Improving Cleanup Decisions at Superfund Smelter Sites

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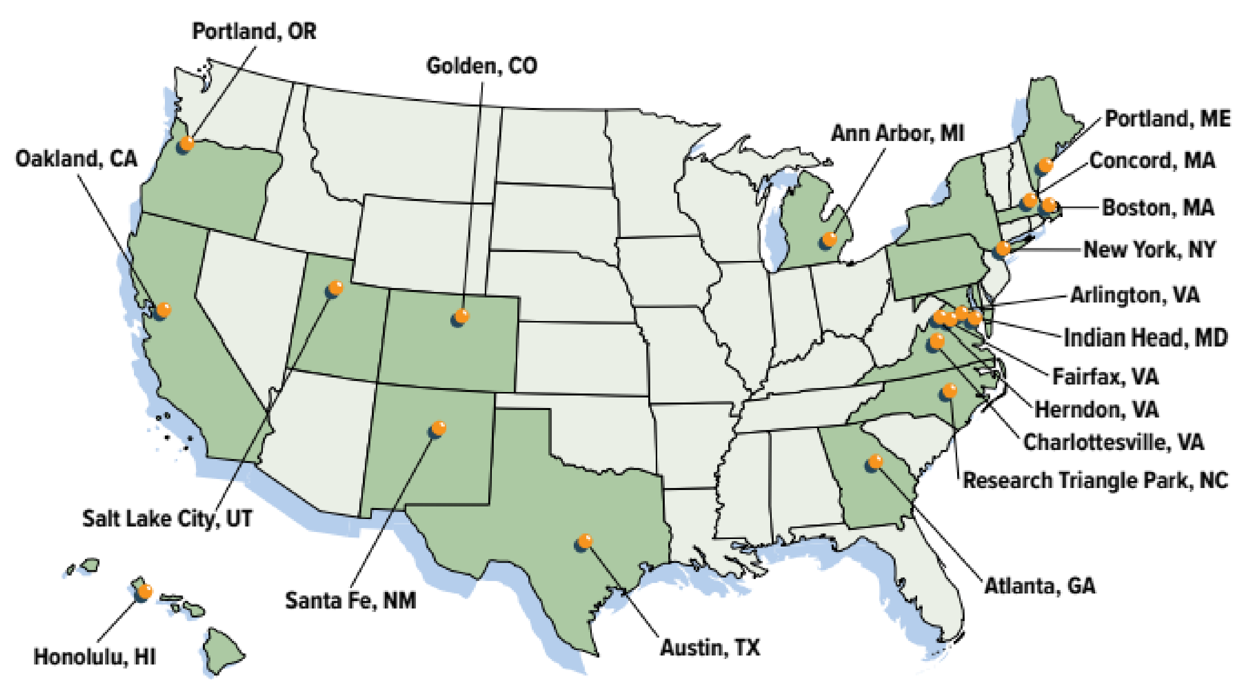
What's to Come

- ERG Overview
- ERG Research of Superfund Smelter Sites
- What is getting left behind?
- What can be done to address it?

Overview of ERG's Work

Nation-wide company with over 800 professionals in the following service areas:

- Architecture and Design Services
- Air Quality
- Circular Economy
- Clean Transportation
- Coastal and Marine Resources
- Digital and Information Services.
- Drinking Water and Infrastructure
- Ecological Services.
- Economic and Policy Analysis
- Energy
- Environmental and Occupational Health
- Environmental Planning and Impact Assessment
- Facilities Planning and Engineering
- Grant Program Support
- Hazardous Waste
- Life Cycle Services
- Measurements and Laboratory Services
- Organizational Effectiveness
- Permitting, Compliance, and Enforcement
- Public Health
- Resilience Solutions
- Strategic Communications
- Survey Design, Implementation, and Analysis
- Toxics
- Wastewater and Infrastructure



Brook McKeown, Joe Watson, Zach Good, Angel Pichla are also attending MECC

CERCLA = Superfund

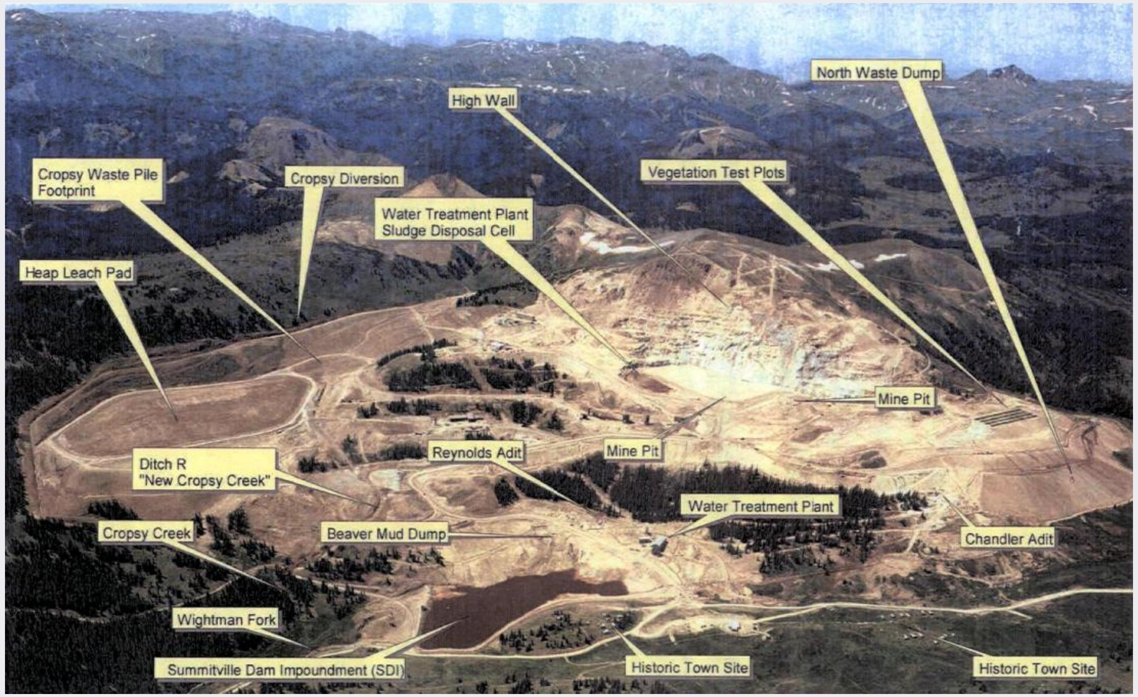
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

Created to manage and clean up closed or abandoned hazardous waste sites

- Taxes collected on chemical and petroleum industries formed a trust fund for this purpose.

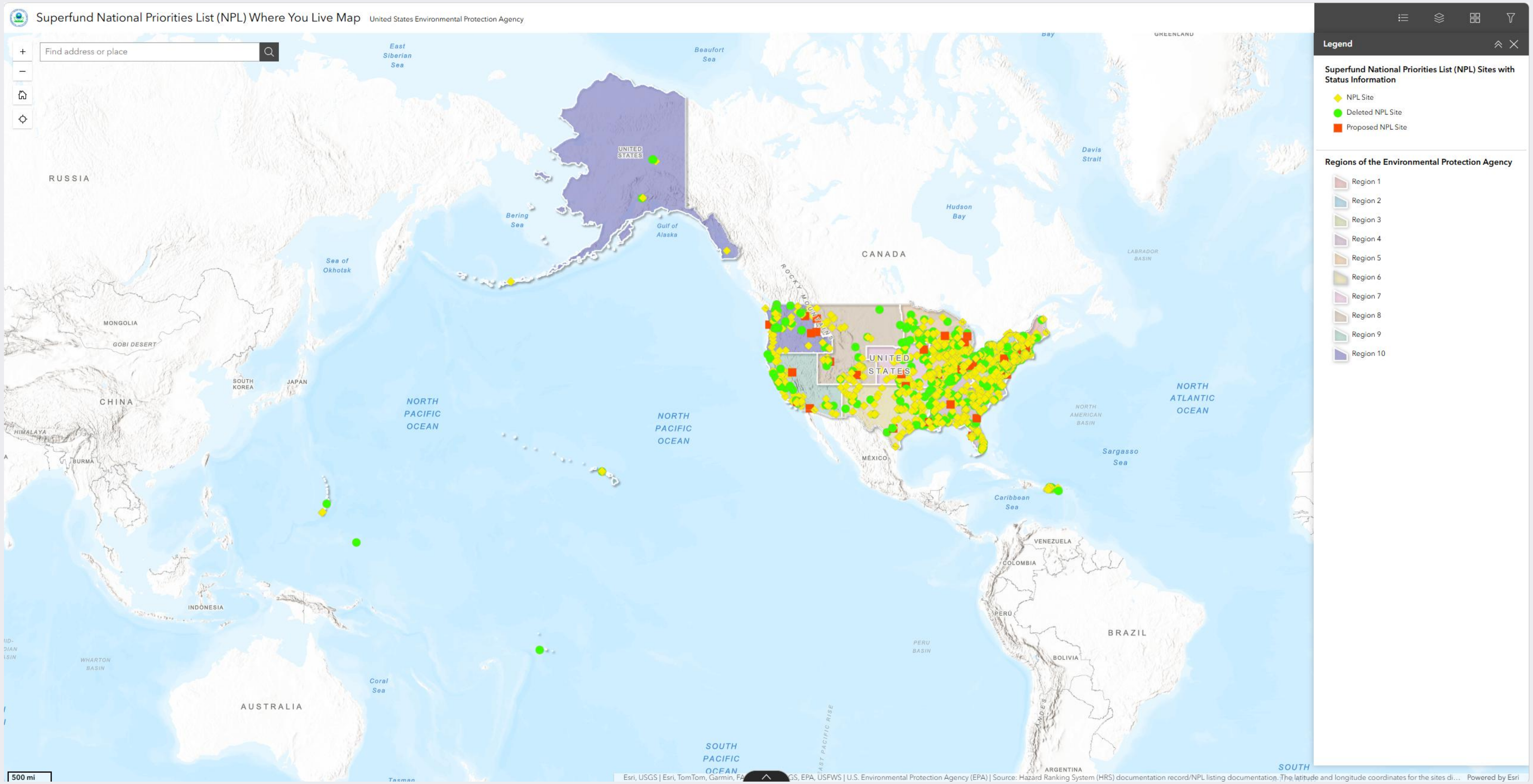
Two kinds of response actions:

- Short-term removals for releases requiring prompt response.
- Long-term remedial response actions that significantly reduce dangers associated with serious, but not life-threatening hazardous substance releases.



Aerial View of Summitville Mine, CO (EPA Preliminary Closeout Report, 2013)

National Priorities List – 1,343 current sites, over 400 deleted

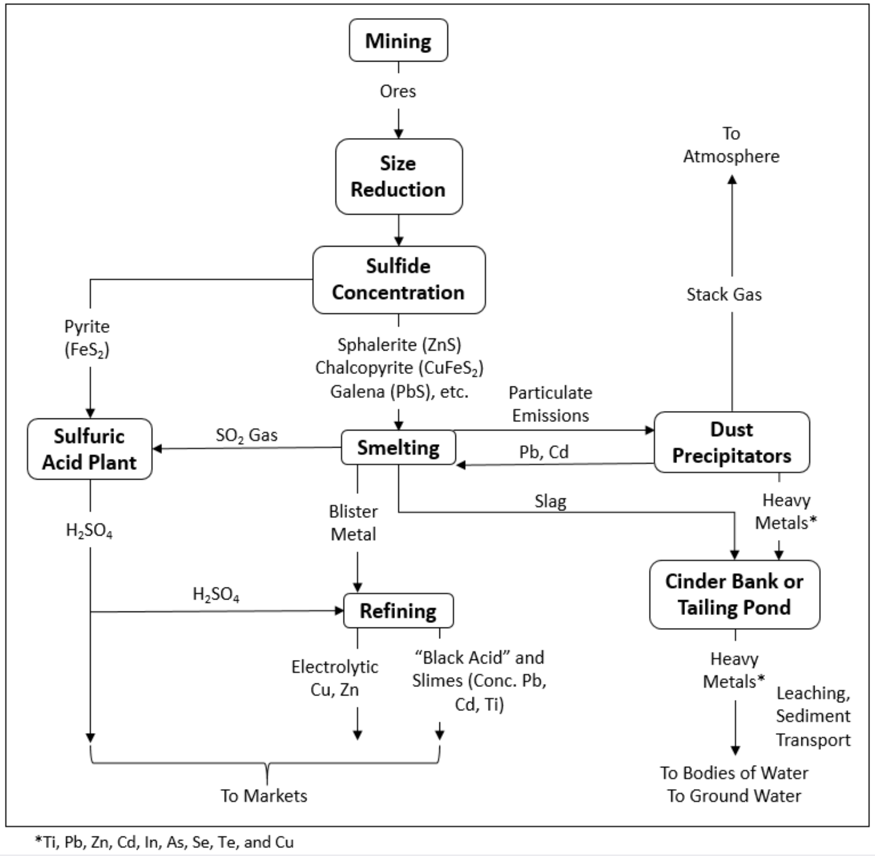


If something can no longer be seen, is it gone?

- Out of sight, Out of mind
- Common for industry to dispose of liquids by discharge into unlined pits, ditches, ponds
- Contaminants seeping into ground can end up in several forms:
  - Dependent on properties of contaminant, soils and rock
  - Coating soil particles
  - Locked up in void space between soil particles
  - Floating atop potentiometric surface (LNAPL)
  - Sinking below potentiometric surface (DNAPL)
  - Dissolved in ground water

Historic Smelter Sites – What Were They For?

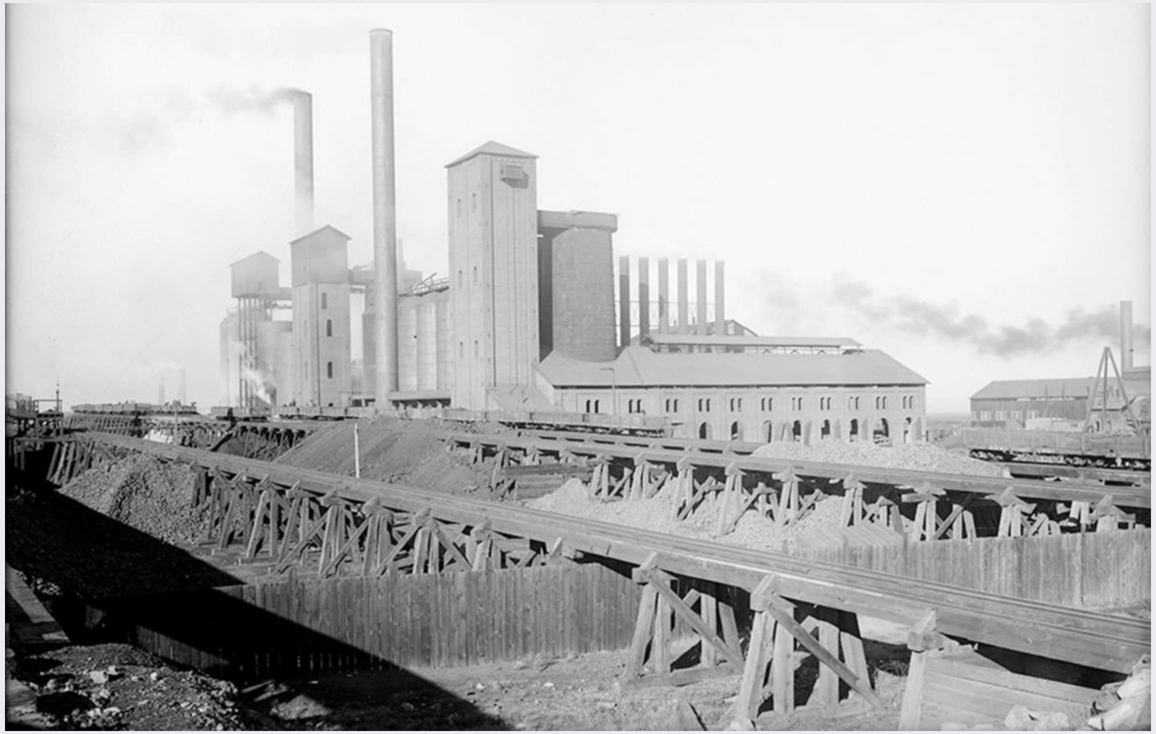
- Smelting – intermediate stage of process converting metal-bearing ore to refined metal.
- Smelting waste products commonly include air emissions, liquid wastes, solid wastes.
- Liquid and solid wastes commonly managed or disposed of on or adjacent to smelter site.
- Up until 1980, liquid and solid smelting wastes were often stored in unlined surface impoundments.
- Documentation was not always very thorough



Where Smelting Fits in Mineral Extraction (Adapted from EPA, 1977)

Smelter Sites – We have a problem

- Air emissions carried offsite by wind, can fall as dust on areas up to several thousand feet downwind of smelter facility boundaries.
- Air emissions could have been dangerous to breath for those downwind of smelters
- Dust settles, can contaminate soil. Soil can be tracked into homes, other buildings, ingested.



Historic Colorado Smelter, Pueblo, CO

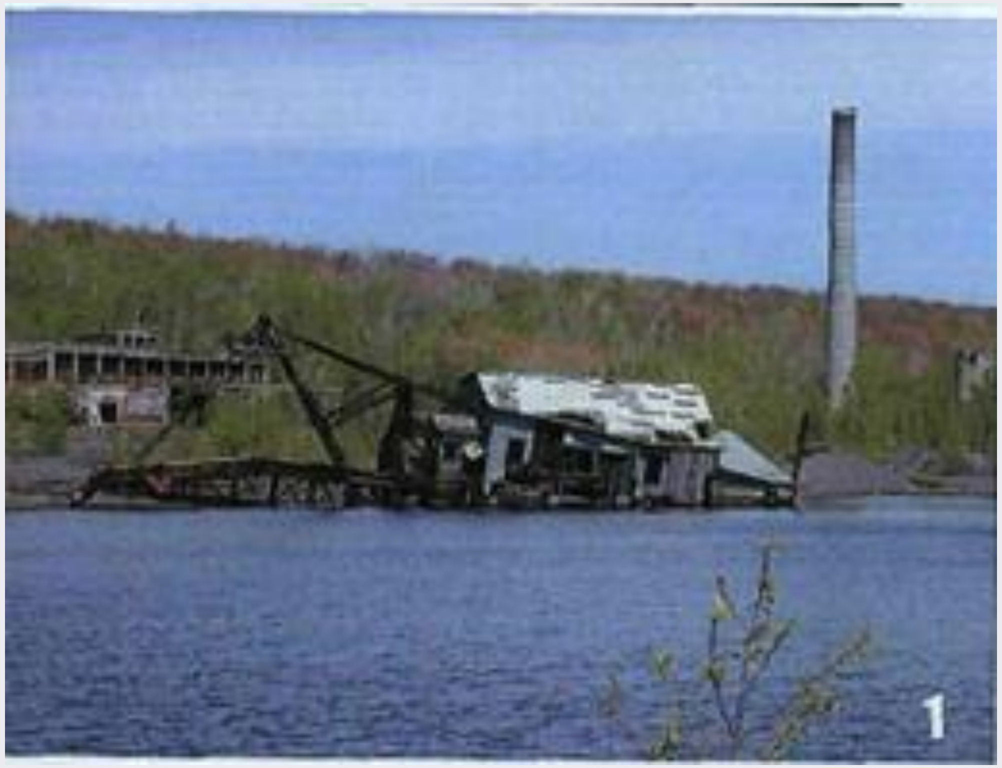
Smelter Sites – We still have a problem

- Rainfall on contaminated soils can then cause two things:
  - Runoff carrying contaminated soils to surface water
  - Recharge to aquifers carrying dissolved contaminants
- Initial focus is on Immediately Dangerous to Life and Health (IDLH). So, this typically means air, soils, and surface water contamination first, then ground water.

Removal of lead and arsenic contaminated soil from the USS Lead Site in East Chicago, IN (EPA, 2025)

Smelter Sites – We still have a problem

- Air, surface water, and soils cleanup may only take days to weeks to accomplish.
- Ground water contamination is likely to take years to remediate.
- This difference in timelines leads to a building backlog of sites with contaminated ground water.
- In support of a task for EPA's Office of Research and Development (ORD), ERG looked at 55 listed smelter sites.
- 12 of the 55 smelter sites reviewed did not include a ground water characterization.



Torch Lake Dredge and Mill (EPA Baseline Study Report, 2001)

Smelter Sites – We still will have a problem

- Focused on 24 other smelter sites with more thorough ground water characterizations.
- All of the 24 sites reviewed had remaining ground water contamination.
- Some employed remediation activities like pump and treat, permeable reactive barriers, in-situ chemical reduction
- Some chose other options, like soil removal, capping and monitoring.
- Some are still in investigation mode, especially those added to the NPL relatively recently.

Smelter Sites – What could be better?

- Ground water characterization should be carried out at all sites so that ground water remediation, if necessary, becomes part of remediation plan as soon as possible.
  - Ground water should be sampled and monitored at enough locations so that full extent of contamination - vertical and horizontal – is understood.
  - Contaminant sources must be adequately determined and characterized so that they can be included as soon as possible in the overall remediation plans.

Cap Liner Installation at Smokey Mountain Smelters Superfund Site (EPA, 2023)

How to Reach Me

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CTI and Associates, Inc.

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Improving Cleanup Decisions at Legacy Contaminated Sites

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Committing to Tomorrow with Integrity

Protecting, Enhancing, and Restoring our Environment

Introduction to CTI and Associates, Inc.

- 50 years of successfully Protecting, Enhancing, and Restoring our Environment for future generations
- ~300 Professional Engineers, Scientists, and Construction Professionals
- Project delivery company specializing in turnkey solutions
- Extensive project experience with Department of Energy, Department of Defense, State and Local Governments, and Commercial clients
- Safety is a core value, quality is our passion

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ENGINEERING

CONSTRUCTION

REMEDIATION

Our Services

- Site Characterization, Compliance, Industrial Hygiene and Health Sciences
- Waste Containment Engineering, Geotechnical Engineering, and Renewable Energy
- Construction Management, Heavy Civil Construction, Site Preparation
- Soil, Groundwater, and Sediment Remediation, Demolition and Abatement

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Agenda

- Project lifecycle framework during investigation and remediation planning
- Scoping phase and stakeholder alignment
- Planning and design phase – developing the preliminary CSM
    - Designing effective investigation programs
- Phasing field investigation activities
    - Real-time data visualization and decision support
    - Visualization tools and software
- Reporting and stakeholder concurrence
- Lessons learned and best practices
- Q&A

Project Lifecycle Framework

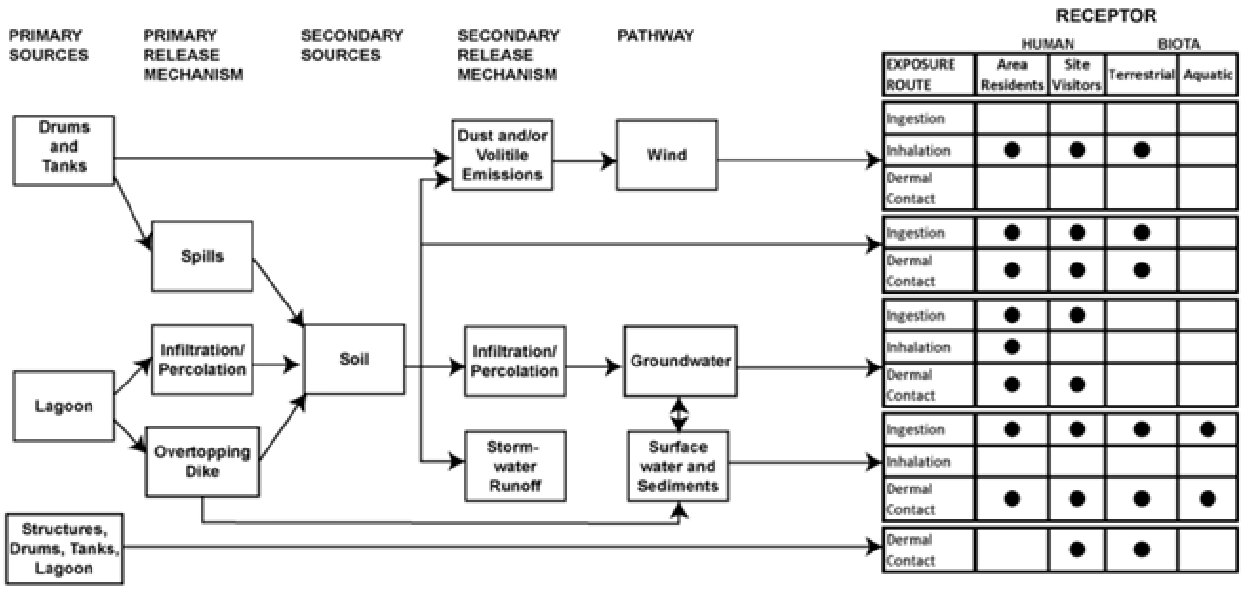
- Scoping and stakeholder alignment
- Contractor proposal evaluation and selection
- Planning and design using existing data
- Phased field investigations
  - Includes real-time data evaluation and visualization
- Reporting, stakeholder concurrence, and transition to the next phase of work

Scoping Phase and Stakeholder Alignment

- Build alignment with stakeholders and regulatory agencies early
- Identify project objectives, regulatory drivers, and end use goals
- Define future land use assumptions and exposure scenarios
- Establish communication pathways and decision-making processes
- Early stakeholder buy-in and assessment of end use goals helps to mitigate a variety of risks (e.g., project delays, potential rework)

Planning and Design Phase – Developing the Preliminary CSM

- Compile and review historical environmental data
- Develop a preliminary CSM to identify data gaps and uncertainties
- Tailor investigation design to contaminant type and site conditions
- Consider future remediation, risk assessment, and construction requirements
- Design sampling frequency and delineation sensitivity to support future decisions



Designing Effective Investigation Programs

- Collect sufficient data to support next-phase decision making and/or with potential remedies in mind
- Balance investigation scope with budget and schedule limitations
- Use adaptive and phased investigation strategies where feasible
- Focus on minimizing data gaps and uncertainty

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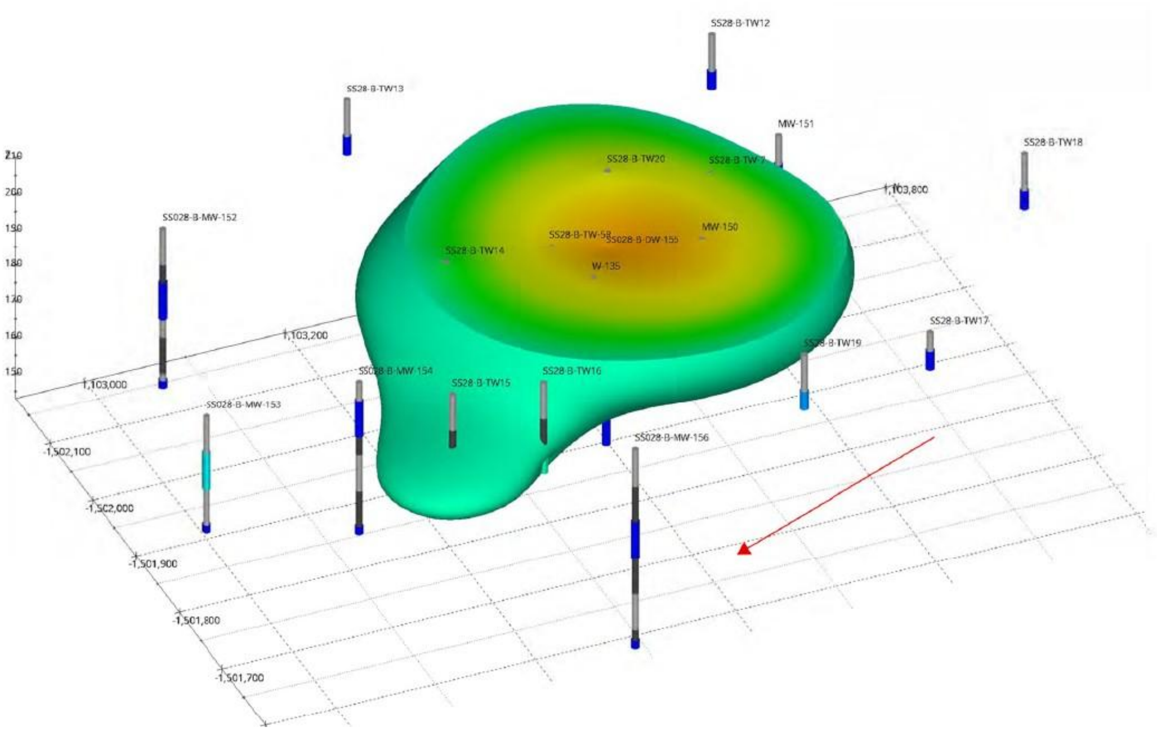
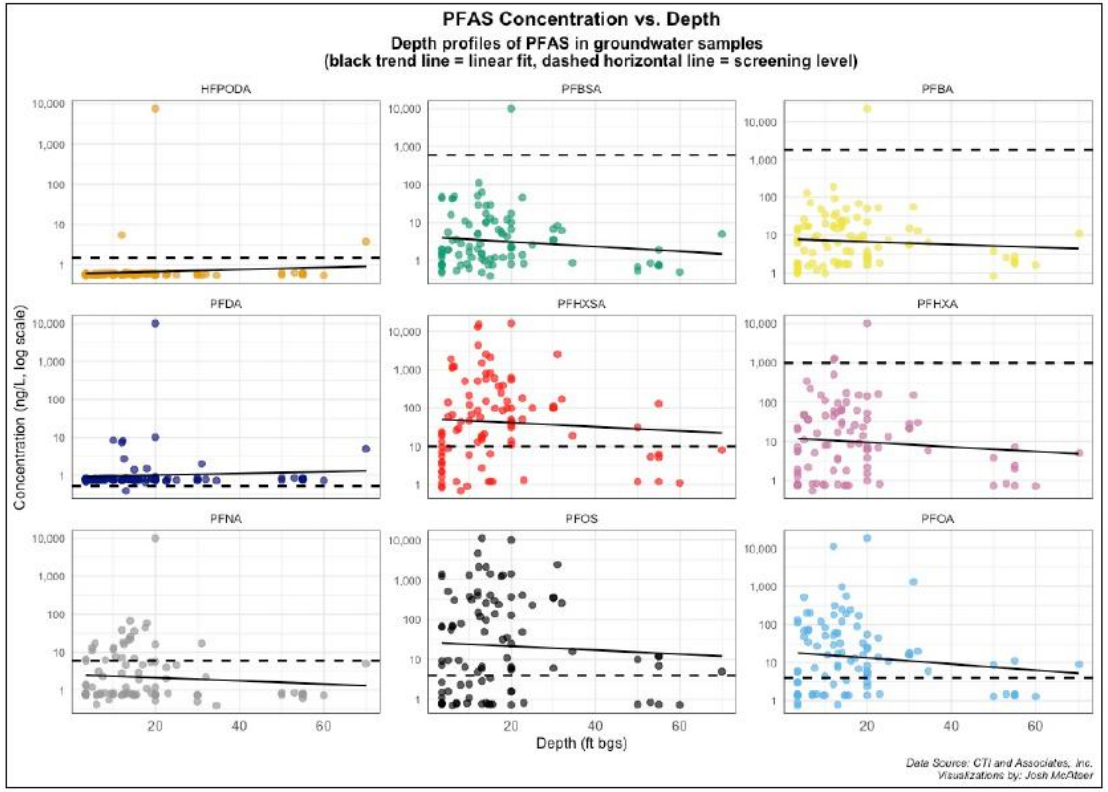
Phasing Field Investigation Activities

- Implement phased investigations to evaluate data before expanding scope
- Refine sampling locations based on field observations and analytical results
- Use rapid turnaround when possible
- Improve efficiency by targeting areas of highest uncertainty
- Reduce unnecessary drilling, sampling, and rework



Real-Time Data Visualization and Decision Support

- Present evolving investigation results to technical teams and stakeholders
- Focus discussions on uncertainties, data gaps, and decision points
- Supply dynamic field decision-making and adaptive investigation planning
- Improve communication between project teams and regulators
- Streamline concurrence and approval processes



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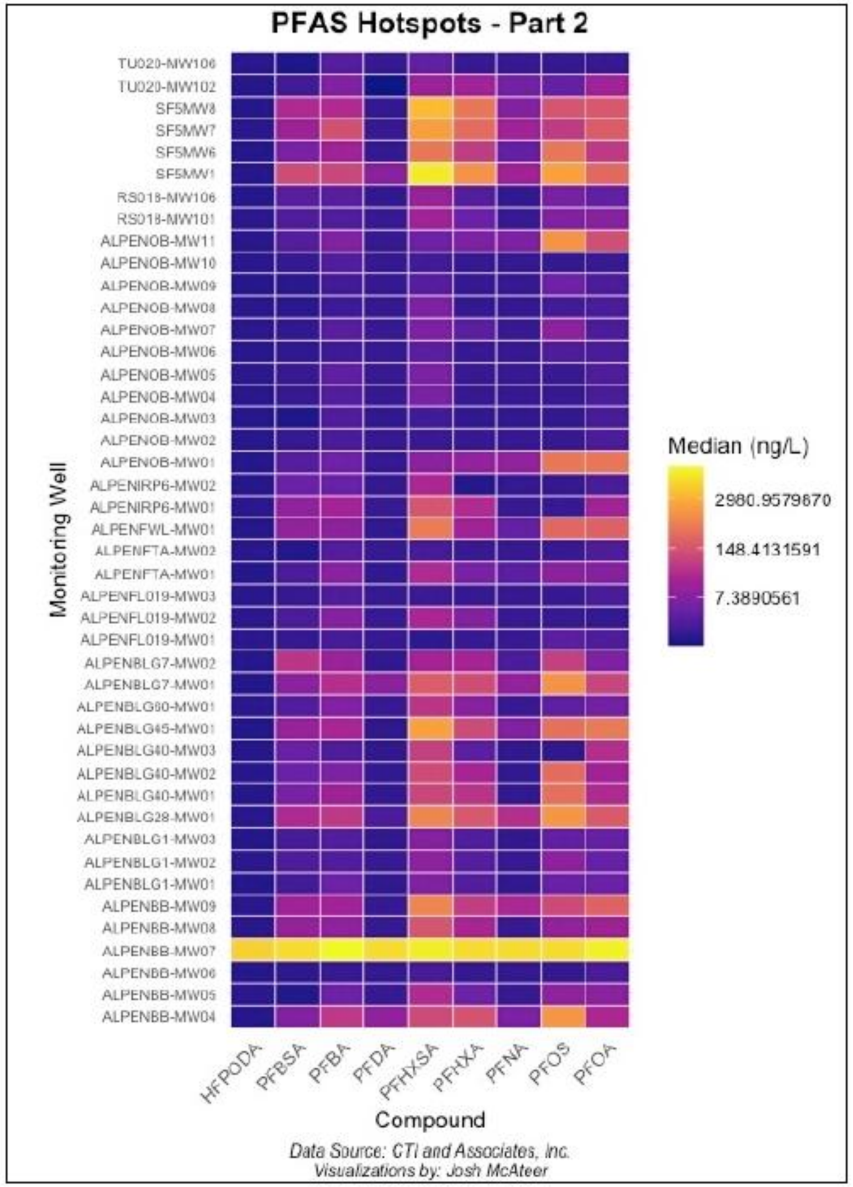
Visualization Tools and Software

- 3D visualization and modeling platforms (e.g., EVS, RockWorks)
- GIS-based mapping and spatial analysis tools (e.g., ArcGIS)
- Interactive dashboards and data management systems (EIM)
- Cross-Sections, plume visualization, and boring logs
- Real-time data integration improves usability and transparency



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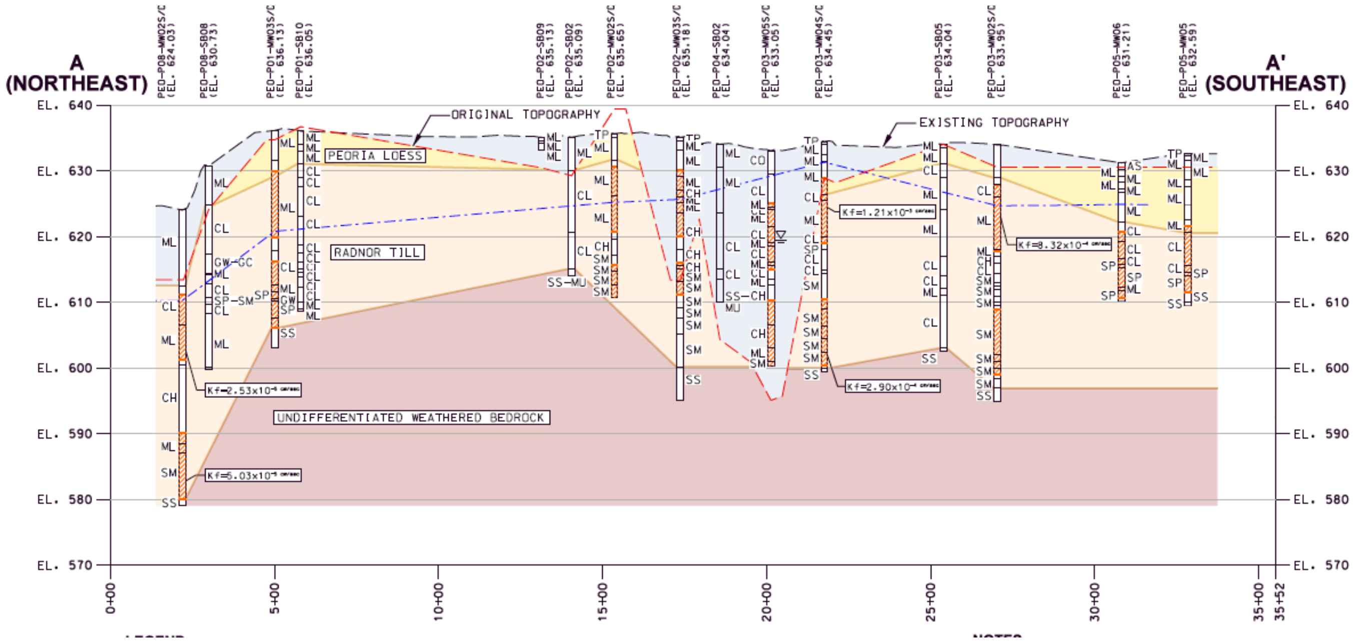
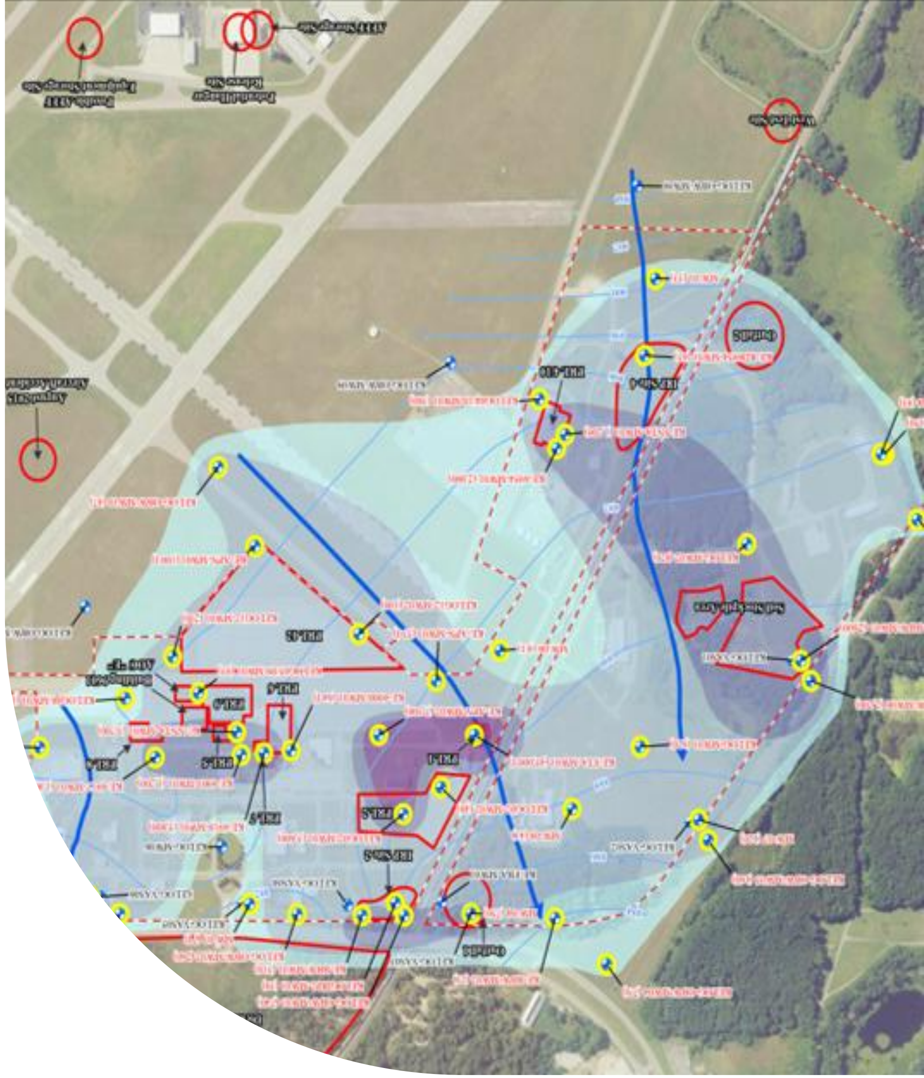
Reporting and Stakeholder Concurrence

- Summarize investigation findings and revised CSM
- Clearly communicate remaining uncertainties and recommendations
- Provide defensible rationale for future actions
- Early and continuous regulatory engagement streamlines approvals
- Well-organized reporting supports efficient project transition



Lessons Learned and Best Practices

- Failure to obtain stakeholder buy-in can delay projects and increase costs
- Understanding future land use is critical for investigation and remediation design
- Phased field approaches reduce uncertainty, improve data quality, a minimize data gaps
- Real-time visualization tools enhance collaboration and decision-making
- Strong communication across all project phases improves project outcomes



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