

## Technology Innovation News Survey

### Entries for June 1-30, 2017

#### Market/Commercialization Information

##### SPECIAL EVENT: BUSINESS OPPORTUNITIES OPEN HOUSE

Department of the Army, U.S. Army Corps of Engineers, USACE District, Pittsburgh.  
Federal Business Opportunities, FBO-5714, Solicitation W911WN17S00002, 2017

The U.S. Army Corps of Engineers Pittsburgh District announces its first annual Business Opportunities Open House and invites interested companies to meet District leadership, program managers, project engineers, and other district personnel about upcoming projects, solicitations, and other business opportunities. The event is scheduled for September 12, 2017, 1:00 - 4:00 PM at the Engineer's Club of Southwestern Pennsylvania, 337 Fourth Ave., Pittsburgh, PA 15222. All companies are welcome to attend. The event is free, although pre-registration is required and will begin on or about August 11, 2017, via Eventbrite. Small disadvantaged, woman-owned, HUBzone, and service-disabled veteran-owned small business concerns doing work in marine, heavy, and civil construction and engineering; remediation and environmental services; and dredging are encouraged to attend. Attendees should bring a one-page capabilities statement with them for scanning, archival, and distribution purposes. <https://www.fbo.gov/sqo/USA/CF/D8/AC59/W911WN17S00002/listing.html>

##### ALTUS AFB WELL ABANDONMENT

Department of the Air Force, AFICA - CONUS, Altus AFB, OK.  
Federal Business Opportunities, FBO-5714, Solicitation FA8903-17-R-0069, 2017

The 772 ESS/PKS intends to award a single firm-fixed-price contract to perform base-wide well decommissioning actions at Altus AFB, OK, under NAICS code 562910 (size standard 750 employees). This requirement is a 100% small business set-aside. The Contractor shall complete abandonment of 60 groundwater monitoring wells in accordance with the Oklahoma Water Resources Board. Forty wells installed to an average depth of 25 ft bgs shall be removed by overdrilling so that all tubing, screens, casings, aggregate, backfill, and sealant are completely removed. Twenty wells installed to an average depth of 45 feet bgs shall be abandoned in place by completely filling with an appropriate sealant in accordance with state, local, and Altus AFB requirements. Funds are not presently available for this effort. No award will be made under this solicitation until funds are available. The period of performance will be 12 months. Submit proposals no later than 2:00 PM CT on August 15, 2017. <https://www.fbo.gov/notices/5b079a3d4102a6e21c7cc2b8ad65216e>

##### GREAT LAKES ARCHITECT ENGINEER SERVICES (GLAES) II

Environmental Protection Agency, Office of Acquisition Management, Region V, Chicago, IL.  
Federal Business Opportunities, FBO-5719, Solicitation SOL-RS-17-00006, 2017

U.S. EPA Region 5 plans to seek support for the A-E Services for Remedial Design class of contracts for the Great Lakes National Program Office to support contaminated sediment activities. This announcement constitutes market research to determine the availability of small and large businesses capable of performing all or portions of the requirements. The resultant contracts (possibly 1 full and open and 1 small business set-aside) are anticipated to be IDIQ-type contracts with a 36-month base period and two 12-month options estimated at \$25M over the life of each contract. Interested firms must show in their capabilities statements that they are qualified to perform the statement of work (SOW) activities under NAICS code 562910 or would cover all the tasks based upon a teaming arrangement. In addition to a capability statement, interested parties are encouraged to provide suggestions and comments on the draft SOW. Capability statements are due by 4:30 PM ET on August 11, 2017. <https://www.fbo.gov/sqo/FPA/DAM/MFC-101/SOL-RS-17-00006/listing.html>

##### HAZARDOUS TOXIC AND RADIOACTIVE WASTE (HTRW) A-E CONTRACTS

U.S. Army Corps of Engineers, USACE District New England, Concord, Mass.  
Federal Business Opportunities, FBO-5720, Solicitation W912WJ17X0020, 2017

The U.S. Army Corps of Engineers, New England District seeks to determine the interest, availability, and capability of 8(a), HUBZone, service-disabled veteran-owned, woman-owned, and small business concerns for HTRW A-E IDIQ contracts under NAICS code 541330. Work will begin in late 2018 for a 5-year period. The intent is to award 8 contracts with a total contract value between \$40M to \$50M for work to be performed mainly in the six New England states (ME, NH, VT, MA, CT, and RI) but also including states and districts covered by the USACE North Atlantic Division's mission areas (NY, PA, NJ, DE, MD, VA, WV, and the District of Columbia). The work calls for performing investigations, feasibility studies, and remedial designs at HTRW sites addressed through EPA's Superfund Program, DoD's BRAC Program, USACE's FUDS Program, and interagency projects that involve investigation and assessment of site contaminants and determination of effective remedial designs. Capability packages are due by 2:00 PM ET on August 17, 2017. <https://www.fbo.gov/sqo/USA/CF/D8/AC31/W912WJ17X0020/listing.html>

##### U.S. COAST GUARD NATIONWIDE ENVIRONMENTAL A-E IDIQ MATOC

Department of Homeland Security, USCG Shore Maintenance Command, Seattle, WA.  
Federal Business Opportunities, FBO-5720, Solicitation HSCG50-17-R-ENVAE2, 2017

The U.S. Coast Guard has issued a draft synopsis for the forthcoming recompete of the existing USCG ENV A-E MATOC. The draft synopsis includes the proposed selection criteria, description of work, and anticipated contract structure. The existing contracts expire October 21, 2018. The future enterprise-wide MATOC is intended to provide prompt responses on an as-needed basis for services to address environmental compliance, restoration, liabilities, planning, sustainability, and training within the 50 United States and its territories and at locations outside the U.S. where the USCG has a mission interest. The announcement will be open to all businesses under NAICS code 541330. Awards may be made to up to four large businesses and up to four small businesses. Comments on the draft synopsis are welcome. Submit responses by 11:59 PM ET on August 10, 2017. [https://www.fbo.gov/index2e-opportunity&modules=form&id=914d0ca7804b779c9d1142df4d0153383ab-core&\\_cview=1](https://www.fbo.gov/index2e-opportunity&modules=form&id=914d0ca7804b779c9d1142df4d0153383ab-core&_cview=1)

##### ANNUAL BROAD AGENCY ANNOUNCEMENT (BAA) - FY17 ENVIRONMENTAL INITIATIVES FOR NAVFAC EXWC

Naval Facilities Engineering Command, NAVFAC Expeditionary Warfare Center, Port Huemene, CA.  
Federal Business Opportunities, FBO-5560, Solicitation N394301787201, 2017

This BAA is open until February 9, 2018. Proposals may be submitted at any time during this period. NAVFAC EXWC is seeking technologies and methodologies to reduce environmental impacts from current and past Navy operations. Areas of interest include Topic No. 1: Environmental assessment, restoration and cleanup, and Topic No. 3: Unexploded ordnance detection, location, de-energizing, disposal, or remediation. When a proposal abstract aligns with a customer need and funding, the contracting office may request a full proposal. As no funding for contracts has been reserved in advance, NEXWC will be sharing qualified abstracts with other federal government activities to seek demonstration sites and/or funding. This notice requests abstracts/white papers only, which can be submitted using the abstract form and instructions at [http://www.navy.mil/navarac-worldwide/specialty\\_centers/exwc/products\\_and\\_services/epwr/baa.html](http://www.navy.mil/navarac-worldwide/specialty_centers/exwc/products_and_services/epwr/baa.html). The FedBizOpps notice is at <https://www.fbo.gov/notices/67773a16a592546e51f76ea27f2f6>

##### ENVIRONMENTAL ENGINEERING

National Science Foundation Funding Opportunity PD-17-1440, 2017

The program goal is to support cutting-edge scientific research for identifying, evaluating, and monitoring the waste assimilative capacity of the natural environment and for removing or reducing contaminants from polluted air, water, and soils. Major areas of interest include:

- Development of innovative biological, chemical, and physical treatment processes to meet the growing demand for water; investigation of processes that remove and degrade contaminants, remediate contaminated soil and groundwater, and convert wastewaters into water suitable for reuse; investigation of environmental engineering aspects of urban watersheds, reservoirs, estuaries and storm water management; and investigation of biogeochemical and transport processes driving water quality in the aquatic and subsurface environment.
- Fate and transport of contaminants of emerging concern in air, water, solid waste, and soils: Investigate the fate, transport, and remediation of potentially harmful contaminants and their by-products.

The duration of unsolicited awards is generally one to three years. The typical annual award size for the program is around \$110,000 per year. Principal investigators requesting a higher amount must consult with the Program Director prior to the submission of a proposal to avoid the possibility of the proposal being returned without review. The window of opportunity for full proposals is October 1-October 20, 2017. For additional details, see NSF Program Description PD-17-1440 at [http://www.nsf.gov/funding/opm\\_summ\\_is27pums\\_id=518162](http://www.nsf.gov/funding/opm_summ_is27pums_id=518162). Proposals should address the novelty and/or potentially transformative nature of the proposed work compared to previous work in the field. <http://www.grants.gov/submit/Grants.gov-opportunity.html?docId=781388>

#### Cleanup News

##### EVALUATION OF THE EFFICIENCY OF A CLAY PERMEABLE REACTIVE BARRIER FOR THE REMEDIATION OF GROUNDWATER CONTAMINATED WITH <sup>137</sup>Cs

Torres, E., P. Gomez, A. Garralon, B. Buli, M.J. Turrero, and J. Pena.  
Procedia Earth and Planetary Science 17:444-447(2017)

In May 1998, a radioactive source hidden in a scrap heap was accidentally melted in the oven of a steel factory located in Southeastern Spain. The contaminated ashes were mixed as fill materials for the remediation of phosphogypsum piles generated in fertilizers. The contamination of the contaminated area (PRB) consisted of a treatment zone filled with a mixture of clay (illite) and wood chips was designed to prevent the migration of the contamination to the ground and surface waters. Periodic sampling campaigns were performed from 2009 to the present. <sup>137</sup>Cs activity in the contaminated area is slightly higher than in the reactive zone but reaches the limit of potability (104 Bq/m<sup>3</sup>), which seems to confirm adequate performance of the barrier. The efficiency of the clay-based PRB for removal of <sup>137</sup>Cs from groundwater after 5 years of operation is discussed. [http://www.csciencejournal.com/science/article/pii/S1878527016301461/pdf?md5=953a38ab72e0b0b2b114b96ca8b7e2ef&pid=1-L-7-0-5-1676573016301461-main.pdf9\\_valic=1](http://www.csciencejournal.com/science/article/pii/S1878527016301461/pdf?md5=953a38ab72e0b0b2b114b96ca8b7e2ef&pid=1-L-7-0-5-1676573016301461-main.pdf9_valic=1)

##### PASSIVE (AGGRESSIVE) BARRIERS FOR PLUME REMEDIATION

Craig, P.  
2017 SMART Remediation Ottawa, February 16, 2017. 24 slides, 2017

This presentation provides an overview of reactive barrier practice; design guidance; and an apples-to-apples comparison of installation methods, costs, and constraints, as well as case studies for mine seepage, permeable absorbent NAPL barriers, reworking chlorinated iron walls, and deep drain infrastructure installation using liquid flowing methods. <http://www.smartremediation.com/wp-content/uploads/2016/09/SMART-Remediation-Ottawa-2017-Pete-Craig.pdf>

##### SEMI-ANNUAL PROGRESS REPORT NO. 7. VOLUNTARY REMEDIATION PROGRAM: RAYLOC FACILITY, 600 RAYLOC DRIVE, FULTON COUNTY, ATLANTA, GEORGIA

Georgia Department of Natural Resources, 156 pp, 2017

Gas-infusion supplemented air sparge/soil vapor extraction has operated in the former parts disassembly and cleaning area since April 2015. As of March 2016, 90% of the PCE mass in the treatment area had declined. To expedite removal of the remaining PCE, gravity-fed in situ chemical oxidation (ISCO) using sodium persulfate and hydrogen in 7 existing injection wells was initiated in January 2017. In the source area, soil blending in summer 2017 will include excavation and treatment of the top 30 ft of soil and in situ treatment of soil from 30-40 ft in a rotary drum blender using either potassium permanganate for chemical oxidation or ABC+ for enhanced reductive dechlorination. Work will be completed within 2 to 3 months, weather permitting. The in situ chemical oxidation/sealant was initiated in 6 existing injection wells in the source area to accelerate groundwater cleanup prior to losing the wells when they are removed for the soil blending activities. This report summarizes groundwater remedial operations for the Rayloc facility during the period September 2016 through January 2017. See additional information in Appendix D, PDF pages 144-155. [https://epd.georgia.gov/sites/epd.georgia.gov/files/NAI491748039\\_Murata%20VTR.pdf](https://epd.georgia.gov/sites/epd.georgia.gov/files/NAI491748039_Murata%20VTR.pdf)

##### VOLUNTARY INVESTIGATION AND REMEDIATION PLAN: MURATA ELECTRONICS, N.A., 308 PROSPECT ROAD, ROCKMART, POLK COUNTY, GEORGIA

Georgia Environmental Protection Division, 162 pp, 2017

A soil vapor extraction and ex situ treatment system installed late in 2006 became operational in February 2007. Modifications to the SVE system were made in 2009 after the identification and investigation of soil contamination near the former hazardous chemical storage area. Groundwater has been remediated at the site through the use of in situ chemical oxidation (ISCO) technology by injection of permanganate (sodium or potassium). The first ISCO injections were performed as pilot tests in March 2007. After issuance of the first Underground Injection Control permit in August 2007, ~256,100 gal of additional permanganate solution has been injected at the site at full scale in 28 injection locations. Monitor well MW-20 has served as the well with the highest volume of injections: ~40,900 gal of permanganate solution (16% of total) has been injected since October 2007. [https://epd.georgia.gov/sites/epd.georgia.gov/files/NAI491748039\\_Murata%20VTR.pdf](https://epd.georgia.gov/sites/epd.georgia.gov/files/NAI491748039_Murata%20VTR.pdf)

##### VOLUNTARY REMEDIATION PROGRAM REVISED COMPLIANCE STATUS REPORT: FORMER VOGUE CLEANERS, COLUMBIA SQUARE SHOPPING CENTER, MARTINEZ, COLUMBIA COUNTY, GEORGIA

Georgia Environmental Protection Division, 458 pp, 2016

The site is affected by PCE and associated degradation products released from drycleaning operations, and remedial activities ongoing since May 2000 have included soil excavation, air sparge/soil vapor extraction (AS/SVE) by the use of ART™ remedial technology, and chemical injection. Between 2002 and 2006, hydrogen release compound (HRC™) was injected into the subsurface at both pilot and full scale. An SVE system was installed within the building at the end of 2011. The ART AS/SVE system operated at the site until August 2013. Between 2012 and 2013, corrective action activities included two chemical injection events and two enhanced fluid recovery (EFR) events, with one more 24-hour EFR event conducted in June 2015. In situ chemical oxidation was implemented in 2014 and 2016 via injection of PersulfOx™. Active remediation activities have been terminated at the property. Ongoing site activities include monitoring the video surveillance system on a regular basis to spot unauthorized activities within the remediation enclosure and identify tampering with on-site monitor wells. Future use of the property will be commercial development. <https://epd.georgia.gov/sites/epd.georgia.gov/files/101354-10ugw-euiseu09P5R.pdf>

##### ENHANCED REDUCTIVE DECHLORINATION AT GENERAL SERVICES ADMINISTRATION RECLAMATION YARD, KENNEDY SPACE CENTER, FL

Chrest, A.M., C. Adkison, H. Faircloth, D. Strickland, and D. Johansen.  
4th International Symposium on Bioremediation and Sustainable Environmental Technologies, 22-25 May 2017, Miami. Battelle, Columbus, OH. Poster, 2017

Enhanced reductive dechlorination (ERD) was selected as an interim measure (IM) to reduce PCE mass (DNAPL, sorbed, and dissolved) and accelerate degradation of PCE and daughter product concentrations to promote overall plume collapse. Initial treatment in 2013 combined injection of 10% or 15% emulsified zero-valent iron (EZVI) and 6% food grade vegetable oil (VATO) (L), based on pore space volume. A total of 9,060 gal of EZVI and 26,000 gal of 6% VO/L injected across 41 locations covering 0.12 acres targeted varying intervals between 11 and 27 ft bgs. Performance monitoring using DPT was conducted at 8, 16, 24 and 32 months after initial treatment. The maximum pre-IM PCE concentration was 214,000 µg/L; by 2016 the PCE concentration detected was 17,700 µg/L. The volume of the PCE plume concentration ≥10,000 µg/L decreased by 93%. Treatment based on parent compound concentration provided effective removal with targeted use of EZVI, the most expensive component. The presence of ethene and ethane at the location with highest VC concentrations indicates complete dechlorination is occurring. Supplemental treatment was completed in March 2017 to sustain ERD. <https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20170004754.pdf>

##### PASSIVE TREATMENT SYSTEMS AID SUSTAINABLE CLEANUP AT SAVANNAH RIVER

U.S. DOE, Office of Environmental Management, 28 Jun 2017

The Savannah River Site (SRS) continues to expand its use of passive groundwater cleanup systems that rely on nature to help lower costs and consume less energy. Active cleanup technologies, such as groundwater pump and treat, have required large amounts of electricity and frequent maintenance. SRS will continue to use the active pump and treat in small areas, but as groundwater cleanup projects mature and the bulk of contamination is removed, the facility is transitioning to the ground to promote the growth of naturally occurring bacteria that aggressively consume the oil, along with chemicals such as solvents, and ~60 acres of trees remove low-level radioactive contamination from groundwater near the center of the site. <https://energy.gov/en/articles/passive-treatment-systems-aid-sustainable-cleanup-savannah-river>

##### ACCELERATED BIODEGRADATION OF CHLORINATED CONTAMINANTS FACILITATED USING AN IN-SITU LIQUID ACTIVATED CARBON: A PILOT STUDY AND FULL-SCALE APPLICATION IN SOUTH CAROLINA

Valentine, M.  
RemTEC 2017, 7-9 March, Denver, Colorado. Abstract only, 2017

A pilot study using a liquid activated carbon (LAC) solution (PlumeStop™) was conducted in two areas near the leading edge of a long, narrow chlorinated VOC plume located in south-central South Carolina. The plume extends over 1,700 ft beyond its identified source, the affected zone is ~20-40 ft bgs, and a residential area lies

## Demonstrations / Feasibility Studies

### BIOREMEDIATION OF CO-MINGLED 1,4-DIOXANE AND CHLORINATED SOLVENT PLUMES

Yuncu, B., R.C. Borden, S.D. Richardson, K. Glover, and A. Bodur.  
Groundwater Professionals of North Carolina, June 2016 Meeting Presentation. 31 slides, 2016

The primary project objective was to demonstrate a simple, low-cost approach for enhancing in situ cometabolic biodegradation of 1,4-D and TCE using a two-barrier system to create distinct geochemical zones (anaerobic/aerobic) within a commingled plume of TCE and 1,4-D with concentrations in groundwater of up to 30,000 µg/L and 660 µg/L, respectively. Area of Concern 1 at Former Air Force Plant 3 in Tulsa, OK, was selected for the field demonstration. An upgradient permeable reactive barrier (PRB) was formed in August 2013 by injecting ~330 gal of diluted emulsified oil substrate (EOS-LS™) and chase water, followed by a commercial dechlorinating bacterial consortium (BAC-9) to enhance CVOC treatment performance and accelerate methane production. Methane serves as a cosubstrate for aerobic cometabolism of 1,4-D in the downgradient oxygen barrier. All injection and monitoring wells were sampled immediately before substrate injection and at 2, 4, 6, 8, 16, and 22 months afterward. TCE degradation was evidenced by the increased concentrations of cis-1,2-DCE, VC, and ethene in all injection wells and up to 40 ft downgradient of the PRB, along with significant methane generation from oil fermentation. Unexpectedly, following PRB installation, 1,4-D concentrations declined in both injection and several monitoring wells, even below detection limits in some injection wells. To better understand possible mechanisms for the observed 1,4-D decrease, Bio-Trap® samplers baited with <sup>13</sup>C-labelled 1,4-D were installed in select wells. Their analysis suggests that ethene might also play a role as a cosubstrate in 1,4-D biodegradation.

<http://owncr.org/june2016Presentation.pdf>

### SEMI-ANNUAL PROGRESS REPORT, FORMER GENERAL TIME FACILITY, ATHENS, GEORGIA

Georgia Environmental Protection Division (EPD), 14 pp, 2016

This report briefly outlines the field activities during implementation of a field-scale pilot test to evaluate the efficacy of enhanced in situ bioremediation. Site contractors conducted in situ injection March 22-25, 2016, to stimulate biodegradation of chlorinated solvent contamination present in the subsurface. The injection event employed 10,800 gal of a sodium lactate and sodium bisulfite solution within 16 newly installed injection points. The injection program utilized 9,000 gal of potable water, 1,800 gal of a 60% sodium lactate solution, and 300 lb of sodium bisulfite, an oxygen scavenger, to create anaerobic conditions quickly and provide an organic hydrogen and carbon donor to stimulate biodegradation. The injection event started at the most downgradient and proceeded toward the most upgradient and least impacted areas. Injections were conducted using individual dedicated pumps and separate mix tanks so that injection pressures and volumes could be regulated more precisely. Each injection point received ~675 gal of the remedial solution, with some limited variation due to short-circuiting of the injectant.

<https://epd.georgia.gov/sites/epd.georgia.gov/files/GeneralTimePRB.pdf> Results of this apparently successful application are described in the 2017 progress report at <https://epd.georgia.gov/sites/epd.georgia.gov/files/GeneralTimePRB.pdf>

### PERMEABLE REACTIVE BARRIER PILOT TEST WORK PLAN, GRENADA MANUFACTURING, LLC, GRENADA, MISSISSIPPI

U.S. EPA Region 4, 514 pp, 2016

Work is ongoing by EPA and the Mississippi Department of Environmental Quality to oversee the cleanup of the former Grenada Manufacturing LLC facility (now Grenada Stamping). Under its RCRA permits, the facility has conducted numerous investigations and response actions over the years, including closure of the former sludge lagoon. Around 239 gal of TCE and 2,200 gal of toluene were removed from the site's groundwater; institutional controls were put in place to prevent potential exposures; and a zero-valent iron (ZVI) permeable reactive barrier (PRB) was installed in 2004-2005 for groundwater migration control and treatment. EPA is conducting a pilot study of the PRB (1) to enhance the barrier's treatment capability by bypassing the front face of the PRB through the use of "in-wall" wells that distribute groundwater within the PRB and place it in direct contact with the ZVI and (2) to test enhanced reductive dechlorination as a method to remediate chlorinated VOC-contaminated groundwater that appears to be moving toward and possibly around the PRB's south end. These two activities will be completed simultaneously.

<https://www.epa.gov/grenadacleanup/march-2016-grenada-manufacturing-llc-submittal-permeable-reactive-barrier-pilot-work>

### PERMEABLE REACTIVE BARRIERS FOR THE REMEDIATION OF GROUNDWATER IN A MINING AREA: RESULTS FOR A PILOT-SCALE PROJECT

Martínez-Sánchez, M.J., C. Pérez-Sirvent, M.L. García-Lorenzo, S. Martínez-López, V. Pérez-Espínosa, E. González-Ciudad, L.B. Martínez-Martínez, C. Hernández, and J. Molina-Ruiz.

Geophysical Research Abstracts 19:EGU2017-9275 (2017).

The Sierra Minera de Cartagena-La Unión is located in the Region of Murcia, Southeastern Spain, where high levels of heavy metals occur due to natural formations. Prolonged mining activity also has affected the area groundwater. Following a hydrogeological study of the zone, a pilot-scale permeable reactive barrier (PRB) was designed and constructed using limestone filler, a waste material produced in many local factories. The limestone residues have good adsorption properties, high alkalinity, low cost, and high availability. The PRB constituted 50% limestone filler and 50% sand, a proportion optimized in independent batch experiments. A layer of gravel was placed above the PRB and topped with a layer of natural soil. The barrier was designed in the form of a continuous trench because the contaminated groundwater was at shallow depth. Six wells were arranged downstream for sample collection parallel to the barrier. All samples collected after PRB installation had basic pH values between 7.5 and 8 and conductivity between 5 and 1.1 mS/cm in all but one well. Concentration values of trace elements mostly fell below the detection limits or showed values below normal levels of the area. Findings after four years of monitoring show that limestone filler is suitable as a reactive PRB component for sites affected by trace elements.

### DEMONSTRATION AND VALIDATION OF A PORTABLE RAMAN SENSOR FOR IN-SITU DETECTION AND MONITORING OF PERCHLORATE (ClO<sub>4</sub><sup>-</sup>)

Gil, B., A. Jubb, G. Eres, and P.B. Hatzinger.

ESTCP Project ER-201307, 107 pp, 2017

A portable Raman sensor based on surface-enhanced Raman scattering (SERS) technology and elevated gold nano-ellipsoid dimer architectures was designed and developed for a perchlorate detection limit of ~100 µg/L in contaminated water. Large-scale commercial production of SERS substrate sensors via nanom imprinting was successfully demonstrated—a major step toward commercialization of the SERS sensors. Commercially produced SERS sensors were demonstrated to detect perchlorate at levels above 100 µg/L using a portable Raman analyzer. Performance of the commercial SERS sensors for perchlorate detection in the presence and absence of interferences was determined for a series of standard solutions. Sulfate exhibited the greatest interference among the anions tested. Field demonstration of the sensor with commercially produced SERS substrates was completed twice at the Indian Head Naval Surface Warfare Center and once at Redstone Arsenal. Multiple wells were sampled at both sites and results were compared with those from a standard ion chromatography approach. Results generally were comparable, but significant variations due to the presence of interference ions and co-contaminants in the groundwater in some samples were observed.

<https://www.estcp.com/content/download/45404/423620/file/ER-2013-07%20Final%20Report.pdf>

### PHYTOREMEDIATION OF HEAVY METALS AND PAHS AT SLAG FILL SITE: THREE-YEAR FIELD-SCALE INVESTIGATION

Reddy, K.R., G. Amaya-Santos, E. Yargicoglu, D.E. Cooper, and M.C. Negri.

International Journal of Geotechnical Engineering [Published online 17 Apr 2017 prior to print]

Big Marsh is a 121-hectare site in the Calumet region (near Chicago) historically affected by the steel industry and decades of dumping. The slag-soil fill at the site contains PAHs and heavy metals. Due to the large size of the area to be remedied and the variable distribution of contaminants throughout the shallow depth at slightly above risk-based levels, the feasibility of using phytoremediation at the site was investigated in a 3-year field study to determine plant survival and the fate of PAHs and heavy metals in soil and in plant roots and stems. Replicate test plots for nine native and restoration plant species were prepared by spreading a thin layer of compost at the ground surface and then tilling and homogenizing the slag-soil fill to a depth of ~0.3 m. Over three growing seasons, monitoring results for plant survival and growth and contaminants fate in soil and plants showed a decrease in PAH soil concentrations, likely due to enhanced biodegradation within the rhizosphere. Despite the lack of significant decrease in heavy metal concentrations in soil, the metals were found to be immobilized. Contaminant concentrations below detection limits in plant root and shoot samples showed insignificant plant uptake. Overall, selected native grasses amended with compost were able to survive the harsh slag fill conditions, helping to degrade or immobilize the contaminants.

### IN-SITU ENHANCED BIOREMEDIATION TREATABILITY STUDY OF RDX CONTAMINATED SOIL AND GROUNDWATER AT A FORMER MILITARY DEMOLITION RANGE

Jugnia, L.-B., D. Manno, and M. Hendry.

RPTC Federal Contaminated Sites Regional Workshop, 6-7 June, Richmond, BC, 19 slides, 2017

The effect of a carbon substrate (waste glycerol) on RDX biodegradation was assessed in a pilot-scale study at a former military demolition range (Garrison Petawawa, ON). A large-scale in situ treatment of a suspected RDX soil hot spot and the associated groundwater was treated using the application of surficial waste glycerol. Results indicated that the added carbon substrate improved RDX biodegradation by anaerobic indigenous microorganisms. No RDX was detected in soil samples collected from the treated area, and concentrations of total organic carbon and volatile fatty acid concentrations increased in three of the study's monitoring wells. An important decrease of RDX concentrations was observed in four out of five groundwater samples from the monitoring wells, with concentrations reduced below detection limits in three wells. All three RDX nitroso-degradation products were detected in groundwater samples, suggesting anaerobic degradation.

[http://www.rptc-bir.ca/images/EFS\\_2017\\_Presentations/Strapal%20In%20situ%20enhanced%20bioremediation%20study%20of%20RDX%20contaminated%20soil%20and%20groundwater%20at%20a%20former%20military%20demolition%20range%20eng.pdf](http://www.rptc-bir.ca/images/EFS_2017_Presentations/Strapal%20In%20situ%20enhanced%20bioremediation%20study%20of%20RDX%20contaminated%20soil%20and%20groundwater%20at%20a%20former%20military%20demolition%20range%20eng.pdf)

### SOLAR-POWERED REMEDIATION AND PH CONTROL: ESTCP COST AND PERFORMANCE REPORT

ESTCP Project ER-201033, 73 pp, 2017

The primary project goal was to demonstrate a solar-powered technology—Proton Reduction Technology (PRT)—to generate hydrogen in situ and reduce aquifer acidity to promote reductive dechlorination. During operation, PRT uses a low voltage potential applied across electrodes installed within an aquifer to impress a direct current in the subsurface. PRT was tested on a plume of dissolved-phase TCE and cis-DCE in a low-pH aquifer at Joint Base McGuire-Dix-Lakehurst, New Jersey. Successful application of this technology would allow economical treatment of contaminated low-pH aquifers and remote contaminant plumes where electrical power is not readily available or where long treatment times are expected. This field demonstration used electrodes inserted into PVC wells within the contaminated low-pH aquifer. The electrodes (three cathodes and two anodes) were operated to generate H<sub>2</sub> to support biodegradation and consume H<sup>+</sup> to increase aquifer pH. The PRT system was operated for 507 days from startup to shutdown. The contaminated aquifer was inoculated with a bioaugmentation culture (SDC-9™) to ensure the presence of dechlorinating bacteria to support biodegradation. Solar panels and deep-cycle 12-volt batteries provided electricity to operate the system. PRT resulted in partial reductive dechlorination of CVOCs in the low-pH aquifer, but TCE dechlorination was incomplete under the demonstration conditions, likely due to borderline pH and reducing conditions in the aquifer.

<https://www.estcp.com/content/download/45406/423581/file/ER-2010-33%20Cost%20and%20Performance%20Report.pdf>

### PHYTOREMEDIATION PILOT STUDY: FMC MIDDELPORT

FMC Middelport Website, accessed June 16, 2017

FMC conducted a pilot phytoremediation study on agricultural land north of the plant site and on two residential plots to determine if plants could be used to absorb arsenic from the soil. While several species of plants were used, most varieties were not compatible with Western New York's growing conditions. Local pests also proved to be problematic. Study plants were harvested in the fall of 2008 and sampled to evaluate As uptake from the soil, and the planted soil was retested to evaluate how much As plants might have absorbed from the soil. Plant residues were destroyed in an approved disposal facility. As part of the study, Cornell University was asked to perform bench-scale tests to identify amendments that might improve plant As uptake from the test soils.

<http://www.fmc-middelport.com/Remediation/Bio/Studies/Phyto/Studies/PhytoStudy.aspx> FMC reported on the results of the pilot phytoremediation study and those of a soil blending/tilling study in May 2010 in a slide presentation at [http://www.fmc-middelport.com/Portals/\\_default/Skins/DarkKnight/Images/solilmixing.pdf](http://www.fmc-middelport.com/Portals/_default/Skins/DarkKnight/Images/solilmixing.pdf)

## Research

### CADMIUM FIXATION STUDIES ON CONTAMINATED SOILS USING NANO CALCIUM SILICATE: TREATMENT STRATEGY

Mohammed, S.A.S., A.B. Mughal, P.F. Samaila, K. Kotresha, and H.P. Reddy.

Geotechnical Frontiers 2017, Orlando, Florida, 12-15 March. American Society of Civil Engineers, Reston, VA. 434-442(2017)

Soils sampled from different locations at high risk for contamination—a steel plant, automobile and batteries work unit, and municipal dumpsite near Bangalore City, India—were spiked with cadmium (Cd<sup>2+</sup>) at ~3,000 mg/L. The leaching behavior of Cd<sup>2+</sup> from these soils and soils amended with nano-calcium silicate (NCS) were studied with four different leaching methods: ASTM D3987, TCLP, extended TCLP, and caged TCLP. To understand the type of sorption taking place in the soil matrices, sequential extraction in five stages was performed on the spiked soils, which revealed that soils treated with NCS sorbed Cd<sup>2+</sup> effectively and as per ASTM D3987. Cd<sup>2+</sup> retention continued over the long term; TCLP tests proved the sorption was 90% for the spiked soils. In the case of the untreated soils, the metals were found to be immobilized. Contaminant concentrations below detection limits in plant root and shoot samples showed insignificant plant uptake. Overall, selected native grasses amended with compost were able to survive the harsh slag fill conditions, helping to degrade or immobilize the contaminants.

### EVALUATION OF A FILTRATION SORBENT FOR REMEDIATION OF ARSENIC IN GROUNDWATER

Do, Clement, Master's thesis, California State University-San Bernardino, 53 pp, 2017

A commercially available product, PURA PhosLock, was evaluated for use as a sorbent to remove dissolved arsenic (As) from drinking water. Marketed as a product to remove phosphate in aquaria, the product is composed of iron oxide hydroxide, which is known to adsorb dissolved As species from water. Arsenic was measured using standard methods and graphite-furnace atomic absorption spectroscopy. In a first rough filtration test, ~50 g of PhosLock was used to filter 10 L of tap water containing 100 µg/L of As species detected in the filtrate. A sorption study showed the time required to reach equilibrium was attained after seven hours. A second set of sorption studies used different As concentrations, and the data were evaluated using the Langmuir adsorption model, which predicted a maximum adsorption capacity of 457 to 636 mg/g. In a final flowing water column breakthrough experiment, 7 L of water were filtered before any As was detected when As spiked tap water (50 ppb) was filtered through 0.5 g of sorbent in a glass chromatography column. Over 10 L were filtered before the maximum contaminant level of 10 ppb was exceeded. Flow-through results showed that PhosLock had an As adsorption capacity of 700 mg/g.

<http://scholarworks.fsu.edu/etd-ohd/4744>

### PHYTOREMEDIATION OF METAL-CONTAMINATED SOILS AND THEIR MONITORING WITH PROXIMAL SPECTRAL SENSING

Rathod, Pareshkumar Himmatlal, Ph.D. dissertation, University of Twente, 230 pp, 2016

The studies presented in this dissertation have a 2-pronged focus: (i) tree-based phytoremediation strategies and (ii) proximal spectral sensing of metal-contaminated soils and plant species used for phytoremediation. The general conclusion drawn from the tree studies (lysimeter studies performed using controlled deficit irrigation) is that the fast-growing species *Eucalyptus camaldulensis* is well-suited for phytoextraction or phytostabilization strategies for Cd-contaminated soil. Studies of proximal spectral sensing of vegetation (barley and mutant sunflower) and soil indicate that plant reflectance spectroscopy holds potential for assessing plant stress due to metals accumulation. Quantification of soil metals using soil reflectance spectra was found to be infeasible for the tested metals and soils.

[https://www.iri.nl/library/publications\\_2016/raathod.pdf](https://www.iri.nl/library/publications_2016/raathod.pdf)

### QUANTIFYING THE REMOVAL OF TRICHLOROETHYLENE VIA PHYTOREMEDIATION AT HILL AIR FORCE BASE, UTAH, OPERATIONAL UNIT 2, USING RECENT AND HISTORICAL DATA

Diamond, J. Oliver, Master's thesis, Utah State University, 101 pp, 2016

Phytoremediation has been implemented as part of a TCE groundwater cleanup at Travis AFB near Sacramento, Calif. Volatilization of TCE from leaves and the soil surface near the trees was shown to be the most important removal mechanism at the Travis site. Past studies conducted on indigenous trees growing above TCE-contaminated groundwater at several Hill AFB locations also have shown that TCE is taken up and volatilized by the trees, but phytoremediation has not been implemented, in part because of the difficulty in predicting the potential effectiveness of TCE removal over time. Flow-through or recirculating chambers were used to quantify the amount of TCE removed by volatilization through leaf, trunk, and soil surfaces, and tree cores were collected to quantify tree TCE mass. Field-measured transpiration stream concentrations and groundwater data were used to calculate transpiration stream concentration factors (TSCF) for TCE. Comparison of current and historical data showed that trees reach a steady-state TSCF value of 0.26 after about 15 years. Using this information, investigators estimated that a phytoremediation plot containing 40 poplar trees located in a seep area within Hill AFB OU2 would remove 4.82 kg of TCE annually. A larger plot covering the entire hillside above this seep (160 trees) could remove up to 19.28 kg of TCE annually, once the trees reach steady-state TSCF.

<http://digitalcommons.usu.edu/etd-ohd/4743>

### ELECTROKINETIC REMEDIATION OF HEAVY METAL-CONTAMINATED MARINE SEDIMENTS: EXPERIMENTS AND MODELLING

Masi, Matteo, Ph.D. Dissertation, University of Pisa, Italy. 218 pp, 2017

A set of lab tests was carried out to identify the main parameters and processes affecting electrokinetic removal of heavy metals from real contaminated sediments. A numerical model developed to simulate transport of multiple species and geochemical reactions occurring during treatment was used to reproduce the lab results, describing the following main phenomena: (1) species transport by diffusion, electromigration, and electroosmosis; (2) pH-dependent buffering of hydrogen ions; (3) adsorption of contaminants onto sediment particle surfaces; (4) aqueous speciation; and (5) formation and dissolution of solid precipitates. When the model was applied to simulate electrokinetic processes at field scale model geometry and boundary conditions, the results were compared with the experimental data. Field measurements demonstrated that a 2-D schematic of the electric field could simulate the actual electric field with sufficient accuracy. Simulations were performed to reproduce acid front migration and Pb transport. After defining consumable costs (i.e., energy expenditure, acid consumption, electrode, and pipe costs), cost curves were calculated from simulation results. The resulting curves allowed identification of the optimum design parameters, which minimized overall costs. These project results can serve as a tool to support evaluation, design, and optimization of electrokinetic remediation systems.

<https://etd.adm.unipi.it/etd-ohd/12701/7-120456/>

### EFFECT OF EDTA, EDDS, NTA AND CITRIC ACID ON ELECTROKINETIC REMEDIATION OF AS, CD, CR, CU, NI, PB AND ZN CONTAMINATED DREDGED MARINE SEDIMENT

Song, Y., M.-T. Ammami, A. Benamar, S. Mezazigh, and H. Wang.

Environmental Science and Pollution Research 23(11):10577-10586(2016)

In electrokinetic (EK) remediation, chelating agents can be used as electrolyte solutions to increase metal mobility. This study investigated the effect of different chelating agents—EDTA, EDDS, NTA, and citric acid—in enhancing heavy metal mobility for EK remediation of As, Cd, Cr, Cu, Ni, Pb, and Zn. For the same agent concentration (0.1 mol/L), EDTA was more effective for enhancing removal of Ni (52.8%), Pb (60.1%), and Zn (34.9%). EDDS was effective in increasing Cu removal efficiency (52%), while EDTA and EDDS had a similar removal enhancement effect on As EK remediation (30.5~31.3%). Citric acid was more effective for enhancing Cd removal (40.2%). Similar Cr removal efficiency was provided by EK remediation (35.6~43.5%). In the migration of metal-chelate complexes directed toward the anode, metals accumulated in the middle sections of the sediment matrix for the tests performed with EDTA, NTA, and citric acid, but only low accumulation of metal contamination in sediment was observed in the test using EDDS. <https://hal.archives-ouvertes.fr/hal-01537604/document>

#### ELECTROCHEMICAL FENCING OF Cr(VI) FROM INDUSTRIAL WASTES TO MITIGATE GROUND WATER CONTAMINATION

Shukla, N., M.K. Harbola, K. Sanjay, and R. Shekhar.  
Transactions of the Indian Institute of Metals 70(2):511-518(2017)

Electrochemical fencing, an extension of electroremediation, appears to be a viable technique for impeding the vertical transport of heavy metals as mobilized by rain water through the soil. Preliminary experiments showed that electrochemical fencing captured 50% of Cr(VI) dissolved in rain water. This percentage could be increased by changing electrolyte configuration and electrolyte composition. A novel mathematical model developed to calculate the trajectory of Cr(VI) ions provides a simple methodology to design and implement real-life electrochemical fencing systems. Because of its versatility, electrochemical fencing can be used to capture a wide variety of heavy metals or even water-soluble organic molecules.

#### ORGANIC SURFACTANT MODIFIED ZEOLITE AS A PERMEABLE REACTIVE BARRIER COMPONENT: A LABORATORY STUDY

Shang, H., S. Javadi, and Q. Zhao.  
Geotechnical Frontiers 2017, Orlando, Florida, 12-15 March. American Society of Civil Engineers, Reston, VA. 443-449(2017)

Organic surfactant-modified zeolites, a group of organo-aluminosilicates that have enhanced sorption capacity for organic compounds, are suited to engineering applications in wastewater treatment, groundwater remediation, and waste containment. Previous research indicated that naturally occurring zeolites placed in permeable reactive barriers (PRBs) are capable of removing nutrients and heavy metals from groundwater but have relatively limited retention capacity for organic pollutants. In this study, natural zeolite was modified by organic surfactant to synthesize a zeolite-surfactant hybrid, and the interaction between benzene and the synthesized zeolite was quantified in packed soil columns to gain an understanding of the interaction between organo-zeolite and organic contaminants as a function of surfactant loading and to evaluate the applicability of organo-zeolites as treatment media for groundwater in PRBs.

#### PERFORMANCE EVALUATION OF A BIOREACTOR LANDFILL OPERATION

Alam, M.Z., Md.S. Hossain, and S. Samir.  
Geotechnical Frontiers 2017, Orlando, Florida, 12-15 March. American Society of Civil Engineers, Reston, VA. 267-273(2017)

Bioreactor landfill operation performance can be evaluated through monitoring indicators such as moisture distribution, leachate generation, gas production, and landfill settlement. During a performance evaluation conducted at the City of Denton Landfill, Texas, electrical resistivity imaging (ERI) was used to monitor moisture distribution within the landfill. ERI results indicated that moisture content rebounded after 14 days of leachate recirculation. Variation from baseline to 14 days is attributed to moisture movement (horizontal and vertical). Leachate generation, and waste leachate composition, are monitored using the HELP model visual showed that actual leachate generation in the field as seen using ERI was ~55% lower than the HELP model results. The added water/leachate used in gas production may have resulted in the lower leachate return from the landfill. Gas generation increased from 543.6 m<sup>3</sup>/h (320 scfm) in 2010-2011 to 1087.3 m<sup>3</sup>/h (640 scfm) in 2014-2015. Landfill settlement was determined through surveying, and a total of 1.524 m (5 ft) maximum settlement was observed in some locations of the landfill cell during 2014-2015 of bioreactor operation. Based on preliminary results, the bioreactor landfill appears to be operating effectively.

#### ACCURATE MEASUREMENT OF CORE RECOVERY USING AN ENHANCED VIBRACORE TECHNOLOGY

McMillan, D., D. Munday, T. Wright, D. Kettellwell, and S. Irwin.  
RPIC Federal Contaminated Sites Regional Workshop, 6-7 June, Richmond, BC. 26 slides, 2017

Investigation of marine sediments is commonly completed using a vibracore-equipped sampling vessel capable of coring marine sediments. With the support of the Canada National Research Council's Industrial Research Assistance Program, a new technology was developed to provide measurements of core tube penetration and core recovery. This new technology offers digital data measurements in real time that can be used to improve coring efficiency. The new measurement system allows the operator to zero the measurement system immediately prior to taking the sample. The core tube penetration measurement is a proxy for depth of sediment. A second measurement system records the level of the sediment as it enters the core tube. Real-time measurement in 1.0-cm increments is recorded and compared to provide percent core recovery for each increment. The operator can adjust vibracore parameters to optimize core recovery. On extraction and retrieval, the measurement system detects any changes (core catcher inversion, washout, etc.) that might affect the data acquired from the core prior to sampling. [http://www.cpic-nrc.ca/images/FCS\\_2017\\_-\\_Presentations/Stream\\_14/New\\_Vibracore\\_Technologies\\_for\\_Accurate\\_Sampling\\_eng.pdf](http://www.cpic-nrc.ca/images/FCS_2017_-_Presentations/Stream_14/New_Vibracore_Technologies_for_Accurate_Sampling_eng.pdf)

#### COMPARING THE EFFECT OF CARBON SOURCES, LACTATE AND WHEY, ON BIOLOGICAL REDUCTIVE DECHLORINATION OF TCE IN LABORATORY FLOW THROUGH COLUMNS

Kissel, Sarah M., Master's thesis, Utah State University, Thesis #5394, 138 pp, 2017

Glass columns packed with aquifer material collected from Hill Air Force Base OU-5, Utah, received a continuous flow of groundwater containing TCE and carbon in the form of whey, lactate, or no carbon (control), and were inoculated with a culture containing *Dehalococcoides mccartyi* (dhc). Changes in carbon metabolites, redox conditions, and TCE degradation byproducts were measured weekly. Soils were analyzed at the point of iron reduction and of TCE reduction to each sequential degradation byproduct: DCE, VC, and ethene for iron mineralogy, sulfides, and microbiology. Sulfate-reducing conditions were met in both carbon treatments. With both carbon sources, TCE was being reduced to ethene by the end of the study, although with significantly greater amount of VC accumulation in the lactate treatment than in the whey. Concentrations of butyrate, hydrogen, and reduced iron (aqueous) were significantly greater in the whey than the lactate treatment, which might have facilitated the high rates of VC reduction. The addition of whey supported the biogeochemical conditions and energy production required to achieve full dechlorination of TCE with high rates of VC reduction. Compared to lactate, the use of whey during TCE bioremediation could reduce the risk of human exposure to VC, a carcinogenic TCE degradation byproduct. <http://digitalcommons.usu.edu/etd/5394>

#### INFLUENCE OF FULVIC ACID ON THE COLLOIDAL STABILITY AND REACTIVITY OF NANOSCALE ZERO-VALENT IRON

Dong, H., K. Ahmad, G. Zeng, Z. Li, G. Chen, Q. He, Y. Xie, Y. Wu, F. Zhao, and Y. Zeng.  
Environmental Pollution 211:363-369(2016)

In a study of the effect of fulvic acid (FA) on the colloidal stability and reactivity of nano zero-valent iron (NZVI) at pH 5, 7, and 9, the sedimentation behavior of NZVI differed at different pH. A biphasic model was used to describe the two time-dependent settling processes (i.e., a rapid settling followed by a slower settling) and to calculate the settling rates. NZVI settling rate generally was more significant at the point of zero charge, which could be varied in the presence of FA due to FA adsorption on the NZVI surface. More FA was adsorbed on the NZVI surface at pH 5-7 than pH 9, resulting in the varying sedimentation behavior of NZVI via the influence of electrostatic repulsion among particles. At pH 9, FA improved Cr(VI) reduction by NZVI. Given that FA adsorption on the NZVI surface was insignificant and its effect on the settling behavior of NZVI particles was minimal, the investigators propose that FA formed soluble complexes with the produced Fe(II)/Cr(III) ions, thus reducing the degree of passivation on the NZVI surface and facilitating Cr(VI) reduction. [http://eeb.hnu.cn/eeb/17gh/news/nir/wunfandongnir\\_1451163444.pdf](http://eeb.hnu.cn/eeb/17gh/news/nir/wunfandongnir_1451163444.pdf)

#### CHROTRAN: A MATHEMATICAL AND COMPUTATIONAL MODEL FOR IN SITU HEAVY METAL REMEDIATION IN HETEROGENEOUS AQUIFERS

Hansen, S.K., S. Pandey, S. Karra, and V.V. Vesselinov.  
LAUR-16-29041, 17 pp, 2017

A 3-D reactive transport model of relevant biogeochemical processes was developed to support decisions on in situ treatment of heavy metal contamination in groundwater. The CHROTRAN model includes full dynamics for five species: a heavy metal to be remediated, donor biomass, a non-donor biomass, a bio-inhibitor, and a biode. Diprotic reduction by donor-metal interaction as well as donor-driven biomass growth and bio-reduction are modeled, along with crucial processes such as donor sorption, bio-fouling and biomass death. The software implementation handles heterogeneous flow fields, arbitrarily many chemical species and amendment injection points, and features full coupling between flow and reactive transport. This paper describes installation and usage and presents two example simulations demonstrating its unique capabilities. One simulation suggests an unorthodox approach to remediation of Cr(VI) contamination. <https://arxiv.org/pdf/1703.01381v1>

#### INTEGRATING MODEL ABSTRACTION INTO SUBSURFACE MONITORING STRATEGIES

Pachepsky, Y., A. Guber, A. Yakirevich, F. Pan, T. Gish, M. Kouznetsov, M. Van Genuchten, R. Cady, and T. Nicholson.  
NUREG/CR-7221, 285 pp, 2017

This research is the culmination of many field and modeling studies conducted by the USDA/Agricultural Research Service. The research design was to identify and examine near-surface water flow pathways by monitoring performance indicators within the unsaturated zone and local water-table system. The peak tracer concentration and the time to peak concentration at several monitoring locations served as the performance indicators. The objective was to apply model abstraction techniques in designing monitoring networks such as those used at nuclear waste facilities. The level of spatial and temporal detail in characterizing soil properties (e.g., water contents and hydraulic conductivities) is based upon the model abstraction considerations. <https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?accessionNumber=ML170741133>

#### MODELING OF RADIONUCLIDE TRANSPORT IN FRESHWATER SYSTEMS ASSOCIATED WITH NUCLEAR POWER PLANTS

Yabusaki, S.B., B.A. Napier, W.A. Perkins, M.C. Richmond, C.L. Rakowski, S.F. Snyder, and L.F. Hibler.  
NUREG/CR-7231, 197 pp, 2017

The potential consequences of radionuclides that have been directly released into a surface water body, as happened in the 2011 Fukushima Daiichi nuclear power plant accident, are not well understood, especially for the lake and river settings where most U.S. nuclear power plant reactors are sited. Hypothetical scoping analyses were performed to gain a better understanding of how radionuclide transport in freshwater systems might be affected by the interaction of radionuclide-specific decay and sorption with hydrologic and sediment conditions. Transport simulations for Cs-137, Cs-134, I-131, Sr-90, H-3, Ru-106, Sb-125, and Ce-144 were based on the release of a 10-day pulse of 1,000 M of water with 1 Bq of activity into small lake, small river, and large river settings. <https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?accessionNumber=ML17111A575>

#### METHODS AND METRICS FOR EVALUATING ENVIRONMENTAL DREDGING AT THE ASHTABULA RIVER AREA OF CONCERN (AOC)

Mills, M., R. Brenne, M. Chabert-Berigan, J. Lazorchak, and J. Meier.  
EPA 600/R-16-322, 215 pp, 2016

Environmental dredging relies on partial mechanical removal of the contaminated sediment layer and subsequent off-site confined disposal. Environmental dredging was selected as the remedy of choice for remediation and cleanup of the Ashtabula River area of concern (AOC), a highly contaminated sediment site in northeastern Ohio. PCBs constituted the primary COC for this site, with PAHs and inorganic chemicals comprising secondary COCs. Dredging on this AOC was carried out from fall 2006 through fall 2007. The site was extensively characterized in the spring and summer of 2006 prior to dredging. A comprehensive evaluation and monitoring program was conducted by EPA during the dredging period, immediately following dredging in early 2008, and then through 2011 to assess long-term recovery. This report summarizes and interprets the results of the 6-year study to monitor pollutant fate and transport and ecosystem recovery through the use of bathymetry; sampling and chemical analysis of sediment, water, and indigenous fish; and deployment and follow-up retrieval and analysis of macrobenthos and passive samplers. <https://nepis.epa.gov/Epse/729BIBL.cgi?Dockey=P100QSTV.txt>

#### REMEDY AND RECONTAMINATION ASSESSMENT ARRAY

Chadwick, B., M. Chabert-Berigan, J. Rosen, A. Burton, and D. Moore.  
SERDP SEED Project 2537, 578 pp, 2017

The objective of this project was to demonstrate proof of concept for a sediment remedy and recontamination assessment (RARA) array that can provide site-specific, direct measurement of sediment recontamination potential and impact on a range of remedies while providing increased realism compared to lab treatability studies and reduced cost and complexity compared to field pilot studies. Using the prototype RARA array developed in task 1 and methodology developed in task 2, a limited initial proof-of-concept event in the field used contaminated sediments collected from Naval Base San Diego Chollas Creek in the array. These sediments received thin-layer treatments of clean sand or clean background sediment from a reference area in San Diego Bay alongside untreated controls. The array was placed in the SSC Pacific test facility in San Diego Bay and monitored for about 5 months. Results from pier-side and field testing provided an initial assessment of the performance and feasibility of the RARA array methodology, indicating that the system design allows for a range of measurement endpoint capabilities to provide a basis for the assessment of remedy effectiveness and recontamination. <https://www.esctr.com/content/download/45146/421970/file/ER-2537%20Final%20Report.pdf>

#### ESTIMATING INORGANIC ARSENIC EXPOSURE FROM U.S. RICE AND TOTAL WATER INTAKES

Mantha, M., E. Yearn, J. Trent, P. Z. Li, K. Kubackha, T. Hanley, N. Shockey, D. Heitkemper, et al.  
Environmental Health Perspectives 125(5): (2017)

Researchers estimated Americans' inorganic arsenic exposures from drinking water and rice—a food that may contain arsenic—and concluded that rice consumption may account for as much inorganic arsenic exposure as drinking water in some U.S. populations. <https://ehp.niehs.nih.gov/ehp418/> See also J.R. Barrett's commentary on the article in the following issue of EHP, *Rice versus Drinking Water: Estimating the Primary Source of Arsenic in the U.S. Diet*, at <https://ehp.niehs.nih.gov/ehp209/>.

#### EASILY REGENERATED READILY DEPLOYABLE ABSORBENT FOR HEAVY METAL REMOVAL FROM CONTAMINATED WATER

Alagappan, P.N., J. Hejran, J. Morris, E. Andreoli, and A.R. Barron.  
Scientific Reports 7:Article 6682(2017)

Graphene oxide (GO) has been suggested as an adsorbent for heavy metals in water supplies; however, a support is desirable to ensure a high surface area and an immobile phase. This paper describes the preparation and characterization of a support-epoxidized carbon nanotube (SENT) via the growth of multi-walled carbon nanotubes (MWNTs) onto a quartz substrate. Subsequent epoxidation provides sufficient functionality to enable adsorption of heavy metals (Cd, Co, Cu, Hg, Ni, and Pb) from aqueous solution with initial concentrations (60–6000 ppm) chosen to simulate high industrial wastewater contamination. The SENT adsorption efficiency is >99.4% for all metals and the saturation concentration is significantly greater than observed for either GO- or acid-treated MWNTs. The SENT adsorbent can be readily regenerated under mild conditions using ordinary household vinegar. One gram of SENT has the potential to treat 83,000 L of contaminated water down to WHO limits, sufficient to serve 11,000 people. **Open Access at** <https://www.nature.com/articles/s41598-017-06734-7>

#### PAH INTERACTIONS WITH SOIL AND EFFECTS ON BIOACCESSIBILITY AND BIOAVAILABILITY TO HUMANS

Lowney, Y.W., M.V. Ruby, A. Bunge, J. Gomez-Eyles, U. Ghosh, J. Kissel, T. Peckham, S. Roberts, J. Shirali, H. Xia, and C. Menzie.  
SERDP Project ER-1743, 366 pp, 2017

The work described in this report was conducted in response to SERDP's 2010 Statement of Need 10-04: *Mechanisms of Contaminant Interaction with Soil Components and its Impact on the Bioavailability of Contaminants*. The project had multiple objectives: 1: Identify which PAH sorption and uptake pathways, and individual PAHs are driving risk assessments and remedial decisions. 2: Develop an understanding of the mechanisms by which PAHs are sequestered in soil to enable prediction of the magnitude of bioavailability adjustments and to elucidate factors that control the dissolution of PAHs from soil. 3: Develop an animal model that provides quantitative measures of the relative oral bioavailability of PAHs in soil, and generate a database from this animal model to understand bioavailability across diverse soil types and contaminant sources. 4: Evaluate use of simple in vitro extraction tests to predict in vivo measures of relative bioavailability. 5: Assess the effect of soil-chemical interactions on dermal absorption of PAHs. The study provides results that can inform assessments and risk management considerations for DoD sites where PAH-contaminated soils drive cleanup decisions. <https://www.esctr.com/content/download/45158/422055/file/ER-1743%20Final%20Report.pdf>

#### COMBINED BIOLOGICAL AND CHEMICAL MECHANISMS FOR DEGRADATION OF INSENSITIVE MUNITIONS IN THE PRESENCE OF ALTERNATE EXPLOSIVES

Finneran, K.T., S.R. Drew, and C. Arnett.  
SERDP Project ER-2222, 120 pp, 2017

The insensitive munitions (IM) 2,4-dinitroanisole (DNAN) and nitroguanidine (NQ) have been used in newly developed explosives as a replacement for the more sensitive TNT. These new formulations are less sensitive to external shocks (e.g., heat or strikes) and thus are safe to store and use in battle conditions. The objective of this research was to quantify the rate and extent to which IM can be transformed by combined biological and chemical reactions with iron and Fe(II)-reducing microorganisms. <https://www.esctr.com/content/download/45405/423930/file/ER-2222%20Final%20Report.pdf>

#### USING PCA TO REVEAL HIDDEN STRUCTURES IN THE REMEDIATION STEPS OF CHLORINATED SOLVENTS

Johansson, Glenn, Master's thesis, Halmstad University, Sweden. 50 pp, 2017

Principle component analyses (PCA) and correlations matrices were used on sets of TCE and PCE field data from an existing remediation site in southern Sweden. Four important components were extracted in the following order: end products of dechlorination, second wave of dechlorination, first wave of dechlorination, and indicators of dechlorination. The underlying pattern found in the data set likely was derived from thermodynamic preference, which explains important correlations such as the correlation between iron and sulfate and the correlation between redox and degree of dechlorination. The law of thermodynamic preference means that a rough estimation is possible of the level of difficulty and the time it will take to remediate a contaminated site. The findings show that similar theoretical and lab results also apply in the field and that PCA is a potent tool for evaluating large sets of environmental data. It is important to note that the correlations must be examined thoroughly, as correlation is not equal to causation. <http://hh.diva-portal.org/smash/get/diva2/1078460>

#### ANALYTICAL MODEL FOR THE DESIGN OF IN SITU HORIZONTAL PERMEABLE REACTIVE BARRIERS (HPRBS) FOR THE MITIGATION OF CHLORINATED SOLVENT VAPORS IN THE UNSATURATED ZONE

Verginelli, I., O. Capobianco, N. Hartog, and R. Bellocchi.  
Journal of Contaminant Hydrology 197:50-61(2017)

A 1-D analytical solution can be used for the design of horizontal permeable reactive barriers (HPRBs) employed for vapor mitigation at sites affected by chlorinated solvents. The model incorporates transient diffusion-dominated transport with a second-order reaction rate constant and accounts for the HPRB lifetime as a function of the oxidant consumption by reaction with upward vapors and its progressive dissolution and leaching by infiltrating water. Simulation results by this new model closely replicated lab-scale tests carried out on TCE using an HPRB containing a mixture of potassium permanganate, water, and sand. For field applications, design criteria in terms of the minimum HPRB thickness required to attenuate vapors at acceptable risk levels and the expected HPRB lifetime are determined from site-specific conditions, such as vapor source concentration, water infiltration rate and HPRB mixture. Results show the field-scale feasibility of this alternative system for mitigation of chlorinated solvent vapors. Depending on the oxidation kinetic of the target contaminant, an HPRB 1 m thick can ensure attenuation of vapor concentrations of orders of magnitude up to 20 years, even for vapor source concentrations up to 10 mg m<sup>-3</sup>. <http://www.nielsbartog.nl/count/request-0b02d114>

#### COMBINED METHODOLOGIES FOR QUANTIFYING GROUNDWATER DISCHARGE TO SURFACE WATER: THE GOWANUS CANAL SUPERFUND SITE

Adelman, D. and P.C. Schilling  
9th International Conference on Remediation and Management of Contaminated Sediments, January 9-12, 2017, New Orleans, Battelle Press, OH. Abstract only, 2017

To investigate groundwater discharge to the Gowanus Canal Superfund Site (Brooklyn, NY) for remedial design, contractors first utilized distributed temperature sensing (DTS) and Trident Probe surveys to identify potential groundwater discharge areas. Groundwater flow into the canal then was characterized using a quantitative approach focused on higher potential areas. Methods included ultrasonic seepage meter surveys to provide high-resolution specific discharge measurements across tidal cycles; vibrating wire piezometer nests for evaluating long-term vertical hydraulic gradients beneath the canal and estimating long-term specific discharge rates; pressure transducers to monitor canal stage and groundwater levels in the uplands; and barge-mounted sonic drilling rigs for sediment core collection and temporary well installation to obtain hydraulic conductivity data through flexible wall permeameter testing and slug testing. Integration of the investigation data enabled a comprehensive understanding of groundwater discharge to the canal. Results include a canal-wide assessment of potential discharge locations from the DTS and Trident Probe surveys; quantification of short-term discharge from seepage meter data; compilation of sediment hydraulic conductivity values from lab and field measurements; vertical hydraulic gradients in sediments and glacial deposits beneath the canal; estimation of long-term specific discharge for each measurement station; estimation of discharge velocity; and canal-wide interpolation of long-term specific discharge. Results will be used to assist calibration of a groundwater flow model to simulate remedial design scenarios, NAPL mobility evaluation, sediment cap design, and refinement of the overall conceptual site model. *More on DTS in a poster: [http://www.seikemetrics.com/DTS\\_Poster.pdf](http://www.seikemetrics.com/DTS_Poster.pdf)*

#### REMEDATION OF HG-CONTAMINATED MARINE SEDIMENTS BY SIMULTANEOUS APPLICATION OF ENHANCING AGENTS AND MICROWAVE HEATING (MWH)

Falciola, P.P., D. Malarbi, R. Maddalena, V. Greco, and F.G.A. Vagliasindi.  
Chemical Engineering Journal 321:1-10(2017)

Hg removal via a novel microwave heating (MWH) treatment for marine sediment remediation was enhanced by application of several agents: biodegradable complexing agent methylglycinediacetic acid (MGDA), surfactant Tween® 80, and citric acid. Main results revealed that MWH allowed very rapid heating (~450°C in 7 min) of the irradiated medium, but without the addition of enhancing agents, a maximum Hg removal of ~72% was achieved. MGDA application led to ~87% contaminant removal (residual concentration = 5.4 mg/kg). Upon simultaneous addition of both chelating agent and surfactant, their synergistic action and stripping processes yielded ~99% Hg removal at an irradiation time of 7 min, corresponding to a residual concentration of 0.56 mg/kg, which is lower than the Italian regulatory limit of 1 mg/kg. The use of citric acid resulted in a shortening of the removal kinetics, which allowed successful application at a remediation time of 5 min. The observed strong passive ability of sediments to convert microwave irradiation energy into a rapid and large temperature increase represents a key factor in the whole remediation process. The kinetic data are suitable for a preliminary assessment of cleanup effectiveness and as basis for scaling up studies on MWH of Hg-contaminated sediments.

#### THE BIOELECTRIC WELL: A NOVEL APPROACH FOR IN SITU TREATMENT OF HYDROCARBON-CONTAMINATED GROUNDWATER

Palma, E., M. Daghighi, A. Franzetti, M. Petrangeli-Papini, and F. Aulenta.  
Microbial Biotechnology [Published online 2017 July 11 prior to print]

Field-scale application of microbial electrochemical technologies so far has been largely hindered by the limited availability of scalable system configurations. This paper describes a bioelectrochemical reactor configuration—the “bioelectric well”—that can be installed directly within groundwater wells and applied to the in situ treatment of organic contaminants, such as petroleum hydrocarbons. A lab-scale prototype of the bioelectric well was set up and operated in continuous-flow regime with phenol as the model contaminant. The best performance was obtained when the system was inoculated with refinery sludge and the anode was potentiostatically controlled at +0.2 V versus SHE. Under this condition, the influent phenol (25 mg/L) was nearly completely (99.5 ± 0.4%) removed, with an average degradation rate of 59 ± 3 mg/L/d and a coulombic efficiency of 104 ± 4%. Microbial community analysis revealed a remarkable enrichment of *Geobacter* species on the surface of the graphite anode, clearly pointing to direct involvement of this electro-active bacterium in the current-generating and phenol-oxidizing process. **Temporarily Open Access at** <http://onlinelibrary.wiley.com/doi/10.1111/1751-7915.12769/full>

#### COMPREHENSIVE DATABASE OF MANUFACTURED GAS PLANT TARS

Gallacher, C., R. Thomas, R. Lord, R.M. Kalin, and C. Taylor.  
Rapid Communications in Mass Spectrometry 31(15):2017

A total of 16 tar samples were analyzed that originated from five different manufactured gas plant production processes: low temperature horizontal retorts, horizontal retorts, vertical retorts, carbureted water gas, and coke ovens. A total of 2369 unique compounds were detected with 948 aromatic compounds, 196 aliphatic compounds, 380 sulfur-containing compounds, 209 nitrogen-containing compounds, and 15 mixed heterocycles. The use of GCxGC/TOFMS and derivatization allowed the detection of 359 unique compounds, the majority in the form of hydroxylated PAHs, many of which would not have been detected without derivatization. Of the 2369 unique compounds detected, 173 were found to be present within all samples. A unique comprehensive database of the detected compounds was produced. The 173 compounds identified within every sample may be of particular importance from a regulatory standpoint. This initial study indicates that different production processes produce tars with different chemical signatures, and it can be expanded upon by in-depth analysis of the different compound types. *The results of the tar sample analysis project are described in 3 papers, and the abstracts for these papers appear in a single journal issue as follows:*

Part A: Database (Pages 1231-1238) <http://onlinelibrary.wiley.com/doi/10.1002/rcm.7900/full>

Part B: Aliphatic and Aromatic Compounds (Pages 1239-1249) <http://onlinelibrary.wiley.com/doi/10.1002/rcm.7900/full>

Part C: Heterocyclic and Hydroxylated PAHs (Pages 1250-1260) <http://onlinelibrary.wiley.com/doi/10.1002/rcm.7900/full>

#### ANALYSIS OF THE TRANSPORT AND FATE OF METALS RELEASED FROM THE GOLD KING MINE IN THE ANIMAS AND SAN JUAN RIVERS

Sullivan, K., M. Cyterski, C. Knightes, S.R. Kraemer, J. Washington, L. Prieto, and B. Avant.  
EPA 600-R-16-296, 328 pp + Appendices A-F, 2017

On August 5, 2015, a field investigation of the Gold King Mine near Silverton, Colorado, inadvertently triggered an estimated release of 3 million gallons of acidic, mine-impacted waters into the Animas River. These waters had been dammed by a collapsed mine structure and rock at the mine entrance, causing the waters to back up and become pressurized. This report is a scientific evaluation that focuses on understanding the river conditions before the blowout; the movement of the released fluids through the river system; and what has happened to the river since the time of the event. The report and a link to its appendices (see “Supporting data”) can be found at <https://www.epa.gov/goldkingmine/fate-transport-analysis>.

#### General News

##### PLANNING FOR RESPONSE ACTIONS AT ABANDONED MINES WITH UNDERGROUND WORKINGS: BEST PRACTICES FOR PREVENTING SUDDEN, UNCONTROLLED FLUID MINING WASTE RELEASES

OLEM 9200-3-118, 70 pp, 2017

Under CERCLA, EPA may perform response actions, including removal, pre-remedial, and remedial activities, at abandoned mine sites where the potential exists for sudden, uncontrolled releases (commonly referred to as “blowouts”) of fluid mine wastes, such as impounded or pooled mining-influenced water (MIW) in underground mine workings. This report compiles, analyzes, and summarizes common best practices and approaches used or researched nationally and internationally to assess, reduce the risk of, or mitigate blowouts as a result of response actions at abandoned mine sites with underground mine workings. The best practices laid out in this report do not constitute guidance; instead, they represent best professional judgment on a range of approaches that can be applied on a site-specific basis to reduce the risks and uncertainty of sudden, uncontrolled releases of MIW. The risk and uncertainty cannot be completely eliminated from many mine sites, particularly long-neglected sites, given the often complex conditions that exist in underground mine workings with MIW pooling. <https://www.epa.gov/epaoswer/land/blowout/best-practices-for-preventing-sudden-uncontrolled-fluid-mining-waste-releases.pdf>

##### PCB FACILITY APPROVAL STREAMLINING TOOLBOX (FAST): A FRAMEWORK FOR STREAMLINING PCB SITE CLEANUP APPROVALS

EPA 530-F-17-002, 56 pp, 2017

In October 2014, EPA Region 9 conducted the “Lean Six Sigma” event to identify potential process improvements for its PCB cleanup program. The event team developed a list of potential actions to reduce the time and effort required to approve and facilitate their PCB cleanups. Before the event, it took Region 9 an average of 80 days to review and approve an initial PCB Cleanup plan. Amendments to the cleanup plan generally took another 56 days to approve. During the event, participants developed over 25 separate recommendations for internal EPA process improvements and external tools to improve the quality of cleanup applications and notifications. The process improvements, measures, and tools in this document are available to be used to accelerate the pace of PCB cleanups in all 10 EPA regions. <https://www.epa.gov/epaoswer/land/blowout/best-practices-for-preventing-sudden-uncontrolled-fluid-mining-waste-releases.pdf>

##### MANUAL TO IDENTIFY SOURCES OF FLUVIAL SEDIMENT

Gellis, A., F. Fitzpatrick, and J. Schubauer-Berigan.  
EPA 600-R-16-210, 117 pp, 2016

Sediment can degrade and alter aquatic habitat. A sediment budget is an accounting of the sources, storage, and export of sediment over a defined spatial and temporal scale. This manual focuses on field approaches to estimate a sediment budget. The objective of this study was to develop a guidance document for sediment source analysis. The guidance document developed synthesized studies that incorporate sediment fingerprinting and sediment budget approaches in agricultural and urban watersheds. <https://www.epa.gov/epaoswer/land/blowout/best-practices-for-preventing-sudden-uncontrolled-fluid-mining-waste-releases.pdf>

##### COMPLEX CHALLENGES AT LIGHT NON-AQUEOUS PHASE LIQUID SITES

Naval Facilities Engineering Command, ESAT N62583-11-D-0515, 8 pp, 2017

A survey of Navy RPMs indicated that the top three challenges that add complexity to their LNAPL sites are 1) the presence of co-contaminants, 2) highly heterogeneous conditions, and 3) the presence of fractured bedrock, including karst. In addition, RPMs have requested assistance on strategies for addressing LNAPL sites within arctic regions and sites contaminated with long-chained hydrocarbons, such as Navy Special Fuel Oil, Bunker C, and heating oil. These site conditions may result in the need for specialized techniques to characterize and remediate the LNAPL in order to achieve remedial action objectives in a reasonable timeframe and cost. This fact sheet presents an overview of the challenges to support the Navy's approach in managing complex LNAPL sites, and identifies conceptual site model elements to consider in addition to site characterization methods and remedial technology selection and design. [https://www.navfac.navy.mil/content/dam/navfac/Specia%20Centers/Engineering%20and%20Expeditionary%20Wafare%20Center/Environmental/Restoration/er\\_pdfs/lnapfacexw-ev-fs-1707-complex%20LNAPL-201704.pdf](https://www.navfac.navy.mil/content/dam/navfac/Specia%20Centers/Engineering%20and%20Expeditionary%20Wafare%20Center/Environmental/Restoration/er_pdfs/lnapfacexw-ev-fs-1707-complex%20LNAPL-201704.pdf)

##### NEW DEVELOPMENTS IN LNAPL SITE MANAGEMENT

Naval Facilities Engineering Command, 8 pp, 2017

The ways in which owners manage industrial sites containing LNAPL is changing rapidly due to new conceptual models, new technologies, and new tools. This fact sheet summarizes new developments in the area of natural source zone depletion and reviews key tools for evaluating the practicability of total petroleum hydrocarbons and LNAPL recovery. [https://www.navfac.navy.mil/content/dam/navfac/Specia%20Centers/Engineering%20and%20Expeditionary%20Wafare%20Center/Environmental/Restoration/er\\_pdfs/lnapfacexw-ev-fs-1709-newdev-lnapli-201704.pdf](https://www.navfac.navy.mil/content/dam/navfac/Specia%20Centers/Engineering%20and%20Expeditionary%20Wafare%20Center/Environmental/Restoration/er_pdfs/lnapfacexw-ev-fs-1709-newdev-lnapli-201704.pdf)

##### PRODUCTION WELL CONSTRUCTION AND MAINTENANCE FACT SHEET

Naval Facilities Engineering Command, 8 pp, 2017

Production wells, whether they are intended for extraction or injection, are constructed and developed very differently from monitoring wells, with the primary goal of establishing a free-flowing connection between well and aquifer. This fact sheet describes how to maintain the functioning of production wells, including groundwater extraction and reagent injection wells. Production well design is summarized, along with operation and maintenance considerations. [https://www.navfac.navy.mil/content/dam/navfac/Specia%20Centers/Engineering%20and%20Expeditionary%20Wafare%20Center/Environmental/Restoration/er\\_pdfs/lnapfacexw-ev-fs-1708-prodwel-maintenance-201704.pdf](https://www.navfac.navy.mil/content/dam/navfac/Specia%20Centers/Engineering%20and%20Expeditionary%20Wafare%20Center/Environmental/Restoration/er_pdfs/lnapfacexw-ev-fs-1708-prodwel-maintenance-201704.pdf)

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