# …echnology Innovation News Survey
## *Entries for June 16-30, 2021*

### Market/Commercialization Information

**TOOELE ARMY DEPOT, UTAH - ENVIRONMENTAL REMEDIATION SERVICES**
U.S. Army Corps of Engineers (USACE), Sacramento District, Sacramento, CA.
Contract Opportunities at SAM.gov, Solicitation W9123821R0064, 2021

Competition for this contract is limited to GSA schedule contractors under small business category only under NAICS code 562910. This is a non-personal services firm-fixed-price contract to provide environmental remediation services for five sites and to clean up to 11 ammunition storage igloos of contaminant residues resulting from repackaging of explosives and riot control agents, with an option for eight areas of concern at Tooele Army Depot, Utah. Offers are due by 10:00 AM PT on August 15, 2021, by electronic means only via DOD SAFE. Award of this contract is subject to availability of funds.
https://beta.sam.gov/opp/699b15031caa418aa6384fd694a84013/view

**CCAO PUTAH CREEK UNDERGROUND STORAGE TANK REMEDIATION**
Bureau of Reclamation, Sacramento, CA.
Contract Opportunities at SAM.gov, Solicitation 140R2021Q0086, 2021

This requirement is solicited as a small business set-aside for which the Bureau of Reclamation intends to award a firm-fixed-price purchase order under NAICS code562910. Contractor shall implement the Corrective Action Plan approved by the Central Valley Regional Water Quality Control Board to remediate contaminated soil and groundwater at the Former Putah Creek Resort located at 7600 Knoxville Road in Napa County, California. This project has a base period of two years with three one-year options. Register by 4:00 PM PT, July 26, 2021, for the site visit/job walk scheduled for 10:00 AM PT on July 28, 2021. Offers are due by 5:00 PM PT on August 16, 2021. https://beta.sam.gov
/opp/db82e3c889394bf5b78b0f43884c151f/view

**REMEDIAL INVESTIGATIONS FOR PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) IMPACTED AREAS AT ARMY INSTALLATIONS IN THE NORTHEAST REGION**
U.S. Army Corps of Engineers (USACE), Baltimore District, Baltimore, MD
Contract Opportunities at SAM.gov, Solicitation W912DR21R0020, 2021

This acquisition is a full and open requirement under NAICS code 562910 to conduct remedial investigations of PFAS contamination with options to conduct feasibility studies at 11 U.S. Army installations located in the Northeast region: Fort AP Hill, VA, Fort Belvoir, VA, Fort Detrick, MD, Fort Drum, NY, Fort Lee, VA, Fort Meade, MD, Letterkenny Army Depot, PA, Picatinny Arsenal, NJ, Radford Army Ammunition Plant, VA, Tobyhanna Army Depot, PA, and Watervliet Arsenal, NY. Associated with the RI and FS tasks, optional time-critical removal actions and non-time-critical removal actions will be exercised as needed. The activities conducted under this requirement shall be performed in compliance with CERCLA, the NCP, and U.S. Army requirements and guidance for field investigations, including specific requirements for sampling for PFASs. This work will be awarded as a firm-fixed-price performance-based contract. Period of performance shall not exceed a 5-year base period with two optional one-year periods from date of award. Offers are due by 11:00 AM ET on August 16, 2021. https://beta.sam.gov/opp/e5d93763edcc4970bb36d4c1a3455e27/view

**ENVIRONMENTAL REMEDIATION SERVICES, STRATFORD ARMY ENGINE PLANT, STRATFORD, CT**
U.S. Army Corps of Engineers (USACE), New England District, Concord, MA.
Contract Opportunities at SAM.gov, Solicitation W912WJ21B0017, 2021

The U.S. Army Corps of Engineers, New England District is issuing a small business set-aside invitation for bid under NAICS code 562910 for dredging and disposal of material at the Stratford Army Engine Plant, located in Stratford, Connecticut. Period of performance is 375 calendar days. This project consists of mechanical dredging of an outfall drainage channel (OF-008) on the Stratford Army Engine Plant property to remediate about 13,000 cubic yards of metals- and PCBs-affected sediments. The successful offeror will provide the equipment and materials required for sediment dredging and processing. Offers are due by 1:00 PM ET on August 18, 2021. https://beta.sam.gov/opp/5a27f2ffa4064f16934487d43dac498f/view

**USAID/VIETNAM TREATMENT FOR DIOXIN REMEDIATION AT THE BIEN HOA AIRBASE AREA - PHASE I (TREATMENT I)**
Agency for International Development, USAID/Vietnam.
Contract Opportunities at SAM.gov, Solicitation 72044021R00002, 2021

The U.S. Agency for International Development Mission in Vietnam is seeking proposals from qualified organizations

interested in providing the services to remediate dioxins at Bien Hoa Airbase Area project under NAICS code 562910. Objectives are (1) Design and build a treatment facility using thermal conductive heating technology; (2) Operate the treatment facility to reduce dioxin in 111,170 m3 (in original excavated bank volume) of stockpiled Airbase area soil, and sediment with high dioxin concentrations equal to or greater than the treatment action level of 1,200 ppt toxic equivalency (TEQ) to a concentration below the project treatment threshold of 100 ppt TEQ; and (3) Ensure that treated soil and sediment can be used by USAID as a beneficial fill on the Airbase in formerly contaminated areas by not significantly altering any existing amounts of inorganic arsenic. USAID/Vietnam anticipates awarding one firm-fixed-price contract for a duration of ~5 years at an order of magnitude between $50M-$80M. Offerors must be eligible in accordance with authorized geographic code 937 for this procurement. A recorded site walk and pre-proposal conference will be scheduled among prospective offerors (tentatively the week of July 19) and will be held virtually from Vietnam. Proposals are due by 1600 Hanoi time on August 19, 2021. https://beta.sam.gov/opp/a0cf3bb5a97b41c0801b8c5171019765/view

Top of Page

## Cleanup News

**PERFLUOROALKYL SUBSTANCES AND PHARMACEUTICALS REMOVAL IN FULL-SCALE DRINKING WATER TREATMENT PLANTS**
Kim, K.Y., O. Dominic, E. Heon-Jun, and L.J.-E. Oh.
Journal of Hazardous Materials Volume 400:123235

The removal of 10 PFAS and 20 pharmaceuticals detected in raw water and drinking water was assessed at five drinking water treatment plants. The mean perfluorohexane sulfonate concentrations in raw and drinking water were the highest of the PFAS, with levels of 106 and 69.6 ng/L, respectively. The ∑14PFAS and individual PFAS removal efficiencies ranged from -36.9% to 70.7% (mean 31.3%). Granular activated carbon process was responsible for >80% of the total long-chain PFAS removal, with removal efficiency increasing as the perfluorocarbon chain length increased. Most of the pharmaceuticals detected in the raw water samples were removed completely during treatment, with oxidation contributing to >90% of the overall removal efficiency, except for metformin. Only caffeine, carbamazepine, crotamiton, fenbendazole, metformin, and sulfamethoxazole were detected in the drinking water samples.

**LONG-TERM MASS FLUX ASSESSMENT OF A DNAPL SOURCE AREA TREATED USING BIOREMEDIATION**
Haluska, A.A., C.E. Schaefer, J. Cho, G.M. Lavorgna, and M.D. Annable.
Journal of Contaminant Hydrology 227:103516(2019)

Long-term effectiveness of bioremediation of a chlorinated, ethene DNAPL source area, consisting of a higher- and a lower-permeability zone, was evaluated. The evaluation used passive flux meters, push-pull tracer tests, and soil cores and was conducted 3.7 years after active source area bioremediation. The molar discharge of total chlorinated ethene from the source area remained relatively unchanged pre-and post-bioremediation, but the composition shifted from TCE and cis-DCE to vinyl chloride and ethene. The first-order rate constant describing the complete dechlorination of TCE at 3.7 years was approximately 1.05/yr, which was >3 times lower than the 3.6/yr rate determined using compound stable isotope analysis. Soil cores and push-pull tracer test data showed that the estimated DNAPL volume was relatively unchanged pre- and post-bioremediation due to remaining DNAPL in the lower-permeability zone, suggesting that DNAPL in the lower-permeability zone continues to serve as a significant source of groundwater contamination. The results suggest that it will take many years under current conditions to attain the Maximum Contaminant Levels cleanup objectives.

**EVALUATION AND REMEDIATION OF A LARGE COMINGLED DILUTE VOC PLUME IN WESTERN, OHIO - A CASE STUDY**
Cox, C. | American Institute of Professional Geologists Michigan Section Workshop, 15-17 June, virtual, 49 minutes, 2021

This case study examines how potential sources of a comingled CVOC plume found at a public well were identified and the potential responsibility evaluated. It addresses plume delineation and remedial actions taken to address sources. A GAC Treatment system was added to the public water system, and affected domestic well owners were provided permanent connections to public water. The approach to monitoring the return of groundwater quality to drinking water standards throughout the plume length is detailed. Due to the very high hydraulic conductivity of the aquifer and groundwater flow velocities, in-plume groundwater treatment options including permeable reactive barriers, containment (pump and treat), recirculating wells, and the like were determined to be infeasible. https://www.youtube.com/watch?v=_peEauWuIJ0

**MATCHING REMEDIATION EFFICIENCY TO SITE GOALS FOR IN-SITU BIOREMEDIATION**
Doliana, I. | American Institute of Professional Geologists Michigan Section Workshop, 15-17 June, virtual, 39 minutes, 2021

This presentation reviews several sites involving various technologies for ISB treatment of chlorinated ethenes. It examines what their combined usage equates to in terms of ability and time to meet closure objectives and the relative costs of implementing these approaches. https://www.youtube.com/watch?v=5h9x8u57I5Y

**DISSOLVED HYDROGEN DYNAMICS ASSOCIATED WITH EMULSIFIED VEGETABLE OIL BIOREMEDIATION OF**

**CHLOROETHENES**
Chapelle, F.H. | Groundwater Monitoring & Remediation [Published online 13 April prior to print]

This study shows how $H_2$ concentrations changed four years following addition of EVO to a sandy coastal plain aquifer underlying Naval Air Station Pensacola. Prior to EVO addition, $H_2$ concentrations at the site were in the range characteristic of Fe(III)-reducing conditions (0.2-0.6 nM). Following EVO addition, $H_2$ concentrations increased exponentially, peaking at approximately 25,000 nM. Concentrations then decreased exponentially and stabilized at 4.0 nM 4 years after EVO addition. That pattern suggests symbiotic cross-feeding between fermentative and respirative microbial populations resulting in a Gaussian rise and fall of $H_2$ concentrations. That further suggests that the increase in H2 concentrations following EVO biostimulation are unlikely to be sustained indefinitely.

Top of Page

## Demonstrations / Feasibility Studies

**REMOVAL OF COMPLEX MIXTURES OF PERFLUOROALKYL ACIDS FROM WATER USING MOLECULARLY ENGINEERED COATINGS ON SAND AND SILICA**
Edmiston, P.L., E. Houtz, and J. McDonough, SERDP Project ER18-1300, 79 pp, 2020

The adsorption of PFAS from water was studied using rationally designed organosilica adsorbents. The goals were to understand adsorption mechanisms better and design optimal adsorbents to minimize remediation costs. Swellable organically modified silica (SOMS) was used as a platform as it can be modified using different silane monomers and entrapped cationic polymers. Adsorbents were studied using a series of bench-scale isotherm and column experiments. Measurements were compared to activated carbon and ion exchange resins currently used in water treatment. The best performing SOMS adsorbent was evaluated in a pilot test installed on a stream at the Former Joint Reserve Base Naval Air Station Willow Grove. Data suggests that PFAS self-assemble into aggregates which enhances the adsorption of long-chain PFAS. https://www.serdp-estcp.org/content/download/53218/523556/file/ER18-1300%20Final%20Report.pdf

**APPLICATION OF CROSS-HOLE ELECTRICAL RESISTIVITY TOMOGRAPHY TO GROUNDWATER CONTAMINATED REMEDIATION SITE**
Wang, T.-P., Y.-T. Chen, C.-C. Chen, T.-H. Tung, S.-N. Cheng, and C.-Y. Yu.
Terrestrial, Atmospheric and Oceanic Sciences Journal 31(5):507-521(2020)

Two groundwater contamination sites were investigated using a time-lapse methodology applied to cross-hole electrical resistivity tomography (CHERT). At site 1, resistivity profiles were used to delineate the contaminant's transport direction and spatial distribution. Information provided a basis for adjusting the remediation treatment. At site 2, changes in electrical conductivity were used to evaluate the remediation reagent's transport direction and area of effect. This information was used to verify the effectiveness of the remediation efforts indirectly. CHERT equipment was installed simultaneously at the monitoring wells, which enhanced the economic benefits of the boreholes. At large-scale groundwater contamination sites or sites with complex hydrogeological environments, applying CHERT techniques can result in greater amounts of data, particularly in analyzing localized preferential flow paths. http://tao.cgu.org.tw/index.php/articles/archive/geophysics/item/1677

**FIELD EVALUATION OF 1.75 GROUNDWATER PROFILER AND FIELD SCREENING DEVICE FOR ON-SITE CONTAMINATION PROFILING OF CHROMIUM(VI) IN GROUNDWATER**
Dutta, S., T.M. Christy, W. McCall, and P. Kurup. | Environmental Earth Sciences 80:241(2021)

A direct push 1.75-inch groundwater profiler (GWP) and portable field screening device were developed to facilitate rapid, cost-effective, on-site detection of heavy metals in groundwater, surface water, and sediment pore water. The GWP obtains groundwater samples from multiple depths in a single push, and the portable field screening device uses novel disposable sensors. Extensive fieldwork was performed at a Cr(VI)-contaminated site to evaluate and validate these two technologies for Cr(VI) contamination profiling in groundwater. A preliminary investigation was performed with an Optical Imaging Profiler Hydraulic profiling tool to determine formation lithology and relative permeability to identify potential groundwater sampling intervals and contaminant migration pathways in the subsurface. Groundwater samples from selected depth intervals were collected and analyzed by lab analysis for total chromium and hexavalent chromium using EPA standards 6020 (SW) and 7196. Comparing the field results with lab results confirmed the potential of these technologies to obtain high-resolution site characterization data to improve the management of heavy metal contamination at hazardous sites.

**LONG-TERM ARSENIC SEQUESTRATION IN BIOGENIC PYRITE FROM CONTAMINATED GROUNDWATER: INSIGHTS FROM FIELD AND LABORATORY STUDIES**
Fischer, A., J. Saunders, S. Speetjens, J. Marks, J. Redwine, S.R. Rogers, A.S. Ojeda, Md M. Rahman, Z.M. Billor, and M.-K. Lee. | Minerals 11:537(2021)

A study was conducted to demonstrate the effectiveness of sulfate-reducing bacteria (SRB) to remediate arsenic using a ferrous sulfate and molasses mixture at an industrial site in Florida over nine months. The optimal dosage of the remediating mixture consisted of 5 kg of ferrous sulfate, ~27 kg of molasses, and ~1 kg of fertilizer per 3785.4 L of water. The mixture was injected into 11 wells hydrologically upgradient of the arsenic plume to attempt full-scale remediation. Analyses determined that As was sequestered, primarily in the form of arsenian pyrite, which rapidly precipitated as euhedral crystals and spherical aggregates 1-30 µm in diameter within two weeks of the injection. Analyses confirmed that the mixture and injection scheme reduced As concentrations to near or below the site's clean-up standard of 0.05 mg/L in nine months. In addition, the arsenian pyrite contained 0.03-0.89 weight percentage (wt%) of sequestered arsenic, with >80% of groundwater arsenic removed by SRB biomineralization. https://www.mdpi.com/2075-163X/11/5/537/pdf

**NO-PURGE GROUNDWATER SAMPLING FOR PFAS**
Armstrong, M., M.J. Seitz, F. Beetle-Moorcroft, and D.S. Lipson.
Groundwater 58(6):872-876(2020)

A no-purge groundwater sampling method using disposable bailers to measure PFAS was demonstrated to be equivalent to standard low-flow groundwater sampling, to a 95% degree of confidence.

Top of Page

## Research

**UNRAVELLING MICROBIAL COMMUNITIES ASSOCIATED WITH DIFFERENT LIGHT NON-AQUEOUS PHASE LIQUID TYPES UNDERGOING NATURAL SOURCE ZONE DEPLETION PROCESSES AT A LEGACY PETROLEUM SITE**
Bruckberger, M.C., D.B. Gleeson, T.P. Bastow, M.J. Morgan, T. Walsh, J.L. Rayner, G.B. Davis, and G.J. Puzon. l Water 13:898(2021)

Microorganisms fundamentally associated with LNAPL were investigated throughout a soil depth profile above and below the water table at a legacy petroleum site undergoing NSZD processes. Microbial community composition was compared to contaminant type, concentration, and its depth of soil cores. A large population of Archaea, particularly *Methanomicrobia* and *Methanobacteria*, and indication of complex syntrophic relationships of methanogens, methanotrophs, and bacteria were found in the contaminated cores. Results indicate methanogenic or anoxic conditions in the deeper and highly contaminated sections of the soil cores. LNAPL was highly weathered, likely resulting in the formation of recalcitrant polar compounds. https://www.mdpi.com/2073-4441/13/7/898

**BIODEGRADATION OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFASS) VIA SUPEROXIDE-HYPER-PRODUCING BACTERIA**
Alvarez, P.J.J., J. Metz, H. Javed, and J. Mathieu. SERDP Project ER20-1430, 41 pp, 2021

The objective of this limited-scope proposal was to evaluate a novel method to remediate PFAS based on bacterial strains that can produce superoxide at high rates to assess their capacity to degrade model PFASs. Specifically, this project explored the potential of superoxide (including that generated by bacterial hyper-producers of extracellular superoxide) to degrade PFAS. https://www.serdp-estcp.org/content/download/53735/527962/file/ER20-1430%20Final%20Report.pdf

**HIGH-RESOLUTION EXPOSURE ASSESSMENT FOR VOLATILE ORGANIC COMPOUNDS IN TWO CALIFORNIA RESIDENCES**
Lunderberg, D.M., P.K. Misztal, Y. Liu, C. Arata, Y. Tian, K. Kristensen, R.J. Weber, W.W. Nazaroff, and A.H. Goldstein.
Environmental Science & Technology 55(10):6740-6751(2021)

Time-resolved exposures using a fast-response online mass spectrometer were reported from multi-season sampling of more than 200 VOCs in two California residences. Chemical-specific source apportionment revealed that time-averaged exposures for most VOCs were primarily attributable to continuous indoor emissions from buildings and their static contents. Occupant-related activities, such as cooking and outdoor-to-indoor transport, also contributed to exposures. Acrolein, acetaldehyde, and acrylic acid concentrations were above chronic advisory health guidelines, while exposures for other assessable species were typically well below the guideline levels. Results indicate that VOC emissions from older buildings and their contents can substantially contribute to occupant exposures.

**NUMERICAL EVALUATION OF THE PERFORMANCE OF INJECTION/EXTRACTION WELL PAIR OPERATION STRATEGIES WITH TEMPORALLY VARIABLE INJECTION/PUMPING RATES**
Suk, H., J.-S. Chen, E. Park, W.S. Han, and Y.H. Kihm.
Journal of Hydrology 598:126494(2021)

The remedial and economic efficiency of a recirculation well system using sinusoidal temporally varying pumping and injection rates to enhance in situ remediation were numerically evaluated. Results were compared to a traditional recirculation well system that used constant injection/extraction rates. Sensitivity analyses were performed to determine the optimal values of four operational parameters associated with the effects of variable pumping or injection rates on the injected chemical amendment area for a given operation time or cumulative injected volume. Findings provided insight into the mechanical process of plume spreading in response to injection/pumping operational strategies and demonstrate that enhanced plume spreading is a key requirement for achieving sufficient contact between chemical amendments and contaminants.

**DEVELOPMENT AND APPLICATION OF PASSIVE SAMPLERS FOR ASSESSING AIR AND FREELY DISSOLVED CONCENTRATIONS OF HYDROPHOBIC ORGANIC CONTAMINANTS**
Odetayo, A.A. Ph.D. thesis, Texas Tech University, 224 pp, 2020

Polyoxymethylene (POM) and polydimethylsiloxane (PDMS) passive sampling techniques were used to assess air concentrations of PCBs at a confined disposal facility (CDF). Uptake kinetics, average equilibrium time, and estimates of the POM-air partition coefficients (KPOM-A) of 16 PCB congeners were assessed in the lab using POM air samplers. Field sampling at 10 stations surrounding the CDF was conducted three times over two years. The POM air samplers provided a long-term average air concentration without needing to collect, analyze and average multiple air high volume air samples. Standardized procedures were also developed to measure freely dissolved concentrations of hydrophobic organic contaminants in sediment porewater using PDMS through phased inter-lab efforts. Results indicated that the objectives of the research study were achieved based on desired accuracies of ±30% and ±50% for target and performance reference compounds (PRCs), respectively, and precisions of ≤ 20% for both targets and PRCs. https://ttu-ir.tdl.org/bitstream/handle/2346/86634/ARIBIDARA-DISSERTATION-2020.pdf?sequence=1&isAllowed=y

**POTENTIAL ENHANCEMENT OF THE IN-SITU BIOREMEDIATION OF CONTAMINATED SITES THROUGH THE ISOLATION AND SCREENING OF BACTERIAL STRAINS IN NATURAL HYDROCARBON SPRINGS**
Rizzo, P., M. Malerba, A. Bucci, A.M. Sanangelantoni, S. Remelli, and F. Celico.
Water 12:2090(2020)

A multidisciplinary approach that included microbiological, geological, and hydrological investigations was used to analyze the microbial communities at a site in southern Italy characterized by hydrocarbons of natural origin. Bacterial communities of two springs, the surrounding soils, and groundwater were studied using a combination of molecular and culture-dependent methodologies to explore biodiversity, isolate microorganisms with degradative abilities, and assess their potential to develop effective strategies to restore the environmental quality. *Proteobacteria* phylum species were dominant, but soil also included autochthonous hydrocarbon-oxidizing microorganisms affiliated with other phyla. The traditional cultivation-based approach led to isolating and identifying 11 aerobic hydrocarbon-oxidizing proteobacteria. Seven isolated bacterial strains produced emulsion with diesel fuel (most of them showing emulsifying capacity values >50%) with a high stability after 24 h and, in some cases, after 48 h. Results pave the way for further investigations to exploit the degradation ability of the bacterial isolates and/or microbial consortia to remediate hydrocarbon-contaminated sites and the capability to produce molecules with a promoting effect for oil-polluted matrices restoration. https://www.mdpi.com/2073-4441/12/8/2090/pdf

**NOVEL SLOW RELEASE AMMONIUM PERSULFATE CAPSULES FOR IN SITU REMEDIATION OF HIGH ARSENIC GROUNDWATER**
Xu, R., X. Xie, B. Ren, and D.D. Dionysiou.
Journal of Hydrology 600:126571(2021)

This study reports on using extended-release microcapsules to control the redox environment, remediate As-contaminated groundwater in situ, and prevent reductive dissolution of hydrous ferric oxide or hydroxide. Microcapsules capable of slowly releasing the ammonium persulfate (APS) oxidant were successfully prepared. The core-shell structure of the microcapsules that enclosed APS with poly(methyl methacrylate) was confirmed with X-ray diffraction and X-ray photoelectron spectroscopic analyses. The uniform morphology of the 1-μm microcapsules was revealed by scanning electron microscopy. Zero-order release kinetics could qualitatively explain the experimental curve and predict the release mechanism.

**POTENTIAL OF ARSENATE-REDUCING BACTERIAL INOCULANTS TO ENHANCE FIELD-SCALE REMEDIATION OF ARSENIC CONTAMINATED SOILS BY *PTERIS VITTATA* L**
Zhu, G., W. Liu, Y. Wen, X. Liao, and L. Sun.
Ecological Engineering 169:106312(2021)

Field experiments were conducted to study the effects of arsenate-reducing bacterial inoculants C13, F2, F2-As, and compound microbial inoculant to remediate As-contaminated soil using *Pteris vittate* L. Applying F2, F2-As, and the compound microbial inoculant significantly promoted plant growth, increased the As accumulation of *P. vittata*, and improved the efficiency of soil As removal. Results showed that arsenate-reducing bacterial inoculants can improve the remediation

efficiency of *P. vittata* and can be promising for As remediation.

Top of Page

## General News

**EXTENDING THE KNOWLEDGE ABOUT PFAS BIOACCUMULATION FACTORS FOR AGRICULTURAL PLANTS - A REVIEW**
Lesmeister, L., F.T. Lange, J. Breuer, A. Biegel-Engler, E. Giese, and M. Scheurer.
Science of The Total Environment 766:142640(2020)

In this review, >4,500 soil-to-plant BAFs are compiled for 45 PFASs from 24 studies involving 27 genera of agricultural crops. Grasses (*Poaceae*) provided most BAFs with the highest number of values for PFOA and PFOS. Factors influencing PFAS transfer, including compound-specific properties (hydrophobicity, chain length, functional group, etc.), plant species, compartments, and other boundary conditions, are discussed. Throughout the literature, BAFs were higher for vegetative plant compartments than for reproductive and storage organs. Decreasing BAFs per additional perfluorinated carbon were clearly apparent for aboveground parts (up to 1.16 in grains) but not always for roots (partly down to zero). Combining all BAFs per single perfluoroalkyl carboxylic acid (C4-C14) and sulfonic acid (C4-C10), median log BAFs decreased by -0.25(±0.029) and -0.24(±0.013) perfluorinated carbon, respectively. For the first time, the plant uptake of ultra-short-chain (≤ C3) PFAAs was reviewed and showed a ubiquitous occurrence of trifluoroacetic acid in plants independent from the presence of other PFAAs.

**NEW APPLICATION OF GEOTECHNICAL TECHNOLOGY TO REMEDIATE LOW-PERMEABILITY CONTAMINATED**
Richardson, S.D., D.M. Hart, M.L. Schofield, J.A. Long, P.R. Kulkarni, and C.J. Newell. ESTCP Project ER-201627, 362 pp, 2020

This project demonstrated and validated the effectiveness of the Grout Bomber geotechnical technology for the rapid installation of zero-valent iron amendment-filled reaction columns within a high concentration trichloroethene source zone in low permeability (low-k) geologic material. https://www.serdp-estcp.org/content/download/53481/525676/file/ER-201627%20Final%20Report.pdf

**TOOLS FOR UNDERSTANDING TRANSIENTS IN VAPOR INTRUSION**
Suuberg, E.M., ESTCP Project ER-201502, 117 pp, 2020

This study was conducted due to recent reports from vapor intrusion (VI)- impacted sites that measured indoor concentrations of chemicals of concern could vary by orders of magnitude. The sites included Hill Air Force Base and Naval Air Station North Island, impacted by operations, and an EPA research site in Indianapolis, IN, impacted by nearby former commercial establishments. The objective of this study was to apply numerical modeling to develop an improved understanding of the VI processes. The goal was to demonstrate that modeling tools offer insights that are difficult to develop without formal analysis and to establish the value of mathematical modeling as a "line of evidence" in analyzing VI scenarios. An additional objective was to demonstrate that the tools needed for numerical analysis have reached a level of development requiring no expertise in numerical analysis to use the tools effectively. https://www.serdp-estcp.org/content/download/53658/527425/file/ER-201502%20Final%20Report.pdf

**BIOREMEDIATION OF TOTAL PETROLEUM HYDROCARBONS (TPH) BY BIOAUGMENTATION AND BIOSTIMULATION IN WATER WITH FLOATING OIL SPILL CONTAINMENT BOOMS AS BIOREACTOR BASIN**
Sayed, K., L. Baloo, and N.K. Sharma.
International Journal of Environmental Research and Public Health 18:2226(2021)

This review introduces various studies related to the bioremediation (bioaugmentation, biostimulation, or both) of crude oil, total petroleum hydrocarbons (TPH), and related petroleum product. The bioremediation studies discussed can treat emulsified residual spilled oil in seawater with floating oil spill containment booms in an enclosed basin, such as a bioreactor, to help environmental researchers clean up oil spills in seawater. https://www.mdpi.com/1660-4601/18/5/2226/pdf

**NEW-GENERATION WASHING AGENTS IN REMEDIATION OF METAL-POLLUTED SOILS AND METHODS FOR WASHING EFFLUENT TREATMENT: A REVIEW**
Gusiatin, Z.M., D. Kulikowska, and B. Klik.
International Journal of Environmental Research and Public Health 17:6220(2020)

Information on soil contaminated with heavy metals is reviewed in this paper. Principles of soil washing and soil flushing are examined as well as their current status. Sources and characteristics of novel washing agents and chemical substitutes for

EDTA and their potential to remove heavy metals are presented. Methods for treating spent washing solutions are also discussed. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7503436/pdf/ijerph-17-06220.pdf

**SUMMARY OF ILLINOIS REGULATIONS AND REVIEW OF TREATMENT ALTERNATIVES FOR CONTAMINATED SOILS IN RIGHT-OF-WAYS**
Hohner, A., A. Pelletier, I.D. Akin, I. Chowdhury, R. Watts, X. Shi, B. Dutmer, and J. Mueller, Illinois Center for Transportation Research Report No. FHWA-ICT-20-010, 72 pp, 2020

This review investigates various onsite and in situ treatment alternatives for remediating soil contaminated with high-molecular-weight PAHs and/or metals. Current environmental laws, regulations, and remediation best management practices pertaining to contaminated soils from construction rights-of-way are reviewed. The goal was to provide the Illinois DOT with information to reexamine the current practice of hauling contaminated soil offsite for disposal where contemporary technologies can reduce cost, time, and nuisance. Conventional and emerging technologies that could be adapted for treating soil for reuse as fill material at construction sites, in compliance with state and federal regulations. Findings were used to develop an experimental program and recommend effective onsite treatment options to minimize non-special, special, and hazardous waste generation. https://www.ideals.illinois.edu/bitstream/handle/2142/108385/FHWA-ICT-20-010.pdf?sequence=2&isAllowed=y

Top of Page