Groundwater Remediation on the Oak Ridge Reservation

Elizabeth Phillips- DOE Program Manager for the Oak Ridge Groundwater Strategy, Technology Development and CERCLA Remedial Actions at the Y-12 Plant

Presentation format:

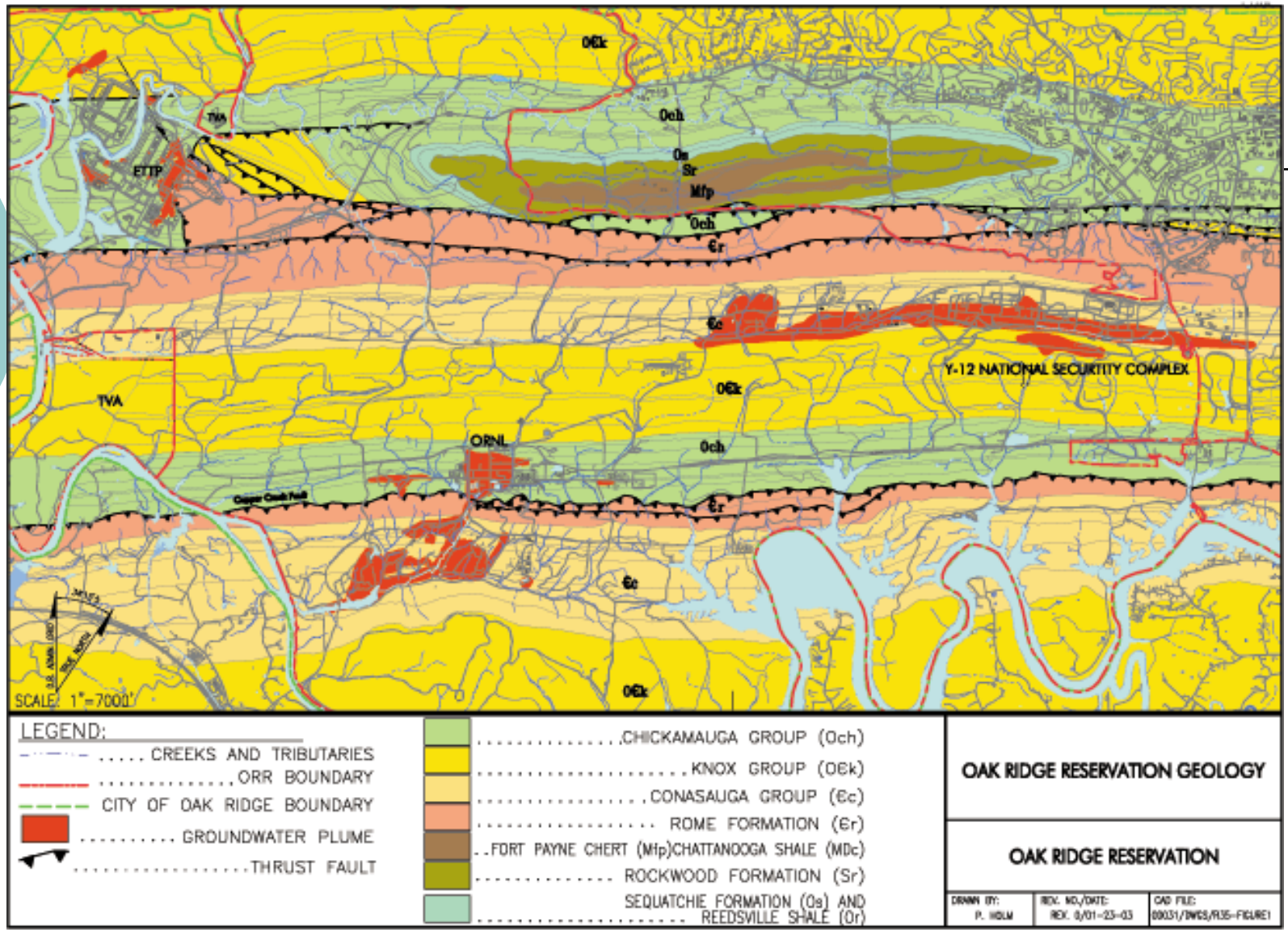
- History of Remedial Action Program
- Past Groundwater Actions
- Present Groundwater Actions
- Future Groundwater Actions and Technology Needs

History of the Oak Ridge Reservation

- U.S. Government built 3 plants in Oak Ridge in 1940's
- Oak Ridge National Laboratory was built as a pilot plant for demonstrating production and separation of plutonium
- K-25 Gaseous Diffusion Plant was built to enrich uranium
- Y-12 Plant was built to separate uranium 235 using the electromagnetic process

History of CERCLA Actions

- Prior to being added to the National Priority List in 1989, regulatory activities were under other programs
- First action was a time critical removal action in 1991 to construct the White Oak Creek Embayment Sediment Retention Structure to address cesium 137 releases to the Clinch River
- A Federal Facility Agreement between DOE, TDEC and EPA was signed in 1992
- The Lower East Fork Poplar Creek ROD was signed in 1995
- First five year review under CERCLA was completed and documented in the 2001 Remedial Effectiveness Review Report. Second five year review was in 2006
- First completion of interim source control actions was the closure of Melton Valley in September 2006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Y-12 NATIONAL SECURITIY COMPLEX
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ETTP
TVA
TVA
ORNL
Copper Creek fault
SCALE: 1"=7000'
LEGEND:
CREEKS AND TRIBUTARIES
ORR BOUNDARY
CITY OF OAK RIDGE BOUNDARY
GROUNDWATER PLUME
THRUST FAULT
CHICKAMAUGA GROUP (Och)
KNOX GROUP (OꞒk)
CONASAUGA GROUP (Ꞓc)
ROME FORMATION (Ꞓr)
FORT PAYNE CHERT (Mfp)CHATTANOOGA SHALE (MDc)
ROCKWOOD FORMATION (Sr)
SEQUATCHIE FORMATION (Os) AND REEDSVILLE SHALE (Or)
OAK RIDGE RESERVATION GEOLOGY
OAK RIDGE RESERVATION
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Past Groundwater Actions

- Removal of 1070 A Burial Ground and G-Pit, 1070 B Pond closure, Mitchell Branch underground barrier, and fuel tank removals to reduce sources at K-25
- Pump and treat containment well, funnel and gate system and passive reactive zero valent iron barrier at Y-12
- Frozen soil barrier, Seep C&D zeolite treatment, Corehole 8 groundwater diversion, surface impoundment capping, burial ground grouting at ORNL

Present Groundwater Actions

- Big Springs Mercury Treatment System
- East End Pump and Treat Well
- Corehole 8 collection system
- Seep C and D treatment systems
- SW-31 Spring effluent and Building 1401 sump water treatment
- Currently OR is working with MSE, Florida International University, AEA Technologies and Mississippi State on technology development projects and there are some publications on this work

Future Groundwater Needs

- FRC research is vital to the ORR Groundwater Strategy and Groundwater ROD in 2015
- EM Technology Development Program is being revived and Oak Ridge has submitted several needs

Groundwater and Soil Remediation

Risk Reduction

Modeling - Groundwater

Release of Subsurface Contaminants During D&D Activities

- Problem
  - D&D activities can disturb the geology/ hydrogeology and release pockets of underground contaminants to soil and water
  - D&D activities (e.g., turning off sump pumps and removing physical barriers, such as slabs) can release contaminants to soil and water
  - Release of contaminants to the ground and surface waters during D&D is a serious concern
- Need: Short-Term
  - Assistance in understanding, predicting, and preventing release of contaminants during D&D
  - Technologies and technical approaches for real-time monitoring during D&D activities
- Drivers & Schedule
  - Clean Water Act
  - NPDES permit
  - EPA water quality standards
  - Tennessee water quality standards

Groundwater and Soil Remediation

Risk Reduction

Basic and Applied Research - Groundwater

Sources, Transport, and Treatment of Mercury Contaminated Water

- Problem
  - Increase in mercury concentrations during routine water monitoring at White Oak Creek exceeding NPDES permit
- Need: Immediate
  - Identify the source of mercury contamination and physical and chemical forms of mercury leaving the area
  - Identify transport pathways and mechanisms
  - Design an effective groundwater treatment system to meet ambient water quality criteria in surface water
- Drivers & Schedule
  - NPDES permit
  - Clean Water Act

Groundwater and Soil Remediation

Risk Reduction

Basic and Applied Research - Groundwater

Reduction of Mercury in Fish with Source Treatment

- Problem
  - Accumulation of methylmercury in fish in East Fork Poplar Creek presents a health risk to humans and wildlife
  - Efforts to reduce waterborne levels of mercury in streams at Y-12 may fail to reduce methylmercury in fish to safe levels
- Need: Short-Term
  - Identify and evaluate alternative technologies to reduce methylmercury in fish without having to further reduce the waterborne concentration levels
- Drivers & Schedule
  - Clean Water Act
  - EPA water quality standards
  - Tennessee water quality standards
  - East Fork Poplar Creek ROD – RER 03/28/07

Groundwater and Soil Remediation

Risk Reduction

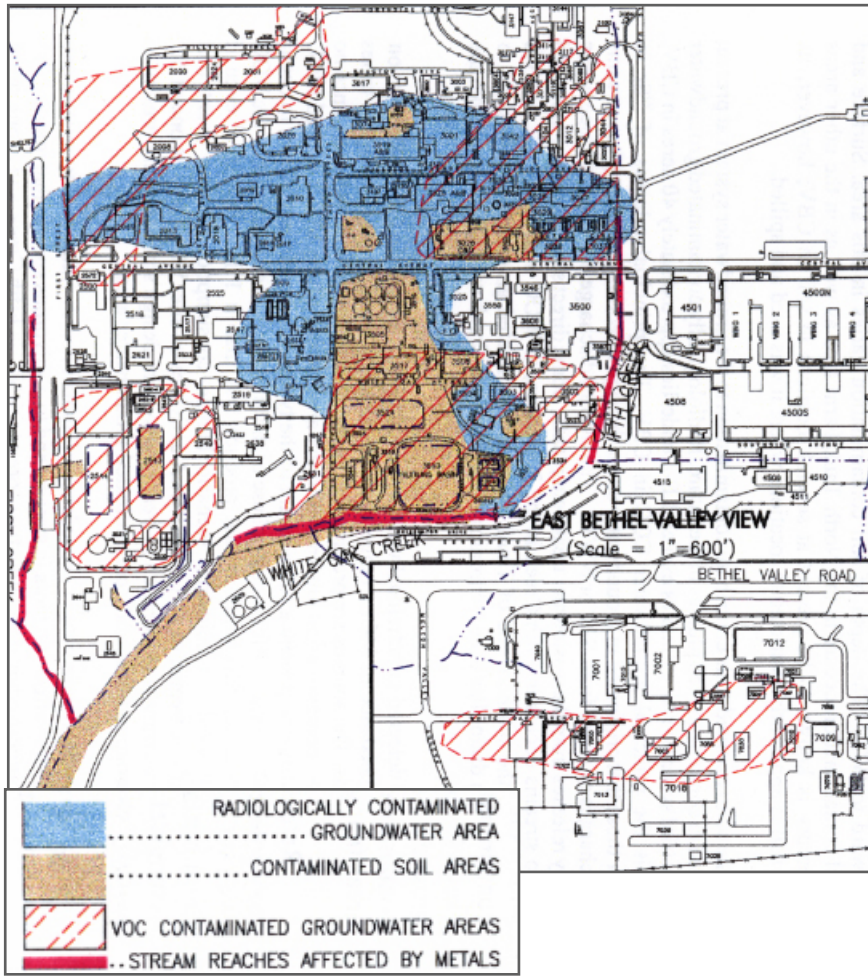
In-Situ Technology - Groundwater

Evaluation of Natural Attenuation Processes for Treatment of Groundwater Plumes

Problem

Complex geology, short flow paths, and little information on the naturally occurring microbial degradation processes prevents DOE from determining if monitored natural attenuation is a viable treatment option for ORR TCE plumes

- Need: Short-Term
  - Detailed evaluation of the natural attenuation processes that are potentially active in the TCE plumes
  - Enhancements that can improve the effectiveness of the existing attenuation processes
  - Characterization and monitoring strategies to assist in the evaluation of the enhancements and natural attenuation capacity
- Drivers & Schedule
  - Melton Valley RAR – 05/31/07
  - Bethel Valley Groundwater RI/FS - 2012



Groundwater and Soil Remediation

Risk Reduction

In-Situ Technology - Groundwater

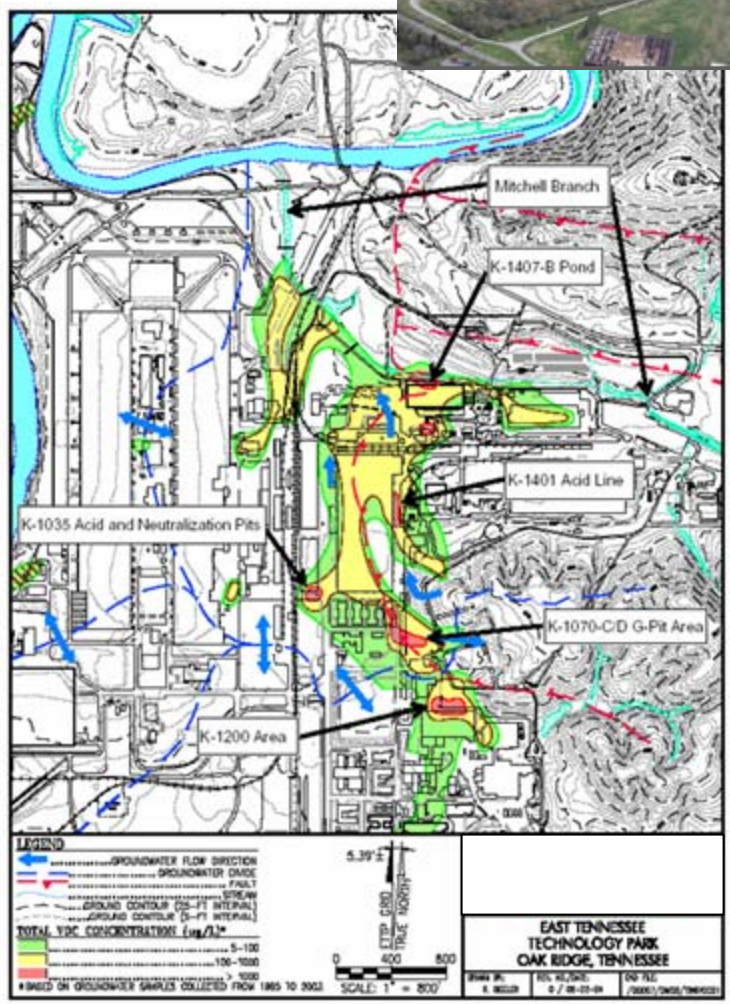
Support for Technical Impracticability (TI) Waiver at ETTP

Problem

Complex geology and undefined sources makes treatment of VOC contaminated groundwater at ETTP impracticable

DOE and EPA Region IV have never done a front-end technical impracticability (TI) waiver

- Need: Immediate
  - Experts with experience in developing and demonstrating the rationale for the TI of remediation in fractured rock, low permeability soils particularly the impact of matrix diffusion
  - Recommendations based on experience from successful TI waiver applications at similar sites
- Drivers & Schedule
  - ETTP Sitewide ROD – 1/30/07
  - FFA milestone – LUCIP 11/08/07
  - Mitchell Branch PCCR – 08/20/09
  - Site closure – 09/30/09



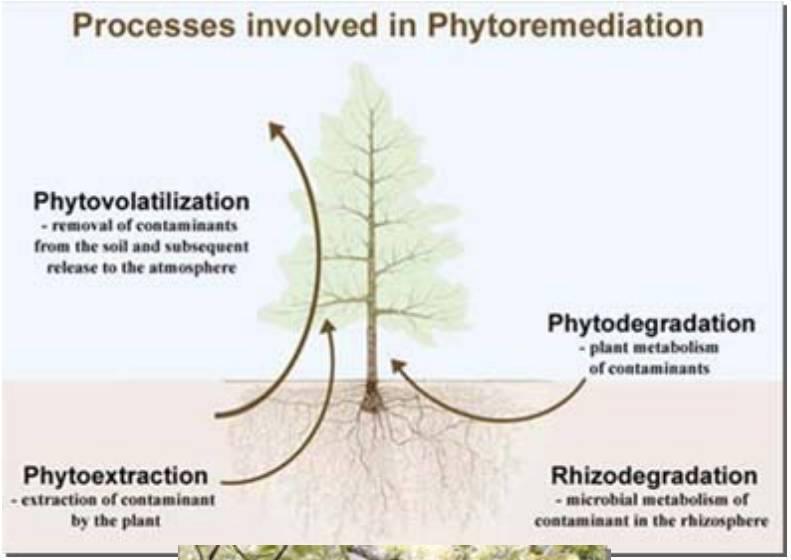
Groundwater and Soil Remediation

Risk Reduction

In-Situ Technology - Soil

Phytoremediation for Mercury Remediation and Monitoring

- Problem
  - Mercury contamination in Upper East Fork Poplar Creek (UEFPC) water, sediments, and floodplains is continuing
  - Excavation and dredging operations are expensive and time consuming
  - Traditional sampling techniques are expensive, time consuming, and may miss hot spots
- Need: Long-Term
  - Evaluation of phytoremediation as a cost-effective and environmentally friendly alternative for removing mercury and other heavy metal contaminants from soil and water
  - Evaluation of reflective analysis of plants to monitor long-term stability, mobility, and bioavailability of mercury along the creek
- Drivers & Schedule
  - Clean Water Act
  - EPA water quality standards
  - Tennessee water quality standards
  - UEFPC Phase I Interim SW actions – RAR 2016
  - UEFPC Final SW ROD – 2018
  - UEFPC Soils – RAR 2013



Groundwater and Soil Remediation

Risk Reduction

In-Situ Technology - Soil

In-Situ Treatment Alternatives for Mercury Contaminated Soils

- Problem
  - Extensive mercury soil contamination > 20 ft deep in the 81-10 area at Y-12
    - soil is also contaminated with radionuclides and other heavy metals
- Need: Short-Term
  - Identify and evaluate in situ mercury remediation approaches as an alternative to costly soil excavation
  - Demonstrate and document performance of alternative in-situ treatments to support the Upper East Fork Poplar Creek Phase II ROD
- Drivers & Schedule
  - Upper East Fork Poplar Creek – EE/CA – 04/30/09
  - Upper East Fork Poplar Creek RAR - 2013

Groundwater and Soil Remediation

Risk Reduction

Ex-Situ Technology - Groundwater

Viability of Large-Scale Mercury Contaminated Water Treatment

Problem

- Technical concerns over the implementability of a large scale treatment system for mercury contaminated water at Y-12

- Need: Short-Term
  - Identify and evaluate the best available technologies and their implementability
  - Document performance and operational costs of existing large-scale treatment systems
  - Develop and/or demonstrate emerging technologies relevant to large-scale mercury treatment systems
- Drivers and Schedule
  - Clean Water Act
  - EPA water quality standards
  - Tennessee water quality standards
  - UEFPC Phase I Interim SW actions – RAR 2016
  - UEFPC Final SW ROD – 2018

Groundwater and Soil Remediation

Risk Reduction

Long-Term Monitoring Technology - Groundwater

Performance Assessment, Monitoring, and Verification Technologies to Support Risk-Based End States

Problem

- Caps and other engineered controls will require vigilant monitoring for decades
- The estimated cost of long-term monitoring is in the hundreds of millions of dollars
- The effectiveness of current monitoring approaches to warn of impending problems in a timely manner could be improved

- Need: Long-Term
  - Identify and evaluate cost-effective and protective monitoring strategies to provide better warning of pending problems with caps and contaminant releases
- Drivers and Schedule
  - ORR Records of Decision 2007 - 2018
  - ETTP and MV site closure

Groundwater and Soil Remediation Technology Needs Summary

Priority

- Modeling – Groundwater: Short-Term Need
  - 6 Release of subsurface contaminants during D&D
- Basic and Applied Research – Groundwater: Short-Term Need
  - 3 Sources, transport, and treatment of mercury contaminated water
  - 4 Reduction of mercury in fish with source treatment
- In-Situ Technology – Groundwater: Immediate and Short-Term Needs
  - 5 Evaluation of natural attenuation processes for treatment of groundwater plumes
  - 1 Support for Technical Impracticability Waiver for ETTP
- In-Situ Technology – Soil: Short-Term Needs
  - 9 Phytoremediation for mercury remediation and monitoring of East Fork Poplar Creek
  - 7 In-situ treatment alternatives for mercury contaminated soils
  - 10 In-situ remediation of pyrophoric materials at Bear Creek Valley Burial Grounds
- Ex-situ Technology – Groundwater: Short-term Need
  - 11 Viability of large-scale mercury contaminated water treatment
- Ex-situ Technology – Soil : Immediate Need
  - 2 Pyrophoric materials in Trench 13 at Melton Valley
- Sampling/Characterization Technology – Soil : Short-Term Need
  - 8 Characterization of contaminated sources under storm drains
- Long-Term Monitoring Technology – Groundwater: Long-Term Need
  - 12 Performance assessment, monitoring, and verification of technologies to support risk-based end states