ORD Technical Support for Contaminated Sites: Regional Highlights

Introduction to Technical Support and Support Centers

In the 1980's, EPA established the Technical Support Project to provide technical assistance to regional Remedial Project Managers, Corrective Action Staff, and On-Scene Coordinators for cleaning up contaminated sites. Under this project, five technical support centers were established that play a critical role in the Agency's work to protect the environment and public health by responding to requests for technical assistance from EPA's program and regional offices.

Within ORD, the Center for Environmental Solutions and Emergency Response (CESER)/Technical Support Coordination Division (TSCD), and their Superfund and Technology Liaisons (STLs), support the Agency in addressing challenges at contaminated sites by providing direct and rapid access to technical expertise through the five Centers:

- **Superfund Health Risk Technical Support Center (STSC):** The STSC provides technical support to EPA staff in program and regional offices in the area of human health risk assessment.
- **Ground Water Technical Support Center (GWTSC):** The GWTSC provides support to EPA staff and their projects on issues regarding subsurface contamination, contaminant fluxes to other media (e.g., surface water or air), and ecosystem restoration.
- **Site Characterization and Monitoring Technical Support Center (SCMTSC):** The SCMTSC supports Superfund and Resource Conservation and Recovery Act (RCRA) staff with monitoring and site characterization approaches. Expertise is also available for statistical analysis support.
- **Engineering Technical Support Center (ETSC):** The ETSC offers short- and long-term assistance to Superfund and RCRA Corrective Action staff. Assistance focuses on treatment technologies and engineering approaches to site management at any phase from problem identification through remedial action.
- **Ecological Risk Assessment Support Center (ERASC):** The ERASC provides technical information and addresses scientific questions of concern or interest on topics relevant to ecological risk assessment at hazardous waste sites for Superfund and RCRA Corrective Action staff.

To provide relevant information being addressed by the current Board of Scientific Counselors (BOSC) review of ORD's activities related to contaminated sites, this document provides examples of technical support for contaminated sites provided by these Centers and is focused on lead, mining, leaking underground storage tanks, and solvent vapor intrusion.

Mining (Including Lead Contamination)

Evaluation of Contamination and Best Management Practices for Tar Creek (R6, OK). The Tar Creek Superfund site has an extension of 40 square miles where toxic contaminants from mining and milling operations were stored or disposed, some of those still produce toxic emanations. To assist with the selection of best management practices (BMPs), metal and other analyte concentrations are being measured at several points in these streams and metal content of bed stream sediments are being determined. Additionally, the project includes conducting a sediment budget in these streams, which will determine the total amount of bed sediments present in the evaluated streams. The collected information will be used to determine if metals are travelling in particulate or dissolved forms and their loadings, which are the criteria for BMPs selection.

Metal Transport and Transformation and Evaluation of BMPs in the Spring River Watershed (R7). The Tri-State Mining District was the leading mining area for zinc and lead between 1850 and 1970, leaving mine waste accumulated throughout the area; EPA has included three Superfund sites from this area on the National Priorities List. Because zinc and other metals are still present in stream water and bed sediments in the Spring River Watershed, monitoring research has been conducted to determine the most suitable BMPs to reduce particulate and dissolved metals transport. A Watershed Analysis Risk Management Framework (WARMF) model is also being implemented to simulate sediments and zinc transport and to assess the effectiveness of the BMPs. By combining the watershed monitoring analytical data and WARMF model results, recommendations about BMPs for the studied streams will be made. In addition, a BMP technology is currently being developed using sorbent bags containing natural material (biochar) that are submerged in streams to capture dissolved metals and eliminate the need for treatment plants, which usually demand reagents and energy inputs.

Evaluating Groundwater Quality Changes in the Ute Mountain Ute Tribe's White Mesa Wells (R8, UT). Low pH and metal content have been reported in the Ute Mountain Ute Tribe's White Mesa community groundwater. Preliminary investigation suggested that pyrite oxidation from water-level fluctuations in the community wells could be origin of this contamination; however, there is an upgradient uranium processing mill that may be releasing contaminants into local springs and potentially to the groundwater sources. Using column experiments of well core samples, research is being conducted to determine if the pyritic materials could generate the low pH and metal content observed in the community wells. The samples will also be evaluated to determine changes in the pyrite content and iron oxidation.

Using Isotopic Analysis and Groundwater Tracers to Evaluate Sources and Transport at Captain Jack and Bonita Peak Mining District Superfund Sites (R8, CO). Technical support is being provided for mining and mineral processing Superfund sites in the Region. Isotopic and groundwater tracer analytical support was requested to better understand shallow and deep groundwater flow paths and how those relate to contaminant transport and groundwater-surface water interactions. In 2020, research efforts have supported remedial investigation activities at the Bonita Peak Mining District and remedy optimization efforts at the Captain Jack Mill Superfund Sites and have provided critical insights into interactions of mine pools, impacted groundwater, and surface water. At the Bonita Peak Mining District, ORD tools provided data that can assist the project team as they consider metals loading assessments and potential targeted actions at specific locations within the watershed. At the Captain Jack Mill Superfund Site, sensors were used to look for changes in groundwater/surface water interactions resulting from optimization of the in-situ remedy at the Big Five Tunnel and potential impacts to the nearby mine pool.

Profiling Mine-Impacted Surface Water to Improve Remediation Efforts (R8). For this project, ORD and Region 8 are partnering on a project to evaluate temperature and conductivity profiling in mine impacted surface water, which will include the deployment of a dense network of sensors that can continuously provide accurate water quality measurements with high spatial resolution to improve remediation efforts. Best practices will be captured and shared with key partners to improve site characterization strategies and lower costs associated with these mitigation efforts.

Hyperspectral Test Evaluation at the Gay Mine Site (R10, OR). This site consists of over 8,500 acres with selenium contaminated soils of varying concentrations. To estimate surface soil concentrations over large areas and determine where to focus future limited sampling efforts, a more cost-effective, non-destructive, and less labor-intensive technology is being evaluated. The spectral data of the soils, together with the coincident lab results, will be used to develop a model to predict soil and waste selenium concentration based on field spectroscopic measurements. The impact to the community will be more targeted remedial actions and more efficient use of funds in cleanup activities. National Mining Team participants expressed strong interest in further development and use of this technology for additional sites across the Nation.

Water Treatment Using Anaerobic Bioreactors and Vertical Wetlands at the Formosa Mine Superfund Site (R10, OR). The Formosa Mine covers an area of 76 acres, where mine waste was left resulting in the discharge of millions of gallons of acidic mining-impacted water that contaminated nearby land and water. Technical support was previously provided to investigate remediation options, results of which led to the belief that a passive system could be feasible. The discharge water from the mine adit (horizontal entrance into a mine) was also subject to a pilot-scale treatability study which resulted in making physical modifications at the adit that changed the water quality. Technical assistance is currently being provided to test a passive treatment for the new chemistry of the mine adit water accomplishing three specific tasks: 1) characterization of the adit water at current conditions, 2) propose a treatment design that will include anaerobic sulfate reducing bioreactors with local materials as substrate, and 3) test the use of biochar as substrate in vertical wetlands to reduce zinc and other metals to below state benchmark limits.

Amendment Technologies to Reduce Lead Bioavailability: Evaluating Remediation Strategies for Metals Contaminated Wetlands at the Bunker Hill Mining and Metallurgical Complex Superfund Site. (R10, ID). The Bunker Hill Mining and Metallurgical Complex Superfund site contains elevated levels of lead and other metals associated with historical mining and smelting activities. The contamination has been distributed throughout downstream ecosystems, which necessitates remediation strategies that can be effectively applied over large areas. Technical assistance is being provided to help identify potential remediation strategies for metal contaminated wetlands within the Lower Basin of the Coeur d'Alene River. Recommendations will be provided on the optimal types of amendment technologies (such as biochar) to apply to sediments that can reduce lead availability for biotic uptake. In addition, investigations into the impact of changing oxidation/reduction (redox) conditions on metal mobility and toxicity are being conducted to help identify site remediation strategies involving hydrological alterations and predict the impacts of changing climate scenarios on metal mobility and bioavailability.

Evaluating Phytoremediation Covers for the Smoky Canyon Mine Superfund Site (R10, ID). Technical expertise was provided for the phytoremediation cover design alternatives outlined in the draft Feasibility Study Technical Memorandum for the Smoky Canyon Mine Superfund Site. EPA recommended that an additional alternative for a single deep layer cover amended with native-mimicking soil and planted with coniferous native forest be considered for review in the Feasibility Study.

Specialized Groundwater Geochemistry Support for Lead Contamination (Mining and Industry Related)

Critical site assessment and site characterization innovations technical support has been, and continues to be, provided in response to lead contamination at Superfund sites by conducting specialized laboratory analytical services (i.e., inorganic isotope and Rare Earth Element analysis) and providing technical expertise. The following are some examples related to this support.

Riverside Industrial Superfund Site (R2, NJ). A technical issue arose at the site related to the geochemistry of lead transport and fate in groundwater. Initial technical reviews of a Dispute Letter from the Responsible Party and EPA's response letter to the Party were provided, along with technical expertise during meetings.

Historic Pottery Site (R2, NJ). Analytical support is being provided to the Region to characterize samples for lead isotope ratios to constrain lead sources in soils.

Captain Jack and Bonita Peak Mining District Superfund Sites (R8, CO). Sample analysis of mine waters is being conducted to support remedial investigations at the sites. Sample analysis includes trace metals, Rare Earth Elements, and lead isotopes. Project team leadership is also being provided to understand mine water geochemistry.

Evaluation of Waste Management for Lead Contamination

Long-Term Fate Evaluation of Lead in Phosphate Treated Waste Materials (R6). The ability of phosphate amendments to reduce the amount of lead released from two waste materials (cathode ray tube glass and waste foundry sand) was evaluated using toxicity characteristic and environmental assessment leaching tests, which were run on the materials with and without phosphate amendments. X-ray absorption speciation experiments were then run on the resulting solids. Results indicated that phosphate amendments reduced the amount of lead leached from the material; however, the mechanism is not completely clear as only a portion of the lead is transformed to the target mineral. In addition, when the foundry sand was mixed with the dry phosphate amendment, no change in lead speciation occurred.

Mitigating Children's Lead Exposures

Data and Maps to Identify High Lead Exposure Locations (R1, R5, R6, R7). Four EPA Regions to date have requested technical support for the use of science-based approaches to identify high lead exposure locations and drivers to effectively target and prioritize lead exposure risk reduction, prevention, and mitigation efforts—especially in our Nation's most vulnerable locations. A generalizable approach was developed and applied utilizing geospatial statistical methods and models to analyze and map available lead exposure data together with children's blood lead level (BLL) data from states. The approach is of potential use to many states, depending on available BLL and other data. Results with this draft methodology were developed for 16 states: CT, VT, IL, IN, MI, MN, OH, WI, IO, KS, MO, NE, TX, LA, OK, and AR. The results included data, maps, and/or analyses identifying high lead exposure locations. EPA Regional offices are using the results to inform federal-state joint planning deliberations and collaborations for lead exposure risk reduction actions and to advance their lead geographic initiatives focused on multi-media enforcement targeting (e.g., lead paint inspections), compliance assistance, and environmental justice efforts. These results provide insights into high lead exposure communities that are informing discussions about places for potential actions and additional data needs.

Leaking Underground Storage Tanks (LUST)

Technical Support for an Abandoned Automobile Dealership Site (R9, AZ). Three underground storage tanks (USTs) discharged gasoline through the subsurface into the sandstone aquifer at an abandoned car dealership near Tuba City, AZ. The initial release occurred on Navajo land and spread onto Hopi land. The Navajo Nation initially investigated the release, implementing soil removal and some characterization efforts at the site. In 2006, the federal government assumed the lead role in advancing site cleanup.

Generally, petroleum hydrocarbon plumes respond well to enhanced biological treatment; however, this site has been extremely difficult to manage. Technical support was requested to review a geophysical report on the site, and based on the review recommendations, data collection support was then provided to characterize the plume. A 3-D representation of the data draped on the topography and a deeper magnetic survey was conducted in 2018, which helped strengthen site subsurface interpretations allowing, well locations to be plotted to assist in the next version of the Conceptual Site Model. A more complete understanding of the subsurface is critical to supporting effective, long-term remediation efforts.

Solvent Vapor Intrusion

Technical Support for the American Cyanamid Superfund Site (R2, NJ). This Superfund site was used for numerous chemical and pharmaceutical manufacturing operations for more than 90 years, resulting in the contamination of waste disposal areas, soil and groundwater with volatile organic compounds, semi-VOCs, and metals. Upon request, a technical review of the draft *Vapor Intrusion Groundwater Monitoring Work Plan* was conducted for the appropriateness of the proposed statistical approach and recommendations were provided to the Region in the fall of 2020.

Technical Support for a Petroleum Refinery Company (R2, VI). Phase separated petroleum hydrocarbon (PSPH) was released to the groundwater at a petroleum refinery facility through slow leaks and other releases from storage and process areas, as well as the underground oily water sewer system. A major facility-wide Interim Corrective Measure is on-going. A cumulative total of 43.212 million gallons of PSPH have been recovered from the groundwater under the facility and recycled back into the facility's process stream, representing an estimated recovery of 99%. Based on the most current estimates, approximately 306,000 gallons of recoverable PSPH still remain in the groundwater underlying the facility. In early 2021, technical support was requested to review comparison of subsurface vapor intrusion modeling calculations. Based on the review, the responsible party was asked to update model parameters.

Technical Support at a Laundry Center (R7, NE). Technical support was provided at a dry cleaner and laundry center that uses chlorinated solvents and Stoddard Solvent (a petroleum mixture). Soil Vapor Extraction and Sub-slab Depressurization remedies had been applied but the facility continued to experience issues with indoor air quality with Stoddard Solvent. Technical review comments were provided, and, now in year three of remediation efforts, conditions at the center are improving.

Commencing and Ongoing Regional/ORD Technical Support Research

ORD has extramural funding programs that facilitate collaboration between ORD researchers and EPA regional, state, and tribal partners. These research projects address partner prioritized issues and thus serve as a cooperative, interactive form of ORD technical support. The following projects have been selected for funding via ORD's Regional Applied Research Effort (RARE), Superfund and Technology Liaison Research (STLR), or Regional-State-Tribal Innovation Program (RSTIP).

Optimize Sorbent Tube Sampling and Analysis Methodology to Decrease Use of Summa Canisters (RARE Project with R7)

The effect of sample humidity on VOC sorption is poorly understood. This research will examine optimizing sample collection parameters for sorbent tubes and analytical parameters for instrumentation to produce data quality equivalent to the summa canister method. The results from this study will help EPA, state, federal, and local agencies and other indoor air/vapor intrusion responders identify the value and efficacy of using more cost-effective passive sorbent tubes for the VOC sampling, as well as define their capabilities and limitations.

Preferential Pathways for Vapor Intrusion (RARE Project with R9)

There likely are over 10,000 buildings in Region 9 that currently have potential for unacceptable and unhealthful levels of chemical vapors exceeding EPA's health protective risk levels. Based on EPA's regional and national studies, vapor intrusion may be dominated by preferential migration routes. Because these migration routes currently are not well understood, the Region 9 Team will review existing data to identify data gaps and make recommendations regarding data collection, analytical methods, and preferential migration routes / points of entry identification. The results will help EPA and other federal, state, and local agencies quantify preferential migration routes and points of entry.

Investigation and Characterization of Portable Air Treatment Units (ATUs) for the Temporary Reduction and Mitigation of Chlorinated Solvents in Indoor Air (STLR Project with R5)

ORD/CEMM is conducting chamber tests to evaluate the chlorinated contaminants removal performance of ATUs under variable atmospheric conditions, primarily temperature and humidity, with the goal of better understanding the capabilities and limitations of ATUs. This information is vital to Superfund On-Scene Coordinators conducting emergency responses at residences receiving solvent vapor intrusion, so they can determine the number of ATUs required and calculate their effective treatment durations.

Soil Amendments to Reduce Bioavailability of Toxic Metals in Contaminated Soils and Sediments (RARE Project with R10)

Within Region 10, there are approximately 20,000 abandoned hardrock mines and numerous other sites having toxic metals contaminated soils and sediments. Only a fraction of these have been remediated. For sites contaminated at relatively low levels, soil amendments may provide a means to reduce exposure to the contaminating metals. Novel approaches to amend soils and sediments to reduce lead bioavailability will be investigated at two Region 10 Superfund sites to optimize field application and identify effectiveness metrics.

High Resolution Thermal Monitoring of Mine Impacted Groundwater and Surface Water (RSTIP Project with R8)

Temperature, streamflow intermittency, and metals loading are critical parameters influencing ecosystem health in mine impacted surface water. Continuous monitoring of temperature, relative conductivity, and pH in surface streams and rivers will be conducted using low cost/high density thermal sensor networks deployed at Superfund Sites in Colorado. Consequently, important zones of surface water/groundwater interactions and potential metals loading from mine influenced water will be identified. Expected insights into temporal and spatial variations will allow improved watershed-level remediation or mitigation of human and ecological risks at large mining sites and districts.

Citizen Science to Investigate Possible Native Plant Contamination at Tribe Abandoned Uranium Mines (RSTIP Project with R9)

The likelihood of significant health effects from traditional plant uses at and around a uranium mine site on tribal land will be evaluated. The mine site includes mines, mills, and tailings. Tribe members and leadership, as well as regulators, site owners, and potentially responsible parties will be informed about the potential uptake, fate, and seasonal behavior of metals commonly found at these former uranium mines.

Select Publications and Webinar Presentations

- **Geophysical Applications for Mine Waste Site Objectives**
  Werkema, D. (2019). CLU-IN Webinar Series: ORD Mine and Mineral Processing Virtual Workshop Session 1-Site Characterization.

  This presentation highlighted techniques used on the surface or near surface of the earth to measure and monitor the physical property changes that occur due to mine waste. The techniques presented give site investigators new tools and methods to understand the impacts of mine waste to the subsurface geology and hydrogeology.

- **Lead Speciation, Bioaccessibility and Source Attribution in Missouri's Big River Watershed**
  Noerpel, M., Pribil, M., Rutherford, D., Law, P., Bradham, K., Nelson, C., Weber, R., Gunn, G., and, Scheckel, K. (2020). Applied Geochemistry, 123:104757.

  Intensive mining conducted in the Southeast Missouri Lead District prior to regulations resulted in a legacy of lead contaminated soil, large piles of mine tailings and elevated childhood blood lead levels. This study seeks to identify the source of the lead contamination in the Big River and inform risk to the public. Isotopic analysis indicated the mine tailing piles at the head of the Big River are the primary source of the lead contamination.

- **Response Activities on Uranium-Impacted Tribal Lands**
  Burton, T. (2019). CLU-IN Webinar Series-Emergency Management.

  Impacts from operations at former uranium mines have negatively affected the health and environment of several Native American communities in the Southwest. As first responders for EPA, Region 6 On Scene Coordinators have provided multiple responses to mining-related issues on tribal and tribal-adjacent lands. This presentation follows one such response at the homeowner scale, including a discussion of the characterization activities, and ends by contrasting this successful response with the stunning scale of the abandoned uranium mines.

- **Terrestrial Metals Bioavailability: A Literature-Derived Classification Procedure for Ecological Risk Assessment (2020, Final Report)**
  U.S. Environmental Protection Agency (2020). Ecological Risk Assessment Support Center, Cincinnati, OH, EPA/600/R-20/042.
  Interstudy variation among bioavailability studies is a primary deterrent to a universal methodology to assess metals bioavailability to soil dwelling organisms and is largely the result of specific experimental conditions unique to independent studies. The primary objective of this review is to synthesize information in the open literature on the effects of soil chemical/physical properties on metals bioavailability independent of extraneous variation due to the specific attributes of individual studies.

- **Separating Anthropogenic Metals Contamination from Background: A Critical Review of Geochemical Evaluations and Proposal of Alternative Methodology (2019, Final Report)**
  U.S. Environmental Protection Agency (2019). Ecological Risk Assessment Support Center, Cincinnati, OH, EPA/600/R-19/196.
  Meaningful estimates of background contaminant levels are a critical component of site assessments. This technical paper relates to the issue of background soil chemical demarcation at metals contaminated sites.

- **Watershed Hydrologic and Contaminated Sediment Transport Modeling in the Tri-State Mining District**
  Rahman, K., Mohamed M. Hantush, A. Hall, and J. McKernan (2019). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-18/247.
  A sediment transport component of the Soil and Water Assessment Tool (SWAT) was constructed and calibrated using three years' worth of biweekly flow and suspended sediment concentration data (2014-2016) sampled from stations in seven different tributaries upstream from Empire Lake. The results are useful for identifying critical source areas of sediment and can be used to inform management decisions on lake dredge and sediment traps as viable remedial measures for metal contamination in heavily contaminated tributaries of Spring River and Empire Lake.

- **Geophysical Assessment of a Proposed Landfill Site in Fredericktown, Missouri**
  Johnson, C., K. Pappas, E. White, Dale Werkema, N. Terry, R. Ford, S. Phillips, K. Limes, and J. Lane Jr. (2020) FastTIMES, Environmental and Engineering Geophysical Society, 25(2):98-106.
  Non-invasive geophysical and hydrogeology techniques were used for the geologic and hydrogeologic characterization of a proposed landfill site for lead mine waste sediments. The study characterized the site as a potential landfill for the dredging of the lead impacted lake sediments, the hydraulic connectivity from the site to the City Lake, and informed Region 7 on critical geologic conditions to aid decision makers and landfill design considerations.

- **Publications Increasing Awareness of the Benefits of High Resolution Site Characterization (HRSC) at LUST Sites (2-part series).** This series explores the use of HRSC at LUST sites, identifying opportunities to expand use and improve characterization and remediation performance at these sites, and aimed to increase awareness of technical and economic benefits of using HRSC tools and strategies for State and Tribal regulators implementing delegated tanks programs, EPA's Office of Underground Storage Tanks, Brownsfield and public partners, along with private partners executing field work at LUST sites.

    - Part 1: HRSC or not? What a great question!
      Dyment, S. and T. Kady (2018). L.U.S.T.Line, New England Interstate Water Pollution Control Commission, Bulletin 84; pgs 1-5.

      This article makes the case for increased use of HRSC tools and strategies at LUST sites. The article looks at Superfund and LUST experiences from site characterization at nonaqueous-phase liquids L sites and implications for remedy applications, optimization, and system performance.

    - Part 2: To HRSC or not? Cost vs. Benefits
      Dyment, S. and T. Kady (2019). L.U.S.T.Line, New England Interstate Water Pollution Control Commission, Bulletin 85; pgs 13-17.

      This article explores national data sets to look at states' costs for characterization and remediation at LUST sites. The article includes State testimonials from officials in Alabama, Colorado, and Virginia on the use of HRSC and impacts to their respective programs. Quantifying remedy cost and performance improvements derived from HRSC and the sheer volume of LUST sites that need to be addressed nationally make it challenging to justify blindly using HRSC at every site, however opportunities exist to increase use of HRSC tools and strategies at sites where expenditures are expected to exceed 10 year averages and in states with higher rates of costly sites (>$1Million).