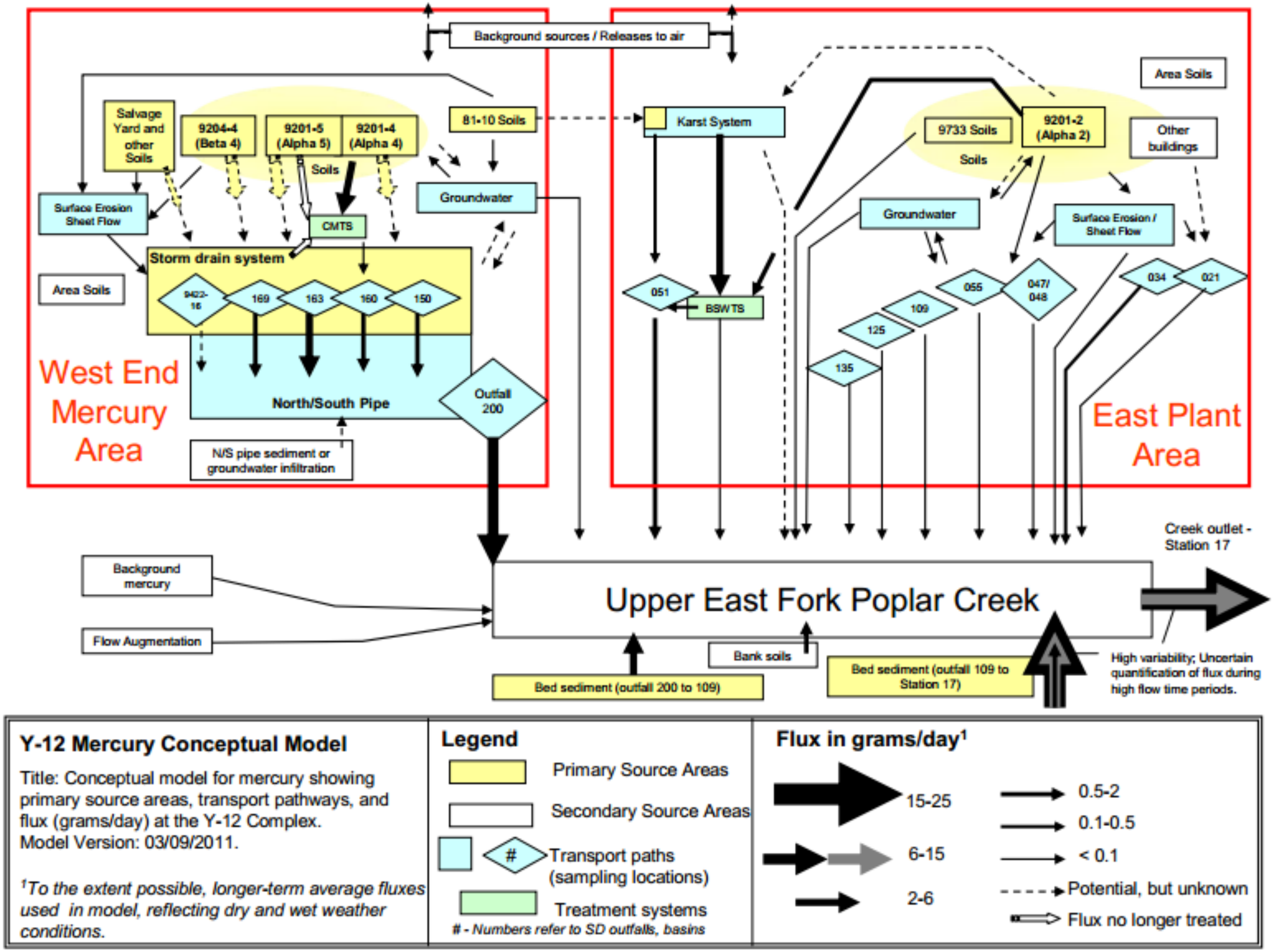
Map of historical mercury-use infrastructure and transport pathways in the Y-12 Complex



Spatial conceptual model for Y-12



Y-12 Conceptual model - Mass Balance



FY18-19 SWAT Activities: SPRU

Current focus of EM is closure and transfer of sites

Separations Process Research Unit (SPRU) is located at the Knolls Atomic Power Laboratory (KAPL) adjacent to the Mohawk River in Niskayuna, New York.

- –Following operation of SPRU between 1950 and 1954, low levels of radioactivity (including cesium-137, strontium-90 and plutonium-239) were discharged into the Mohawk River.
- –Multiple studies, beginning in 1969, sampled the Mohawk River sediments and biota for radioactivity. The last study was conducted in 2002.
- – In 2012, Superstorm Sandy exposed residual contamination in stream creating concern for future migration

Goal of SWAT activity is to provide technical basis to support site closure and transfer

- –Provided technical review of locations and processes that may expose residual contamination
- –Identified targeted sampling plan to address uncertainties

FY18-19 SWAT Activities: LANL

Challenge: Develop remedial systems that use passive or enhanced attenuation remedies to reduce operational costs

- Identify site-specific remedies and carefully match strategies to site and contaminant characteristics

Problem: Significant challenges impact treatment of chromium contamination

- Plume is several hundred feet deep and located in fractured rock
- Well costs for characterization exceed $1M per vertical well
- Non-traditional methods will be required to effectively deliver amendments to stabilize contamination in place
- LANL is investigating the use of Horizontal Wells and Forced Gradient Methods

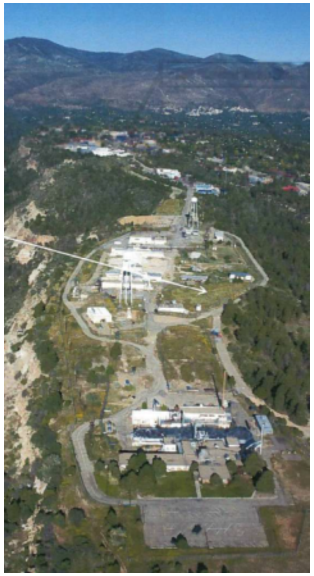
SWAT approach:

Provide expert technical team to evaluate technologies from outside of DOE (e.g., mining, oil and gas exploration, etc.) to provide recommendations for innovative strategies to effectively deploy selected amendments to subsurface.

Examples of Technical Assistance Program Projects

- Recommendations to improve performance of the Richland 200W treatment system
- Optimization strategies for the Fernald Backwash Basin
- Worked with site technical groups to develop a robust-actionable conceptual model to support environmental decision making for characterization and remediation of mercury contamination in soils, sediments and groundwater at the Oak Ridge Y-12 site.
- Initiated Study of Tin and Mercury Behavior in a Small Stream System in support of Oak Ridge stannous chloride mercury treatment demonstration.
- Developed technically robust, cost-effective approach for characterization of mercury contaminated soils/sediments (MIP); deployed at Oak Ridge with direct push system.
- Initiated three LANL technical assistance efforts: support for SVE pilot testing, review of well installation and characterization activities, and development of remedial options for TRU buried waste.
- Developed recommendations for interim actions to address a deep chromium (Cr) plume at the LANL site boundary and proposed characterization alternatives to support implementation of a Monitored Natural Attenuation (MNA) strategy.
- Recommended soil remediation alternatives for Bldg 812 Operable Unit at Site 300 at LLNL; presented to Federal and State regulators
- Provided independent technical review of Bldg 100 plume at former Pinellas Site in Largo, FL; recommended phased subsurface investigation/monitoring on- and off-site

Oak Ridge
Y-12 Plant



Los Alamos
National Laboratory

Pinellas Site

Wrap-Up – SWAT Program

- Over the last two decades have provided technical recommendations to address complex problems at varied DOE-EM and LM sites including Richland, Fernald, Pantex, Oak Ridge, Hanford, Brookhaven, Ashtabula, Kansas City, Mound, Portsmouth, Paducah, Savannah River, Livermore, Los Alamos, Berkeley, SLAC, Pinellas, Rocky Flats, SPRU, and Columbus
- Recommended effective solutions that were implemented at many sites that replaced more traditional approaches
- Since 2000, resulted in a combined savings of over $100 million (Program cost of $5 million)
- Rapid triage that focuses on specific problems using actionable framework approaches to generate a set of viable strategies