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Engineering Technical Support Center Annual Report Fiscal Year 2013

Technical Support and Innovative Research for Contaminated Sites

Engineering Technical Support Center
Land Remediation and Pollution Control Division
National Risk Management Research Laboratory
Office of Research and Development
U.S. Environmental Protection Agency
Cincinnati, OH 45268

Abstract

The Engineering Technical Support Center (ETSC) was created in 1987 as one of a number of technical support centers in the Technical Support Project (TSP) to provide engineering expertise to U.S. EPA program offices and remediation teams working at contaminated sites across the United States. The ETSC is operated within ORD's National Risk Management Research Laboratory (NRMRL) in Cincinnati, OH. ETSC's mission is to provide site-specific scientific and engineering technical support to remedial project managers (RPMs), on-scene coordinators and other remediation personnel at contaminated sites. ETSC's mission allows the responsible local, regional or national authorities to work more quickly, efficiently and cost-effectively, while also increasing the technical experience of the remediation team. Since its inception, ETSC has supported countless projects across all EPA Regions in almost all 50 states and Territories.

This report highlights significant projects that the ETSC has supported throughout fiscal year 2013. Projects have addressed an array of environmental scenarios, including but not limited to remote mining contamination, expansive landfill waste, sediment remediation by capping, and persistent threats from abandoned industrial sites. A major component of affecting meaningful remediation lies in constructing and testing new, innovative treatment technologies through pilot and field research. For example, ETSC teams have gone into the field to spearhead projects that are at the cutting edge of remediation research in the areas of bioremediation and groundwater treatment, active sediment capping, in-situ stabilization, and sustainable site cleanup. ETSC organizes and reports significant developments in environmental engineering in the form of Engineering Issue Papers and peer-reviewed journal publications. ETSC has also taken on a selection of newer initiatives that focus on integrating sustainability into communities and land use plans. While ETSC's principal mission of bolstering technical expertise for site-specific remediation at contaminated sites remains a central focus, ETSC teams are reaching out to support other efforts in prevention thereby reducing EPA's burden from legacy sites in the future. NRMRL/LRPCD and the ETSC have evolved continually to meet the demands, as well as scientific and engineering needs of the EPA program offices and regional clients.

Acknowledgements

The ETSC would like to acknowledge the contributions from ORD scientists for their efforts in support of ETSC's mission. The ETSC extends a thank you to our numerous clients in the Office of Science Policy, Office of Solid Waste and Emergency Response, Office of Superfund Remediation and Technology Innovation, and the EPA Regions, particularly the Superfund Technology Liaisons (STLs), the On Scene Coordinators (OSCs) and their management for their patronage and financial support. The ETSC would also like to recognize the exemplary support provided by our contractors this year, Battelle Memorial Institute and RTI International. Finally the ETSC extends special thanks to everyone that provides document reviews, responds to technical request phone calls, and provides all other manner of assistance.

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List of Acronyms

ARRA	American Reinvestment and Recovery Act
ASARCO	American Smelting and Refining Company Inc.
BCR	biochemical reactor
BLM	Bureau of Land Management
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
COC	contaminant of concern
EPA	U.S. Environmental Protection Agency
ET	evapotranspiration
ETSC	Engineering Technical Support Center
GLNPO	Great Lakes National Program Office
GWTSC	Ground Water Technical Support Center
LRPCD	Land Remediation and Pollution Control Division
MIW	mining-influenced water
NPL	National Priorities List
NRMRL	National Risk Management Research Laboratory
ORD	Office of Research and Development
OSC	On Scene Coordinator
OSRTI	Office of Superfund Remediation and Technology Innovation
OSWER	Office of Solid Waste and Emergency Response
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	perchloroethylene or tetrachloroethene
RCRA	Resource Conservation and Recovery Act
RI, RI/FS	remedial investigation, remedial investigation/feasibility study
RPM	remedial project manager
STARS	Site Technical Assistance Reporting System
STL	Superfund Technology Liaison
SVE	soil vapor extraction
SVOC	semi-volatile organic compounds
TCE	trichloroethylene
TSC	Technical Support Center
VI	Vapor intrusion
VOC	volatile organic compounds

Introduction

The ETSC is operated and staffed by ORD's National Risk Management Research Laboratory (NRMRL), Land Remediation and Pollution Control Division in Cincinnati, OH. Created in 1987, ETSC is part of the Technical Support Project (TSP), a partnership between ORD and the Office of Solid Waste and Emergency Response (OSWER). The TSP consists of a network of Regional Forums, the Environmental Response Team, and specialized Technical Support Centers. The Centers and Forums have evolved through time as Agency needs have changed. Currently, there are 5 active TSCs in the TSP.

- Engineering Technical Support Center (ETSC) in Cincinnati, Ohio
- Ground Water Technical Support Center (GWTSC) in Ada, Oklahoma
- Site Characterization and Monitoring Technical Support Center (SCMTSC) in Atlanta, Georgia
- Superfund Health Risk Assessment Technical Support Center (SHRATSC) in Cincinnati, Ohio
- Ecological Risk Assessment Support Center (ERASC) in Cincinnati, Ohio

Each center has a specific focus of expertise and is staffed with engineers and scientists that are eager to assist on the most difficult matters that are encountered at contaminated sites. ETSC's mission is to provide scientific and engineering knowledge and expertise in soil, surface waters, sediment, and mine remediation and technology to program offices and Regional clients for risk management decisions. The ETSC provides site-specific assistance, technical support, and conducts targeted research for EPA Regions and program offices. The center networks with EPA programs and other federal agencies to deliver the latest methods, approaches, and technologies needed to characterize, remediate, and manage risk at contaminated sites. Impacts across regions include but are not limited to: developing, evaluating and demonstrating bioremediation and groundwater treatment technologies; evaluating capping and beneficial waste reuse technologies; providing engineering review and design assistance; recommending proven, viable technologies; conducting focused research on the sustainability of selected site remedies; and providing on-call technical assistance.

In the past several years, ETSC staff have assisted in five-year Superfund site reviews and technology optimization studies, and completed applied research projects that support site-specific and more broadly applicable research for program office and regional technical assistance requests.
ETSC is primarily staffed with scientists and engineers from the LRPCD. Additional assistance was provided by other Divisions or ORD Laboratory personnel, as well as external contractors and consultants. In FY13, ETSC responded to approximately 200 technical support requests from over 150 contaminated sites in all 10 EPA Regions, Territories (Puerto Rico) and internationally (Vietnam and Canada). Sixty-six percent of the contaminated site requests were Superfund National Priority List (NPL) sites.

Receiving Technical Support for Contaminated Sites:

The flow chart below provides a basic understanding of how ETSC addresses technical support requests. Typically, the process begins with a problem encountered at a contaminated site. An RPM, OSC or other decision-maker associated with the site contacts ETSC through their Regional ORD liaison or can directly contact the ETSC Director. The request is logged in the ETSC Site Technical Assistance Reporting System (STARS) database, and an EPA subject-matter expert is consulted simultaneously. Once an EPA expert is identified, the request is then serviced by that individual through three general channels of action: research, new technology or knowledge gap identification. Once the appropriate contaminated site need is determined, the subject-matter expert undertakes the appropriate actions from the flow chart below to address the contaminated site need and deliverables related to the request are sent to the client and the ETSC Director.

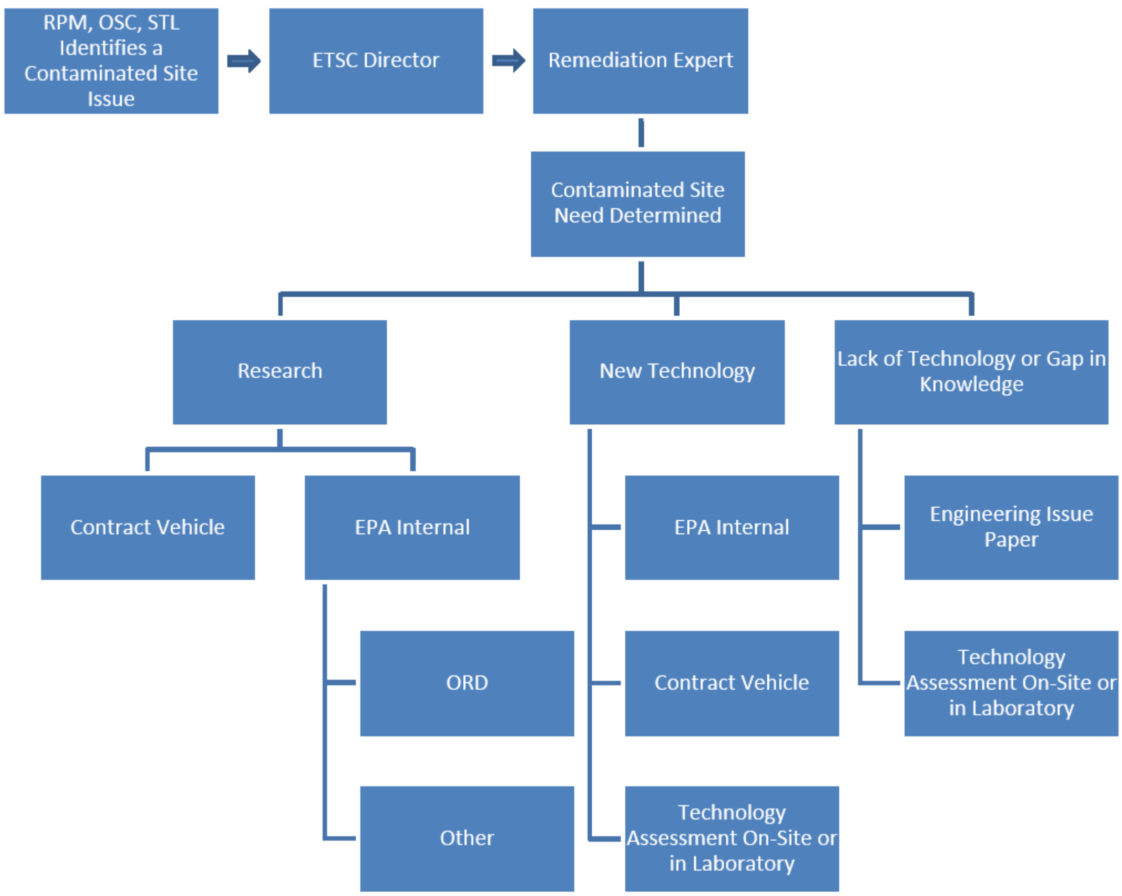


Figure 1 : Engineering Technical Support Request Flow Chart

Engineering Issue Papers

Engineering issue papers are prepared when gaps in existing knowledge on a technical subject are found. To support RPM decisions on what technologies to utilize at a contaminated site, ETSC can review the current understanding of the theory, design and implementation of remedial or treatment technologies. This is the product of an extensive literature review, consulting with leading edge engineers and scientists, and finally drafting a summary for the Office or Regional client's use.

Listed and described below are engineering issue papers (EIPs) that were initiated or completed in fiscal year 2013.

Soil Vapor Extraction

Figure 2: Example of Well Heads for Soil Vapor Extraction System

Soil Vapor Extraction (SVE) systems are a common remediation method where volatile (VOC) and semi-volatile (SVOC) organic compounds are removed from soil matrices. Generally, negative pressure (vacuum) is applied to extraction wells, and the VOC and SVOC contaminants are drawn up from the wells, and collected through various means. These systems are installed in areas where there is easy access to electricity. Implementation can be challenging in rural settings or areas with limited access to power. Ideal conditions for SVE treatment are well-drained, highly permeable soils (e.g. sand and gravel) with low organic carbon content. A completion date of 2014 is targeted for this EIP.

Technology Alternatives for the Remediation of Polychlorinated Biphenyl (PCB) Contaminated Soils and Sediments

Treatment techniques for PCBs are numerous, and there are limited resources that provide a concise, unbiased assessment of the efficacies of the varied techniques. This EIP primarily condenses information that can be found in more comprehensive reports, trade journals and other scientific documents. The EIP summarizes the available information on selected treatment and site remediation technologies for PCBs so that RPMs and other clients can easily understand and implement the appropriate technique at their contaminated site. This EIP product is published on the EPA website, accessible at: http://cfpub.epa.gov/si/si_public_record_report.cfm?dirEntryId=258244.

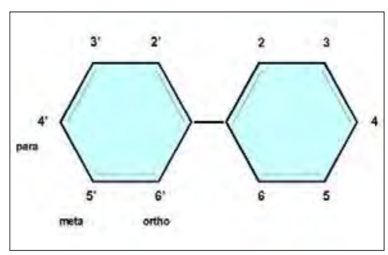


Figure 3: Structure of Polychlorinated Biphenyl (PCB) Molecule

Bioremediation Potential for Arsenic and Dioxin

The Center is preparing two ETSC EIPs regarding bioremediation potential for dioxin and arsenic that summarizes the available information for this treatment technique. These documents primarily condense information that can be found in more comprehensive reports, trade journals and other scientific documents. The products were developed by external and internal experts on bioremediation. Drafts of each of the products have been received and are currently with expert panels consisting of external and internal reviewers.

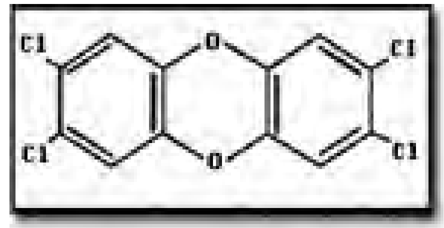


Figure 4: Structure of Dioxin Molecule

International Efforts (Vietnam)

Figure 5: In-pile Thermal Desorption Cell, Danang, Vietnam

Issues of pesticide and dioxin contamination have been encountered at historic U.S. military installations in Vietnam. The ETSC is collaborating with the Joint Advisory Committee for Vietnam, U.S. State Department, U.S. DHHS/CDC, and internal EPA entities ORD/NERL, and OITA to help guide in the selection of the best remedial solutions military sites. The ETSC provided Vietnamese officials with presentations that outlined dioxin chemistry and bioremediation techniques, and is preparing an EIP that summarize the available scientific and technical information on bioremediation techniques for dioxin. Pilot demonstrations of alternative dioxin treatment technologies are also being considered for remediation of dioxin contaminated sites in Vietnam. For example, Figure 5 illustrates a state of the art, in-pile thermal desorption project that is being carried out at the Danang airport in Vietnam. The treatment cell in the figure is the largest ever constructed for this purpose, with a soil capacity of 34,000 cubic meters. It is undecided at this point if this technology will be implemented at other contaminated sites.

Commonly Used ETSC Technologies

The following highlighted technologies represent a paradigm shift to longer-term, sustainable technologies for site remediation and control. We use these technologies for a number of reasons, including their sustainability, low-energy usage and overall 'greenness' when compared to standard technologies.

Vapor Intrusion Mitigation

Vapor intrusion occurs when soil or groundwater below a building is contaminated with volatile or semivolatile chemicals or gasses. Migration of these chemicals or gasses from soil or groundwater into buildings can cause an indoor buildup of airborne pollutants (e.g., radon or trichloroethylene [TCE]). This is a common problem on sites where industrial solvents were used and entered into the vadose zone and groundwater. TCE is one of the more common persistent contaminants encountered. The most common method utilized to remediate vapor intrusion issues is to create a vacuum under the slab of the structure, and redirect the gas into a treatment or emission system. More recently, another method referred to as building pressurization is becoming accepted as another means of control. With this technology, the building is over-pressurized, thereby making a slightly increased pressure inside compared to outside (and underneath) the building. In some cases, this has been found to retard or prevent vapor infiltration. Figure 6 provides a simplified diagram of the vapor intrusion issue. Three percent of the technical support requests involve this technology.

Figure 6: Typical Vapor Intrusion Scenario

Solidification and Stabilization

Solidification and stabilization (utilized at 8% of ETSC assisted sites in FY2013) is a process by which radioactive, organic or mixed wastes are contained within a matrix to reduce contaminant leaching to safe levels. This method does not destroy contaminants, but immobilizes and encapsulates them, keeping them from contaminating local soils, groundwater or surface waters. Certain refuse material from industrial processes, such as fly ash, can be implemented when concrete is used in the solidification process.

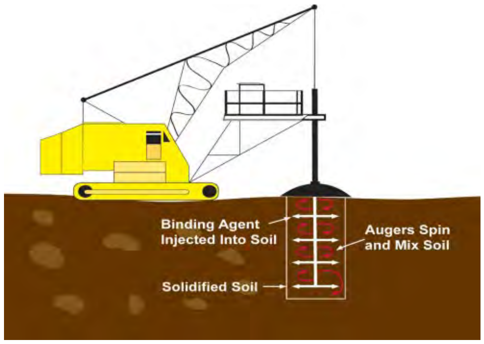


Figure 7: Typical In-situ Solidification Application Illustrating Diameter of Influence (area where augers spin and mix soil with binding agent)

Capping

Capping (explored on 8% of ETSC assisted sites in FY2013) is a remedial technique where an impermeable cover, of either natural or man-made material, is placed on top of a landfill or other waste to keep rainwater or overland water flow from infiltrating the waste. Cap applications are also intended to reduce or prevent wind erosion of contaminated sediment. Figure 8 provides two examples of capping applications that the EPA has implemented. The cap design on the left illustrates the use of a man-made geomembrane layer in the cap design.

Figure 8: Examples of Capping Applications

Evapotranspiration (ET) Cover

Figure 9: Examples of Evapotranspiration Covers

An evapotranspiration (ET) cover uses plants and soil to capture rainfall to later return it to the atmosphere by evaporation and transpiration, which limits the amount of moisture reaching the contaminated area. Although ET covers are used more extensively for landfill applications, another potential use is to attenuate or remediate volatile contaminants present in low concentrations at Brownfields or other legacy contaminated sites. Therefore, if designed properly, this method can provide both a remediation and restoration solution in one effort. An ET cover starts by placing an impermeable sediment cap over a landfill or other contaminated site, then placing a layer of topsoil selectively seeded with native grasses, shrubs and trees that will grow on the surface. Figure 9 provides examples of successfully installed evapotranspiration covers.

Biochemical Reactors

Figure 10: Example of Full-scale Bioreactor at a Remote Mining Site

A biochemical reactor (BCR), a technology piloted and marketed by ETSC and now being adopted widely, relies on the constant interchange between chemical and biological processes (implemented on 8% of ETSC assisted sites in FY2013). Sulfate-reducing bacteria create basic sulfide species, which mix with free metals to precipitate metal sulfides. The gas from this process may be captured, while the metal sulfide precipitates settle into a less mobile sludge. Advances in this technology show promise for the recovery of metals, like iron, from BCR sludges. Conceptually, this system discharges clean water, turns a liability into an asset, and is self-sustaining (passive treatment). BCRs appear to be a good match for sites that have restricted access and no available power sources, since they require low maintenance and no electricity.

ETSC staff evaluated solid substrate-free bioreactor treatment of aluminum, copper, iron, nickel, selenium and zinc in acid rock drainage from the Aspen Seep of the Leviathan Mine Superfund site. An EPA report, Compost-Free Bioreactor Treatment of Acid Rock Drainage, Leviathan Mine, California (93 pp, 4.2M, EPA/540/R-06/009, Abstract) summarizes the results and application of this research conducted from 2003-2005

Slurry Wall

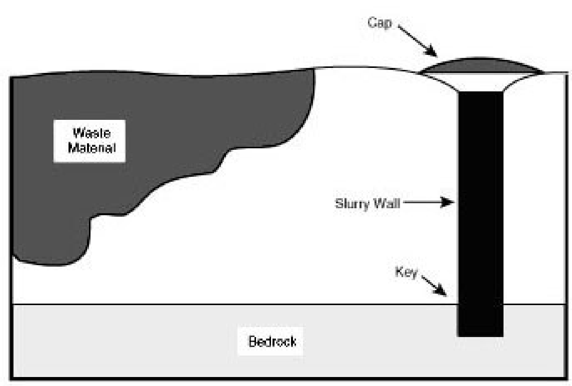


Figure 11: Trenching Activities at a Superfund Site for the Installation of a Slurry Wall, and Example Installation of a Slurry Wall

A slurry is a watery mixture of insoluble material, like mud. A slurry wall is a trench filled with a non-permeable or low-permeability material, such as bentonite, that can obstruct or filter surface water or groundwater. Slurry walls can behave as a hydraulic barrier, or a sieve depending on design and material content. The slurry can also provide opportunities for water treatment by formulating a mixture with the appropriate constituents to either bind or react with the contaminants present. Binding the contaminants reduces their bioavailability and mobility, and reacting with the contaminants such as oxidation or pH neutralization to reduce potential hazard and risk in the environment.

Thermal Desorption

Figure 12: Field-scale Ex-situ Thermal Desorption Facility

Thermal desorption (TD) (used at 5% of ETSC assisted sites in FY2013) uses heat to transform chemicals into gasses. These gasses are then sent through a collection or treatment process to remove targeted substances according to the physical and chemical principles of adsorption and desorption. TD is most useful to clean soils polluted by coal tar, pesticides, solvents and wood-preserving chemicals. Depending on contaminant load, TD can be a fast and effective method of cleaning polluted soils. For more information about TD, the reader is referred to the EPA document titled, A Citizen's Guide to Thermal Desorption (PDF) (2 pp, 65K, EPA/542/F-01/003).

Soil Flushing

Soil flushing (In-Situ Flushing) uses a prepared solution to bring a controlled flow of contaminated fluid to the surface where engineers treat or properly dispose of the waste. As an example, an application of this technology can remove metals through the use of an acidic solution injected into the soil. This solution is then extracted either by the solution returning to the surface (due to favorable geological conditions) or through an extraction well. Businesses in the energy sector regularly use flushing for enhanced petroleum recovery from underground deposits.

Selected FY 2013 Technical Support Projects

In FY 2013 alone, the ETSC received approximately 200 technical support requests from over 150 contaminated sites all across the U.S. and its Territories - a couple of international requests were received as well. Due to the large volume of technical support requests received annually by the ETSC, a selected number of technical support projects will be discussed in the following sections. They are organized by the type of work involved (mining, landfills, materials management and sustainability) and each site includes the appropriate EPA Region the request originated from.

ETSC Impacts at Mining Sites

Rico – Argentine Mine (Region 8)

The Rico – Argentine Mine Superfund site in Rico, Colorado was serviced by ETSC in collaboration with the OSC, state, and Atlantic Richfield Company (Tesoro Corporation). The mine drainage from the Rico-Argentine site impacts both Silver Creek and the Delores River watersheds. Ponds were constructed near this site in the Delores River flood plain to assist in settling suspended contaminants from the mine drainage, and assist in reducing the pH. ETSC scientists reviewed engineering design and cleanup plans for the site and advised the OSC and Region on cost-effective and sustainable remediation and removal options. Contaminants at this site include concentrated metals and low pH water flowing from the adit.

Figure 13: Ponds in the Delores River Flood plain, Rico, CO

Formosa Mine (Region 10)

Formosa Mine Superfund site in Southwestern Oregon is a legacy mine that has been found to be draining acidic effluent and metals into local streams, which in turn have impaired biological function for miles downstream. ETSC has been involved with this project for a number of years. ETSC is conducting innovative research developing a bench and pilot BCR system to assist in site remediation. The bioremediation treatment technique being studied holds the promise of efficient metal remediation and pH neutralization with little to no power input, and limited servicing requirements. If successful at this site, this technique could be

Figure 14: Mining Influenced Waters Flowing from Formosa Adit, Douglas Co., OR

applied at numerous abandoned mines throughout the U.S. to sequester and immobilize metals where there is limited site access and no available power sources.

Black Butte (Region 10)

Figure 15: Location of Black Butte Mine, Near Cottage Grove, OR

Black Butte Superfund mine site is located in Lane County in rural western Oregon (pictured). The site is situated on the south slope of Black Butte Mountain, which is part of the Calapooya Divide. The Cottage Grove reservoir is uniquely connected with Black Butte, in that the mine is the principle source of mercury (Hg) contaminating the reservoir sediments. The environmental threats on the site are massive tailings piles that are exposed to the elements. These tailings piles are leaching mercury and arsenic into the surrounding soil and surface waters. There is concern about Hg and methyl mercury (MeHg) contamination of drinking water and fish in the Cottage Grove reservoir. ETSC has provided scientific and financial support to begin an assessment of where and how much MeHg is present in the stream leading from the mine to the reservoir, and also to better understand the dynamic processes that cause methylation. Through this investigation, the ETSC has outlined the dynamic process of MeHg that happens in the benthos of the lake in the Cottage Grove reservoir when water levels are seasonally modulated by the U.S. Army Corps of Engineers. This research will lead to a better understanding of the methylation process, thereby allowing researchers and contaminated site managers to reduce methylation in this, and other similarly contaminated watersheds. This knowledge can potentially be applied to a number of other contaminated sites in the west including Carson River and Sulfur Bank Superfund sites - where methyl mercury continues to contaminate community drinking water sources.

ETSC Impact at Landfill Remediation Sites

Fort Devens (Region 1)

Fort Devens Superfund site, once a military base with extensive contamination, is now part of a large-scale redevelopment effort in central Massachusetts. Soil and groundwater contamination occurred from military activities at the site since 1917. The primary contaminant of concern associated with the site is arsenic in the landfill, which has been detected in surface water at the site called 'Red Cove'. The red color of the cove is associated with iron and arsenic in the sediments. Iron and arsenic are deposited there through chemical processes as the contaminated groundwater flowing from the landfill emerges from the base of the pond. ETSC personnel have been involved at the site for a number of years, and have produced publications relevant to the cleanup of the site, and technical support for the remediation of the landfill on site (Final Report; Arsenic Fate, Transport and Stability Study; Groundwater, Surface Water, Soil And Sediment Investigation, Fort Devens Superfund Site, Devens, Massachusetts). ORD recommendations were implemented at this site, including the installation of a slurry wall upgradient of Red Cove to divert the contaminated groundwater plume, targeted removal of contaminated sediments in Red Cove portion of pond, and the design and installation of a performance monitoring system to verify groundwater contaminant flux reduction from the landfill. The closure and cleanup of the site attracted numerous public and private sector organizations that recognized the redevelopment potential for part of the site. The State redevelopment authority 'MassDevelopment' has brought warehouses and distribution centers, manufacturing and industrial space, and research and development facilities to the remediated and restored part of the site. Several federal agencies, including the Department of Justice, the Department of Labor and the Department of Defense collaborated on the site's redevelopment, and put almost 600 acres back into productive use. The U.S. Fish and Wildlife Service (USFWS) used another 836 acres of the site to expand the Oxbow National Wildlife Refuge. This successful partnership between EPA, the Department of Defense, the U.S. Army, the State of Massachusetts and 'MassDevelopment' in support of redevelopment has contributed to increased employment opportunities as well as increased revenue for the local community.

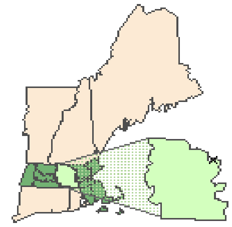


Figure 16: Location of Ft. Devens, Ayer, MA, and a Frog Pictured in 'Red Cove'

Goose Farm (Region 2)

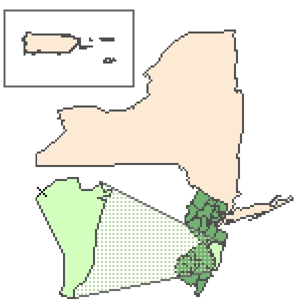


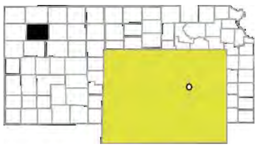
Figure 17: Location of Goose Farm, Plumstead, NJ

Goose Farm Superfund site is a 6.6 acre area located in Ocean County, New Jersey. Between 1940 and 1970, the site owner manufactured rubber and rocket fuel/propellant. The site owner also landfilled laboratory waste chemicals, bulk liquids and drums at the site. Soil and groundwater are contaminated with VOC and SVOC, which are potentially harmful and can easily evaporate. Soil was also found to be contaminated with PCB. Contaminants from the on-site burial pit entered the groundwater, and contaminated a tributary of the Delaware River. Source removal and site remediation were undertaken by the Region, and approximately 5,000 containers of waste, as well as approximately 9,000 gallons of bulk liquids were removed from the site. This action included removing drums filled with PCB waste, contaminated soil and liquids. In 1985, EPA installed a groundwater extraction and treatment system (GETS), and conducted soil flushing to

Figure 18: Example of an In-situ Chemical Oxidation Process at a Superfund Site

remove contaminants from the soil. The site owner constructed a wall around the contaminated groundwater area to prevent migration off-site. In 2013, the ETSC provided an engineering review of plans for a pilot plant to perform in-situ chemical oxidation of contaminated shallow groundwater at the site using an ozone air sparging technique to remediate VOCs.

ETSC Assisted Materials Management Sites



Ace Services (Region 7)

The 2.5-acre Ace Services Superfund site in Colby, Kansas once hosted a chrome plating plant. The soil, shallow groundwater and surface water at the site are contaminated with chromium, and of particular concern – Chromium VI. Over the 13 year EPA and state involvement at the site, the overarching goal has been replacing contaminated drinking water wells with a centralized, city-based water treatment system to substantially reduce human health risk. ETSC involvement at the site includes providing groundwater modeling efforts to understand contaminant concentrations, appropriate pumping rates for the water treatment facility, time to meet cleanup standards, and potential rebound if the pumping system is shut down. Along with cleanup efforts, EPA has been actively involved in addressing the concerns of the community of Colby, KS. EPA keeps up-to-date fact sheets, an 800 number, and regular media briefings to keep the community informed on progress at the site. In working with residents, EPA found that the community's primary concerns centered on conserving and cleaning up the groundwater and the potential for economic development at the Ace site. Community leaders see potential for property reuse; however, the overarching concern remains the town's water quality and EPA is committed to addressing that key issue.

Figure 19: Location of Ace Services in Colby, KS and an operations team at the site.

American Cyanamid (Region 2)

The 575-acre American Cyanamid Superfund site in Bridgewater, New Jersey is located adjacent to the Raritan River and lies above the Brunswick Aquifer, New Jersey's second largest source for drinking water. The site has many operational units with both groundwater and

Figure 20: Location of the American Cyanamid Site in Bridgewater, NJ; along with an aerial photo and a lagoon located at the site post Hurricane Sandy.

soil that are contaminated with VOC, SVOC, metals, and other harmful chemicals. In September 2012, EPA selected a remedy for site-wide soils, groundwater, and impoundment contents. This remedy called for in-situ solidification and/or the installation of engineered capping systems to address contaminated soils and the three contaminated impoundments on-site. The remedy also called for installation and operation of a collection and treatment system for contaminated groundwater. An ecological risk assessment was also prescribed to determine whether the impoundments on-site would require excavation and relocation. A settlement agreement was executed in March, 2013 for the remedial design. The site-wide remedy should be completed in 2015.
ETSC involvement included comments on plans for a thermal desorption and in-situ stabilization project in Operational Unit 8 (OU-8). Properties adjacent to this one were included in the Superfund National Priority List (NPL), but were successfully remediated and removed from the NPL in 1998. These were considered admirable success stories. These de-listed NPL sites have since been redeveloped for commercial use including retail stores, a baseball stadium, and a commuter/baseball parking lot.

Salford Quarry (Region 3)

Figure 21: Location of the Salford Quarry Site in Salford Township, PA

Salford Quarry Superfund site is a historic backfilled shale quarry located in eastern Pennsylvania that was added to the NPL in 2009. The backfilled quarry is in the vicinity of both public and private water wells that serve ~54,000 people. After quarrying, the site was used for a number of purposes including dumping of industrial, commercial and residential waste. Fly ash and buried tanks containing boron and fuel oil were also deposited at the site. ETSC involvement at the site includes a water sampling effort to quantify boron contamination, and a feasibility study to identify the best methods for remediating boron contaminated soil and water. Technologies under consideration are an ion exchange resin, pH-driven precipitation in large treatment ponds, or a reactive barrier-forward osmosis treatment system to sequester boron and selenium from the pumped groundwater. Our goal at this site is to assist the region and local stakeholders in selecting and implementing a GETS that meets the region's Superfund remediation requirements, and complies with state and federal groundwater standards.

Raritan Bay Slag Site (Region 2)

The Raritan Bay Slag Superfund site is located in the Laurence Harbor section of Old Bridge and in Sayreville, Middlesex County, New Jersey. The site was added to the NPL in 2009. The Laurence Harbor seawall, which makes up part of the site, was reported to contain metal slag from blast furnace bottoms deposited along the beachfront in the late 1960s and early 1970s. Remedial Investigation field activities were conducted from September 2010 through June 2011. Results showed significantly elevated levels of lead in the slag, soil, sediment, and surface water. The seawall also contains shredded automotive batteries.

Figure 22: Raritan Bay Slag Superfund Site (top); EPA-led Sediment Sampling Being Carried Out (bottom)

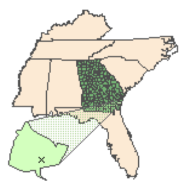
In September 2012 EPA released a [Proposed Plan] for the site which identified EPA's preferred cleanup plan. Public comment on the preferred cleanup plan concluded in 2012. The preferred cleanup plan included, among other things, excavation/dredging and off-site disposal. Slag, battery casings and associated wastes and contaminated and highly impacted soils and sediment above the cleanup level would be excavated and/or dredged and disposed of at appropriate off-site facilities. Surface water monitoring would be performed to confirm that there are no increased risks due to removal activities. Currently, EPA estimates that once started, remediation activities would last 5-7 years until the site is fully remediated. The ETSC is involved at the site to develop a remediation technique to remove the lead from the contaminated beach area. The ETSC carried out a review of the technologies available for the lead separation from the slag/beach area and the technique of magnetic separation was found to be most feasible. A bench scale study on lead removal from slag was submitted to the RPM for consideration. Post deletion from the NPL, plans for reuse include a recreational space and park on-site.

Franklin Slag (Region 3)

Figure 23: Location of the Franklin Slag Pile Superfund Site and the Adjacent Franklin Smelter Site Where the Slag Was Generated.

The Franklin Slag Pile Superfund site is located on a three-acre property in the Port Richmond industrial area of Philadelphia; bordered to the west by Interstate 95 and to the east by the Delaware River. The site consists of a covered slag pile containing an estimated 68,000 cubic yards of slag material (comprised of many metals, including aluminum, beryllium, chromium, cobalt, copper, iron, manganese, and lead) – a byproduct from the copper smelter at the neighboring Franklin Smelting and Refining Corp. MDC, the operator of the site from the 1950's to 1999, sold the slag as sand-blasting grit. The Franklin Slag site was added to the NPL in 2002 after a series of emergency cleanup efforts at the site resulting in shipping 12,000 tons of slag and soil, 246 tons of hazardous debris, and 20 tons of bagged slag off-site for disposal; cleaning and dismantling equipment, buildings and structures; transporting fuels and oils off-site for reuse. Post emergency cleanups, EPA covered the remaining site with thick plastic and fenced the entire property. The agency completed a Remedial Investigation and Feasibility Study for the site in June 2007, and proposed installing a permanent cap over the site. Post RI/FS, other remediation solutions are being explored and ETSC has been consulted to solicit proposals from private entities for potential slag cleanup methods. Dantig Inc. submitted a proposal to build a furnace on site that would remediate the slag efficiently while collecting all potential environmental contaminants for beneficial reuse. Reuse plans at the site will be contingent upon the remediation technique chosen. On a positive note, properties associated with the smelting operation are now being re-used for commercial purposes.

LCP Chemical (Region 4)



The 550 acre [LCP Chemical Superfund site] in Brunswick, GA consists mostly of tidal marsh. The site was added to the NPL in 1996. The remaining portion of the site includes former petroleum process buildings, former mercury cell buildings and an administration office. The site is located near a paper company, a county facility and an estuary. The site is bordered by the Turtle River marshes to the west and south, and urban populations of Brunswick to the north and east. Several residences are located south of the site. The site also includes a 10.5-acre highly alkaline caustic brine pool.

From the 1920s to 1994, facilities at the site included an oil refinery, a paint manufacturing company, a power plant and a chlor-alkali plant. The companies operating these facilities included Atlantic Refining Company, Georgia Power Company, Dixie Paints and Varnish Company (now the O'Brien Company), Allied Chemical Inc. (now Honeywell International, Inc.), and Hanlin Group subsidiary LCP Chemicals-Georgia, Inc. Site investigations identified contamination in groundwater, soil and sediments from the sites manufacturing legacy that could potentially harm people in the area. Contaminants of concern identified include polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons and heavy metals, including mercury, lead, chromium, beryllium, arsenic and vanadium. ETSC involvement at the site includes servicing an RPM request for design assistance and commentary on a Thin Layer Capping project within the estuary area on the site to encapsulate and reduce exposure for benthic micro- and macro-organisms. EPA has worked with the community and its state partner to develop a long-term cleanup plan for the site, reflecting the Agency’s commitment to safe, healthy communities and environmental protection. EPA has conducted a range of community involvement activities to solicit community input and to make sure the public remains informed about site activities throughout the cleanup process. Outreach efforts have

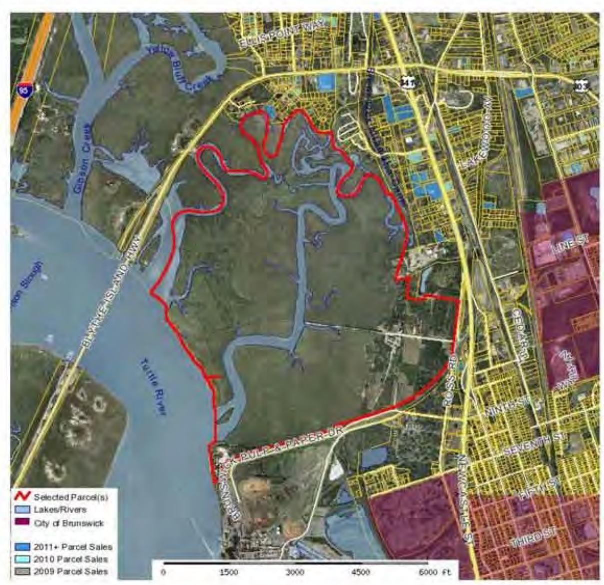


Figure 24: Location and Aerial photo of the LCP Chemical Superfund Site in Brunswick, GA

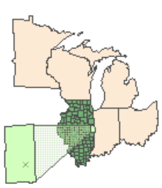
included public meetings and public notices regarding major cleanup activities. The Glynn Environmental Coalition is an active community group engaged at the site. EPA's site project manager provides quarterly site updates to the group and speaks at their monthly meetings.

Stauffer Chemical (Region 4)

The Stauffer Chemical Co. (Cold Creek Plant) Superfund site in Bucks, AL includes the area where Stauffer Chemical Company (Stauffer), an agricultural chemical manufacturing facility, operated beginning in 1966. EPA placed the site on the NPL in 1984 due to contaminated groundwater, sediment and soil resulting from manufacturing operations. Contaminants encountered at the site include carbon tetrachloride, carbon disulfide and mercury. This contamination, chiefly mercury, has been detected in the fish in the adjacent wetland. The site's potentially responsible party (PRP), EPA and the Alabama Department of Environmental Management (ADEM) have investigated site conditions and concluded that site contamination does not currently threaten people living and working near the area. ETSC involvement at the site includes research and design of a thin layer cap that will be placed in a brackish wetland on the site. The ultimate goal of the cap is to separate the contaminated sediment from benthic feeding organisms to cut off the bioaccumulation pathway. In addition, EPA has worked with the community and its state partner to develop a long-term cleanup plan for the site, reflecting the Agency's commitment to safe, healthy communities and environmental protection. In addition to cleanup activities, EPA is connected to the community near this site. Activities connecting the community and EPA include; regular public meetings to inform the concerned citizens of ongoing work on the site, community input on all site activities, and including public comment on proposed amendments to the original 1993 Record of Decision (ROD).

Figure 25: Location and aerial photo of the Stauffer Chemical Superfund Site including both the Cold Creek and Lemoyne Plants. The Tensaw River, a highly biodiverse river system, is pictured on the right.

Matthiessen and Hegeler Zinc Company (Region 5)

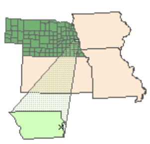


The 160-acre Matthiessen and Hegeler Zinc Company Superfund site is located in La Salle, IL along the Little Vermillion River. From 1858 until 1978, the site primarily housed a zinc smelting and rolling facility. Other site operations included ammonium sulfate fertilizer production, sulfuric acid production and coal mining. La Salle Rolling Mills continued operations on the site until the firm's bankruptcy in 2001. These industrial activities led to the site being listed on the NPL in 2005. Samples collected from the two large slag piles located along the Little Vermillion River revealed elevated concentrations of several metals including cadmium, copper, chromium, lead, nickel and zinc. Sediment samples collected within the river were also found to contain high levels of the same metals found in the slag piles, indicating that the river has likely been impacted by the site. Other samples collected on-site show low levels of a variety of contaminants that include pesticides, polychlorinated biphenyls (PCBs), and solvents and chemicals related to oil and coal. In September 1999, the Agency for Toxic Substances and Disease Registry (ATSDR) and the Illinois Department of Public Health issued a public health statement to the nearly 1,700 nearby residents stating that the site was a public health hazard due to the presence of cadmium and lead found in soil. At the request of the region, ETSC provided a review of the remediation investigation/feasibility study (RI/FS) for this site and provided comments to the Region.

Figure 26: Location and a representative zinc slag pile at the Matthiessen and Hegeler Zinc Company in La Salle, IL.

Sustainability in the Community

Omaha Lead (Region 7)



[Omaha Lead Site](#) in Omaha, NE is one of the largest urban Superfund sites in the United States. The site was added to the NPL in 2003. ASARCO operated a lead refinery from the 1870's until 1997 on the site. For 125 years, smokestacks from the refinery released lead containing particulates that eventually contaminated 27 square miles of downtown Omaha. The site was also near a lead battery recycling plant, another potential contributor to the soil contamination across the area. After the refinery was shutdown, soil from residential and business properties across east Omaha were sampled for lead, and routinely found to exceed 2,500 mg/kg. Clean up and removal actions on the site began in 1999 with child care facilities, and has continued with 2600+ properties being remediated to date. In recent years, EPA has committed approximately $25 million in Recovery Act funds to significantly increase the pace of ongoing long-term soil cleanup and lead-based paint stabilization activities. Small businesses with incentives to hire and purchase materials locally will conduct the work. While EPA continues to work at this site, the funding will help expedite implementation of the final cleanup approach for the site. This site is projected to be completed in five to ten years. In FY2013, ETSC was involved in two projects at the site. The first was creating a report from the Phase 1 assessment completed in late 2012 that was submitted to the region in 2013. The second project is a complex, socioeconomic investigation of the links between lead exposure and quality of human life. The results of this study are currently being analyzed, and EPA number documents and peer-reviewed journal articles will eventually be prepared. Public/community involvement in Superfund action is of central importance to the EPA, in the case of the Omaha Lead Superfund site, questions of environmental effects of lead exposure on humans were encountered often. In response to these community concerns, A Community Advisory Group (CAG) has been active at this site since its formation in January 2004. The CAG has worked with EPA to ensure the public and community have easy access to site information. Two examples of this access are: 1) site oversight personnel are present in the community, and 2) a local office and phone number were established for community engagement. Community awareness and EPA action has led to a steady decline in the number of children in the affected area identified with elevated blood-lead levels.

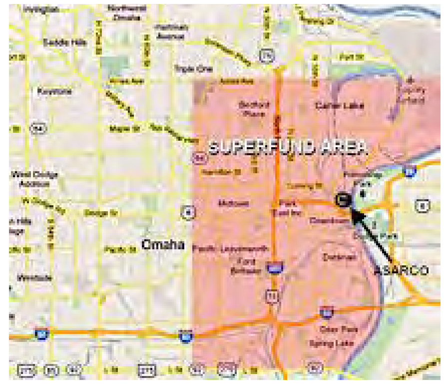


Figure 27: Omaha Lead Superfund Site, one of the largest Superfund sites in the United States.

San Jacinto River Waste Pits (Region 6)

Figure 28: Location of the San Jacinto River waste pits in Channelview, TX.

The San Jacinto River Waste Pits Superfund site is located in Harris County in Eastern Texas. The site consists of 2 impoundments located north and south of U.S. Interstate 10. These impoundments were constructed in the mid-1960's to house paper mill waste from the Champion Paper Mill, in Pasadena, TX. The mill used chlorine as a bleaching agent for paper production, and the process wastes were deposited in the impoundments seen in Fig. 29. This waste was contaminated with polychlorinated dibenzo-p-dioxins, polychlorinated furans (dioxins and furans), and some metals. Physical changes at the site in the 1970s and 1980s resulted in partial submergence of the impoundments north of I-10 and exposure of the contents to surface waters, creating health risks at the site. Furthermore, residential, commercial, industrial and other land use activities are occurring within the area surrounding the site.

To prevent surface water infiltration and human/benthic contact on the site, EPA installed temporary caps to stabilize the waste pits in 2010 until the remedial investigation and feasibility studies were carried out. In 2012, pore water sampling within the surface of the caps found the caps successfully contained the contaminated material. In July 2012 some erosion of the armor rock was seen on the west side of one of the caps. The underlying geotextile was intact, and there was no visible exposure of the waste material in the waste pits. Maintenance of the cap consisted of placing new armor rock material that is denser than the material originally specified for this area. The repair work was performed in August, 2012 (Fig. 30). ETSC provided support to the region in the form of comments/input on the Superfund cleanup plan for this site involving sustainable ex-situ treatment technologies to permanently stabilize the contents of

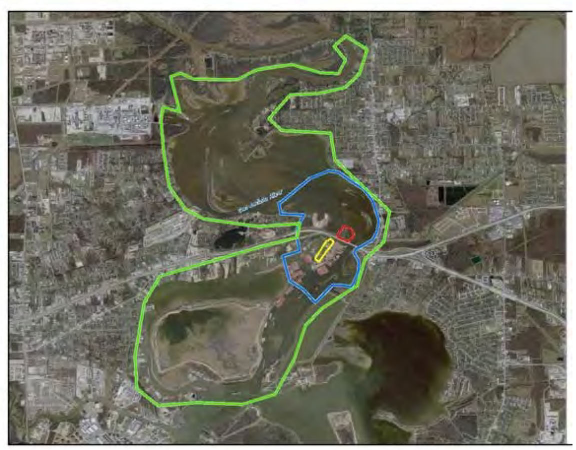


Figure 29: Aerial photo of the San Jacinto River waste pits. Operational Units 1 and 2 are separated by Interstate 10. The southern portion of the site is tidally influenced.

the waste pits. If ex-situ treatment technologies are successful at the site, EPA assistance can be reduced and the site could be removed from the National Priority List.

Figure 30: Repair activities to the armor cap at the San Jacinto Waste Pit Superfund Site in 2012.

Grants Chlorinated Solvents (Region 6)

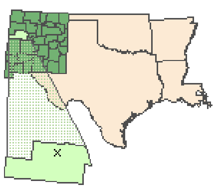


Figure 31: Location of the Grants Chlorinated Sovents Superfund site in Grants, NM.

[Grants Chlorinated Solvents Superfund site](#) is located in northwestern New Mexico along the I-40 corridor in the heart of Navajo Country. The site was once occupied by a dry cleaner and the shallow groundwater is contaminated with PCE. It was added to the NPL in 2004. The contamination is believed to be present in a shallow aquifer underlying residential and commercial facilities within the city of Grants causing vapor intrusion in buildings above the plume. The wells for the city are located 2 miles north of the site and have not been impacted by the plume. The city water wells provide drinking water to approximately 14,000 residents in Grants, San Rafael and Milan. The primary contaminant of concern, tetrachloroethene (PCE) has been found at levels up to 51,000 parts per billion (ppb) in the groundwater.

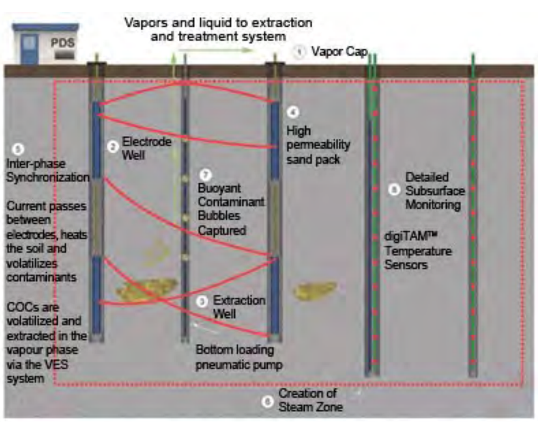


Figure 32: Schematic of the electrical resistance heating (ERH) thermal technology installed at the Grants Chlorinated Solvents Superfund Site. This system is responsible for remediation of 33,000 cubic yards of soil.

To remediate PCE, an electrical resistance heating (ERH) system integrated with multiphase extraction (MPE) was installed at the site in late 2011. This system has capacity to remove 94 and 100% of contaminant mass from soil and groundwater, respectively. This system has successfully remediated 33,000 cubic yards of soil. Other selected remedy includes mitigation for vapor intrusion and chemical dechlorination technologies to address shallow and deep groundwater contamination. The ETSC has partnered with OSWER to evaluate the performance and compare three models for characterizing behavior and movement of groundwater contamination.

This green footprint related analysis is scheduled to be published as an EPA numbered document in 2014.

Treasure Island (Region 9)

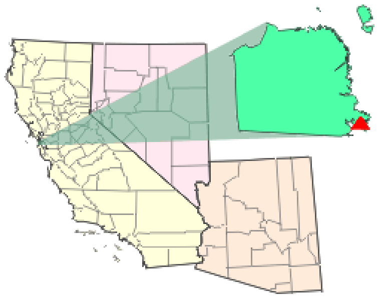


Figure 33: Location of the Treasure Island (Hunter's Point) Naval Yard Superfund Site in San Francisco, CA

Treasure Island Superfund site (Hunter's Point) was established as a private dock in 1869 and encompasses 936 acres (522 acres dry land and 414 acres submerged in San Francisco Bay) in the southeast corner of San Francisco, CA. Over time, the site was owned by both public and private entities, including the United States Navy, and generated massive amounts of wastes including paints, solvents, fuels, acids, bases, metals, PCBs and asbestos. Before regulation, these contaminants were sometimes dumped directly into the San Francisco Bay causing contamination of the surrounding marine benthos.
In 1989, EPA placed the Shipyard on the NPL. The cleanup program is conducted by the Navy pursuant to the Installation Restoration Program, a federally funded program established by the Department of Defense (DOD) to identify, investigate, and control the migration of hazardous substances at military and other DOD facilities. The major remediation efforts to date include the removal of 20,000 truckloads of chemically contaminated soils, 4,000 truckloads of radiologically contaminated soils, and 23 miles of sewer and storm drain pipelines removed. The site also contains VOC contaminated soil that is being remediated through a soil vapor extraction system. Currently, ETSC has partnered with the Navy in conducting thermal remediation and solidification pilot studies. The ETSC is involved to ensure that the method selected will be effective for the contaminants present, so the land can be safely used by the public after remediation is complete.

Figure 34: Aerial photo of the Treasure Island (Hunter's Point) Naval Yard Superfund Site in 2010.

Community involvement at the site is encouraged by both the EPA and Navy. Regular public meetings as well as a small grant program, implemented in 1995, are available to citizens with concerns or innovative ideas to help clean up the site.

Interagency Collaborations; Great Lakes National Program Office (GLNPO)

The Trenton Channel Sediments site is located on the Detroit River in Detroit, MI. This eight mile 'straight' flows past the suburban Detroit communities of Wyandotte, Riverview, Trenton, and Grosse Ile, MI. The area is part of the Detroit River Area of Concern, an area of about 700 square miles that is comprised of lands owned by both the United States and Canada. Moreover, the Trenton Channel also lies within the Detroit River International Wildlife Refuge, the first international refuge designated in North America.

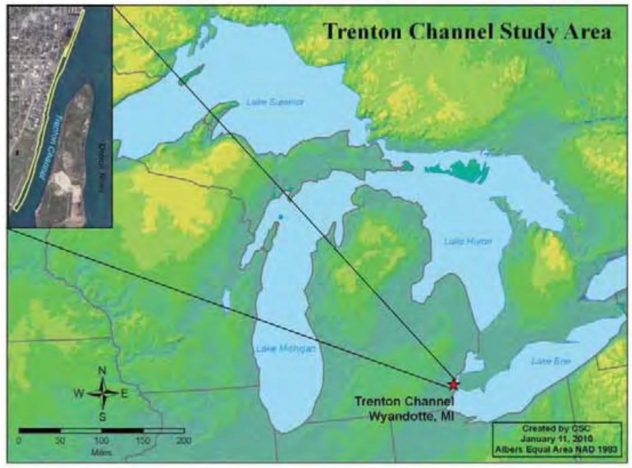


Figure 35: Map of the location of the Trenton Channel GLNPO site.

Trenton Channel falls under the jurisdiction of the EPA's [Great Lakes National Program Office (GLNPO)] an organization that coordinates U.S. efforts with Canada under the Great Lakes Water Quality Agreement (GLWQA) to restore and maintain the chemical, physical and biological integrity of the Great Lakes Basin Ecosystem, which includes Lakes Superior, Michigan, Huron, Erie, and Ontario. GLNPO is part of the Great Lakes Restoration Initiative, an effort by 11 federal agencies to develop an action plan centered on cleaning up toxic areas of concern, combating invasive species, reducing runoff to protect near shore habitat, and restoring wetlands.

Historical contamination of the Trenton Channel comes from a variety of sources including industry, municipal discharges, urban runoff, sewer overflows, and other non-point source pollutants. A remedial investigation, funded by the Great Lakes Legacy Act of 2002, was undertaken in 2006 by GLNPO and the Michigan Department of Environmental Quality. The final report was issued in 2010. Findings include PAH, PCB, and mercury concentrations in sediments were elevated above set benchmarks. Sediment contamination is the main concern for the Trenton Channel area due to toxicity issues affecting benthic micro/ macrofauna feeding within the sediment, along with documented bioaccumulation of contaminants into larger organisms feeding on these benthic fauna. Large remediation efforts at the site include a BASF Wyandotte Corporation funded dredging effort near the BASF Riverview site (located in the Trenton Channel). This effort resulted in removal of 30,000 cubic yards of contaminated sediments. This project is still in its early stages and many contaminants of concern have been identified to date. In 2013, ETSC conducted a literature review to assist GLNPO in the establishment of a toxicity screening level for chloronapthalenes in the Trenton Channel. The ETSC completed this project, but continues to consult with GLNPO, as requested.

Figure 36: "Mudpuppy," the sediment sampling vessel used at the Trenton Channel GLNPO site.

National and Global Impacts of the ETSC

In FY 2013, the ETSC received 189 unique technical support requests (see Figure 37). One-hundred fifteen of those requests fulfilled Superfund related issues (74% of total sites serviced), and 66% of those Superfund sites were listed on the National Priority List. The ETSC also serviced 24 RCRA, two Brownfields and three international sites, including two sites in Vietnam and one in Canada. In 2013, the ETSC also provided support to sites located in Alaska, Hawaii and Puerto Rico.

Figure 37: Map of ETSC FY2013 Technical Support Requests including sites in Vietnam, Canada, Alaska, Puerto Rico, and Hawaii.

Categorization of ETSC activities illustrates that U.S. EPA Regions 7, 9 and 10 account for more than half of the technical support requests to the Center, with Region 10 alone accounting for 25% of the total. Metals, PCBs and chlorinated solvents are the most common contaminants involved in technical support requests. In the past year, the most common remedial solutions applied at sites were groundwater pump and treat systems, landfilling, and fate and transport modeling. The most common types of media involved in technical support requests were soil, groundwater and sediments.

The pie charts in Figure 38 illustrate the breakdown of where ETSC work took place, the contaminants of concern, types of contaminated media, and remedial solutions applied at sites. Note that a single site could have multiple remedial solutions, contaminants, and contaminated media types.

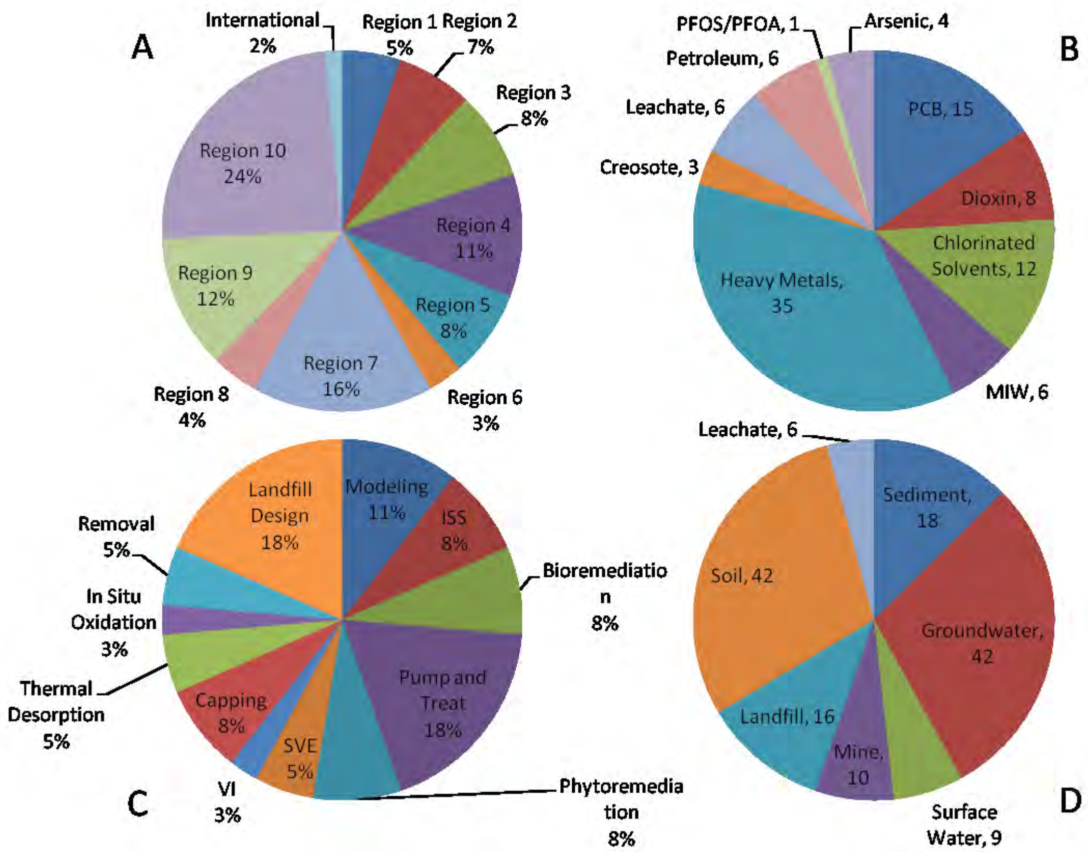


Figure 38: A. Regional breakdown of technical support requests (%), B. contaminants encountered (#), C. remedial solutions used at sites in % (multiple solutions could be used at one site), and D., type of media that is being remediated (#).

Summary

The projects and investigations presented here are a selected sample of those being undertaken by the ETSC. A number of these investigations have provided substantial results, and others are working toward that end. The selected investigations provide insight into the unique role that ETSC plays as a bridge between environmental remediation (as applied research) and innovative engineering research in ORD. Firm examples of the impact and contributions the ETSC provides to clients in EPA Offices and the Regions include:

1) Development, field evaluation, and demonstration of bioremediation technologies:
- Biochemical reactors for potential treatment option at metal-rich acid mine drainage sites
- Design and implement evapotranspiration covers for landfills and Superfund sites to assist in remediating VOCs and other compounds from soil.

2) Development, field evaluation, and demonstration of groundwater treatment technologies:
- Design, develop and evaluate permeable reactive barrier technologies to slow or stop groundwater contaminants from escaping sites.
- Provide state of the art spatiotemporal fate and transport groundwater modeling to evaluate existing systems or guide remedy selection.
- Provide groundwater pump and treat system design and optimization.

3) Evaluate sediment capping efficacy, environmental impacts, and long-term sustainability.

4) Conduct analyses or studies to determine beneficial reuse of waste.

5) Provide engineering plan design reviews to ensure efficacy of selected site treatment or remedy, and cost efficiency:
- Implement proven technologies when it is a viable solution, such as applications of in-situ solidification, thermal desorption and in-situ chemical oxidation.

6) Continue to provide timely and relevant technical support to contaminated sites:
- Research, evaluate or demonstrate new and innovative treatment technologies.
- Provide expert assistance in a broad range of topics including toxicity and health effects studies, and life-cycle analyses (e.g., determining 'green footprint' and evaluating other sustainable practices and remedies.)

Through its interdisciplinary background, the ETSC staff brings creative thinking to life by applying innovative engineering research in real-world scenarios. In addition to the promise they inspire, these innovations have the potential to produce long-lasting dividends and ultimately safer and healthier communities.

ETSC Contact Information:

John McKernan; Director, ORD Engineering Technical Support Center
U.S. Environmental Protection Agency
26 W. Martin Luther King Dr., Mail Stop 489A
Cincinnati, OH 45268
513.569.7415 (Office) | 513.569.7676 (Fax)
McKernan.John@epa.gov