Thank you for signing in early

The webinar will begin promptly at 12:00 pm ET, 9:00 am PT
SERDP and ESTCP Webinar Series

*The webinar will begin promptly at 12:00 pm ET, 9:00 am PT*

- You have two options for accessing the webinar
  1. Listen to the broadcast audio if your computer is equipped with speakers
  2. Call into the conference line: 303-248-0285
     Required conference ID: 6102000
- For any question or issues, please email serdp-estcp@noblis.org or call 571-372-6565
Managing Groundwater Impacts at Chlorinated Solvent Sites

October 4, 2018
Welcome and Introductions

Rula A. Deeb, Ph.D.
Webinar Coordinator
Webinar Agenda

- **Webinar Logistics** (5 minutes)
  Dr. Rula Deeb, Geosyntec Consultants

- **Overview of SERDP and ESTCP** (5 minutes)
  Dr. Andrea Leeson, SERDP and ESTCP

- **SERDP and ESTCP Strategic Research for Managing Chlorinated Solvents in Groundwater** (15 minutes + Q&A)
  Dr. Andrea Leeson, SERDP and ESTCP

- **Effective Treatment of Chlorinated Solvents in Clay and Silt Using Electrokinetic Techniques** (35 minutes + Q&A)
  Mr. Evan Cox, Geosyntec Consultants

- **Final Q&A session**
How to Ask Questions

Type and send questions at any time using the Q&A panel.
In Case of Technical Difficulties

- Delays in the broadcast audio
  - Click the mute/connect button
  - Wait 3-5 seconds
  - Click the mute/connect button again
  - If delays continue, call into the conference line
    - Call into the conference line: 303-248-0285
    - Required conference ID: 6102000

- Submit a question using the chat box
SERDP & ESTCP Overview

Andrea Leeson, Ph.D.
SERDP & ESTCP
DoD’s Environmental Technology Programs

Science and Technology
- Statutory program established 1991
- DoD, DOE, EPA partnership
  - Advanced technology development to address near-term needs
  - Fundamental research to impact real world environmental management

Demonstration and Validation
- Demonstrate innovative cost-effective environmental and energy technologies
  - Transition technology out of the lab
  - Establish cost and performance
  - Partner with end user and regulator
  - Technology transfer
    - Accelerate commercialization or broader adoption
    - Direct technology insertion
Environmental Drivers

Sustaining Ranges, Facilities and Operations

Maritime Sustainability
Threatened and Endangered Species

UXO and Munitions
Constituents

Sustainable FOB

Toxic Air Emissions and Dust

Noise
Environmental Drivers
Reducing Current and Future Liability

Contamination from Past Practices

- Groundwater, soils and sediments
- Large UXO liability
- Emerging contaminants

Pollution Prevention to Control Life Cycle Costs

- Elimination of pollutants and hazardous materials in manufacturing, maintenance, and operations
- Achieve compliance through pollution prevention
www.serdp-estcp.org
## SERDP and ESTCP Webinar Series

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>October 18, 2018</td>
<td>Restoration of Chlorinated Solvent Contaminated Groundwater Sites: The Value of Information Challenge</td>
</tr>
<tr>
<td>November 1, 2018</td>
<td>Supporting DoD Installation Sustainability Through Informed Stormwater Management</td>
</tr>
<tr>
<td>November 15, 2018</td>
<td>Stormwater Impacts on Sediment Recontamination</td>
</tr>
<tr>
<td>December 13, 2018</td>
<td>Installation Energy and Water Program Area Webinar</td>
</tr>
</tbody>
</table>
For upcoming webinars, please visit

Save the Date!

A three-day symposium showcasing the latest technologies that enhance DoD’s mission through improved environmental and energy performance

November 27-29, 2018
Washington Hilton Hotel

Registration is open
SERDP and ESTCP Strategic Research for Managing Chlorinated Solvents in Groundwater

Andrea Leeson, Ph.D.
SERDP & ESTCP
Strategic Process

SERDP Technical Committees
- Army
- Navy
- Air Force
- DOE
- EPA

Environmental Requirements

Statements of Need

Proposals

Solicitations

Funded Projects
Workshops

Key to identifying data gaps and research questions

Gather end users, policy makers and technology implementers to brainstorm for two days

Generate report summarizing discussions and data needs

Feeds into SERDP & ESTCP strategic plan
Research and Development Efforts
**SERDP Chlorinated Solvents Statement-of-Needs**
Research and Development Efforts
SERDP Chlorinated Solvents Statement-of-Needs

Technologies  Characterization  Complexities  Decision Support

Technologies:
- In Situ Bio
- ISCO
- Abiotic Attenuation
- In Situ Thermal
- Long-Term Monitoring
- Long-Term Attenuation
- Abiotic Attenuation

Timeline:
- 1998
- 2000
- 2002
- 2004
- 2006
- 2008
- 2010
- 2012
- 2014
- 2016
Research and Development Efforts
SERDP Chlorinated Solvents Statement-of-Needs

Technologies
Characterization
Complexities
Decision Support

- DNAPL Source Identification
- In Situ Bio
- ISCO
- Source Delineation
- Abiotic Attenuation
- In Situ Thermal
- MBTs
- Vapor Intrusion
- Long-Term Monitoring
- Fine Scale Delineation
- Long-Term Attenuation
- Abiotic Attenuation
- In Situ Bio
Research and Development Efforts
SERDP Chlorinated Solvents Statement-of-Needs

Technologies
- Improved Mixing
- Source Delineation
- Improved Distribution
- Fractured Media
- Large Dilute Plumes
- Remedy Optimization
- Fine Scale Delineation
- Mixed Contamination

Characterization
- DNAPL Source Identification
- In Situ Bio
- ISCO
- Abiotic Attenuation
- In Situ Thermal
- MBTs
- Vapor Intrusion
- Long-Term Monitoring
- Long-Term Attenuation
- Abiotic Attenuation

Complexities
- Improved Mixing
- Source Delineation
- Improved Distribution
- Fractured Media
- Low-K Zones
- Long-Term Attenuation
- In Situ Thermal
- ISCO
- MBTs
- Vapor Intrusion
- Long-Term Monitoring
- Long-Term Attenuation
- Mixed Contamination

Decision Support
- Improved Mixing
- Source Delineation
- Improved Distribution
- Fractured Media
- Large Dilute Plumes
- Remedy Optimization
- Fine Scale Delineation
- Mixed Contamination

Technologies: Characterization Complexities Decision Support
Research and Development Efforts
SERDP Chlorinated Solvents Statement-of-Needs

- Technologies
- Characterization
- Complexities
- Decision Support

- Improved Mixing
- Source Delineation
- Impacts of Treating Sources
- Abiotic Attenuation
- In Situ Bio
- ISCO
- Abiotic Attenuation
- In Situ Thermal
- Improved Distribution
- Fractured Media
- MBTs
- Vapor Intrusion
- Plume Response
- Long-Term Monitoring
- Long-Term Attenuation
- Fine Scale Delineation
- Post-Remediation Performance
- Abiotic Attenuation
- Low-K Zones
- Large Dilute Plumes
- Remediation GW Impacts
- Remedy Optimization
- Mixed Contamination

- DNAPL Source Identification
- Impacts of Treating Sources
- Abiotic Attenuation
- ISCO
- In Situ Bio
- ISCO
- In Situ Thermal
- Improved Distribution
- Fractured Media
- MBTs
- Vapor Intrusion
- Plume Response
- Long-Term Monitoring
- Long-Term Attenuation
- Fine Scale Delineation
- Post-Remediation Performance
- Abiotic Attenuation
- Low-K Zones
- Large Dilute Plumes
- Remediation GW Impacts
- Remedy Optimization
- Mixed Contamination

Pending Issues

- Are we done yet?
- Implications of shrinking budgets?
- Future technologies (omics, sensors, IoT)?
- How to handle “underperforming remedies”? 
- Accept limits or overwhelm complex sites?
**Workshop: Management of DoD’s Chlorinated Solvents in Groundwater Sites**

- Held July 2018; attended by ~70 representatives from academia, industry, DoD, DOE, EPA and State agencies

- Objectives
  - Review current state of the science regarding chlorinated solvent contamination in groundwater;
  - Evaluate whether currently available characterization, remediation, and monitoring technologies meet users’ needs and requirements; and
  - *Identify and prioritize remaining research, demonstration and technology transfer opportunities*
Workshop Approach

- **Formal presentations**
  - State of the science
  - Current management challenges, barriers and limitations to achieving cleanup goals

- **Small breakout group discussions**
  - Optimal role for SERDP/ESTCP
  - Each breakout group received focus questions

- **Large group discussion for consensus**
Focus Questions

- Defining the new conceptual site model (CSM) for remaining sites in the DoD inventory
  - Do we have source zones that still need to be addressed?
  - How should we address back-diffusion?
  - How does the presence of contaminants such as PFASs, ethanes, 1,4-dioxane, and other emerging and recalcitrant compounds impact the CSM?
Focus Questions (Cont’d)

- Site characterization and fine scale delineation
  - Do we have the tools we need?
  - What major challenges and opportunities in characterizing and managing chlorinated solvent sites remain?
Focus Questions (Cont’d)

- Long term performance of remediation technologies
  - What are the most promising technologies?
  - What are the opportunities to reduce monitoring and O&M costs?
Focus Questions (Cont’d)

- Technology transfer issues
  - Where is technology transfer most critically absent?
  - What methodologies could be used to improve technology transfer to key communities?
Focus Questions (Cont’d)

- Future directions
  - Are there issues associated with contaminated groundwater that are not being addressed? Do we need to revisit issues we thought to be complete (i.e., petroleum hydrocarbons, etc.)?
Research, demonstration and technology transfer needs

CSM

- Long term performance
- Site Characterization
- Future
- Tech transfer
Preliminary Workshop Report Results

- Improved understanding and quantification of natural attenuation mechanisms in plumes
- Quantitative understanding of effect of co-contaminants on CVOCs
- Integration of information from fine-scale delineation tools for improved decision making at complex sites
- Comprehensive decision framework for remedy selection
- Improved CSMs for understanding the factors sustaining and controlling persistent chlorinated solvent plume behavior
- Fundamental understanding of processes influencing effectiveness and fate of particulate amendments
- Improved analysis of performance data from P&T systems to predict decline in mass discharge over time
- Methodologies to determine ability to transition from active measures
Preliminary Workshop Report Results

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- Methodologies to determine ability to transition from active measures
Timeline

- Report published: Mid-October
- SERDP Solicitation Released: Late October
- ESTCP Solicitation Released: Early January
For additional information, please visit https://www.serdp-estcp.org/

Speaker Contact Information
andrea.leeson.civ@mail.mil
Effective Treatment of Chlorinated Solvents in Clay and Silt Using Electrokinetic Techniques

Evan Cox
Geosyntec Consultants
Agenda

- Frustrated with low permeability materials?
- What is EK and how does it work?
- How is EK applied in the field?
- EK applicability to DoD sites
- PCE source treatment by EK-BIO™
- New EK frontiers

Notes:
DoD = Department of Defense, EK = electrokinetic, EK-BIO™ = EK-enhanced bioremediation
Frustrated With Low Permeability Materials?

- Secondary sources of contaminants
- Distribution of EISB, ISCO, and ISCR amendment poor in low-K and heterogeneous materials

Notes:
DNAPL = dense non-aqueous phase liquid, EISB = enhanced in-situ bioremediation, ISCO = in situ chemical oxidation, ISCR = in situ chemical reduction
Frustrated With Low Permeability Materials?

Need Better Amendment Delivery Techniques

Delivery + Contact
What is EK and How Does it Work?

- Application of direct current (DC) to saturated subsurface
- Amendments move through clays and silts by
  - Electro-migration (EM) – movement of charged ions
  - Electro-osmosis (EO) – bulk movement of water
What is EK and How Does it Work?

Notes:
- Anions: negatively-charged ions
- Cations: positively-charged ions
- Anode: positively-charged electrode
- Cathode: positively-charged electrode
Why EK where Hydraulic Injection Fails?

- Electrical (not hydraulic) soil properties affect transport
- Soil electrical properties = between sand and clay
- EK more efficient as $K_h$ decreases

Note:

$K_h =$ horizontal hydraulic conductivity
Why EK where Hydraulic Injection Fails?

Permeability (centimeters per second [cm/s])

- Fine sand
- Silty clay
- Rock flour
- Kaolin
- Yazoo clay
- Bentonite

$K_e$ and $K_h$
How is EK Applied in the Field?

Electron donor amendment

Amendment supply well

Electron donors follow electric field
## EK Technologies

<table>
<thead>
<tr>
<th>Technology</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EK-BIO™</td>
<td>Distribution of electron donors (lactate) or acceptors (oxygen, nitrate) and/or microorganisms (<em>Dehalococcoides, Dehalobacter</em>) to promote biodegradation</td>
</tr>
<tr>
<td>EK-ISCO™</td>
<td>Distribution of permanganate (MnO$_4^-$) to promote oxidation</td>
</tr>
<tr>
<td>EK-TAP™</td>
<td>Distribution of persulfate (S$_2$O$_8^{2-}$) by EK (DC current), followed by thermal activation of the persulfate (AC current)</td>
</tr>
<tr>
<td>EK-ISCR™</td>
<td>Distribution of reductants such as nano-zero valent ion (ZVI) to promote reduction</td>
</tr>
<tr>
<td>EK-SALT™</td>
<td>Use of electromigration to migrate salts to collection points for removal or destruction</td>
</tr>
</tbody>
</table>
# EK Applicability to DoD Sites

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>EK-BIO&lt;sup&gt;TM&lt;/sup&gt;</th>
<th>EK-ISCO&lt;sup&gt;TM&lt;/sup&gt;</th>
<th>EK-TAP&lt;sup&gt;TM&lt;/sup&gt;</th>
<th>EK-ISCR&lt;sup&gt;TM&lt;/sup&gt;</th>
<th>EK (Other)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorinated Ethenes (PCE, TCE)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Chlorinated Ethanes and Methanes (TCA, CT)</td>
<td>Yes</td>
<td>Selected</td>
<td>Yes</td>
<td>Selected</td>
<td></td>
</tr>
<tr>
<td>1,4-Dioxane</td>
<td>TBD</td>
<td></td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perchlorate</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td>Yes (SALT)</td>
</tr>
<tr>
<td>RDX</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td>Yes (Alkaline Hydrolysis)</td>
</tr>
<tr>
<td>Redox-Sensitive Metals</td>
<td>Some</td>
<td></td>
<td>Some</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PFAS</td>
<td></td>
<td>TBD</td>
<td></td>
<td>TBD</td>
<td></td>
</tr>
</tbody>
</table>

CT = carbon tetrachloride, RDX = royal demolition explosive, PFAS = per- and polyfluoroalkyl substances, TBD = to be determined, TCA = 1,1,1-trichloroethane, TCE = trichloroethene

SERDP & ESTCP Webinar Series (#80)
PCE Source Treatment by EK-BIO™
Naval Air Station Jacksonville, Florida

- Former dry cleaner
- Source for large dissolved plume in shallow sandy aquifer
  - Source area under active parking lot
- Many subsurface utilities

Demonstration area
Source Area Characterization

Contaminants Diffused into Low-K Materials

OU3-3 Soil (VOC) (µg/g soil)

Groundwater Concentration (µg/L)

Notes:
CL = clay, mg/L = milligrams per liter, NC = not characterized, SP = sand, µg/g = micrograms per gram, µg/L = micrograms per liter, VOC = volatile organic compound

PCE at 15 – 40 mg/L in clay (long term source)
EK-BIO™ Installation

- Treatment area
  35 ft x 35 ft
- 9 electrode wells
  (~ 17.5 ft spacing)
- 8 supply wells
  (no electrode)
Remediation Operation

- Two stages of 5 months active operation
- Total power ~1,500 kilowatt-hours (kW-hr)
  - ~2 100-W lightbulbs
- Lactate and buffer amendment supply
- One-time KB-1® bioaugmentation
# Electron Donor Distribution

<table>
<thead>
<tr>
<th>Well ID</th>
<th>TOC (baseline)</th>
<th>TOC (maximum)</th>
<th>VFA (baseline)</th>
<th>VFA (maximum)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EKMW-01</td>
<td>2.5</td>
<td>20.1</td>
<td>2.3</td>
<td>60.7</td>
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<tr>
<td>EKMW-02</td>
<td>2.5</td>
<td>36.2</td>
<td>1.6</td>
<td>141.3</td>
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<tr>
<td>EKMW-03</td>
<td>2.5</td>
<td>57.9</td>
<td>0.7</td>
<td>233</td>
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<td>EKMW-04</td>
<td>3.6</td>
<td>4.7</td>
<td>1.9</td>
<td>18.3</td>
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<td>EKMW-05</td>
<td>1.7</td>
<td>15.9</td>
<td>1.8</td>
<td>6.6</td>
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<tr>
<td>EKMW-07</td>
<td>6.8</td>
<td>57</td>
<td>2.2</td>
<td>204.7</td>
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<tr>
<td>EKMW-09*</td>
<td>1.6</td>
<td>1.9</td>
<td>2.3</td>
<td>1.4</td>
</tr>
<tr>
<td>EKMW-10*</td>
<td>1.9</td>
<td>10.1</td>
<td>1.3</td>
<td>1.4</td>
</tr>
</tbody>
</table>

Notes:
TOC = total organic carbon; VFA = volatile fatty acids
* EKMW-09 and EKMW-10 are background wells outside target treatment area (TTA)
Well and Geoprobe Locations
Background Wells
VOCs and Biomarkers

EKMW-09 (Upgradient)

Notes:
Dhc = *dehalococcoides*, µm = micromolar, vcrA = vinyl chloride reductase

<table>
<thead>
<tr>
<th>Date</th>
<th>Stage 1</th>
<th>Stage 2</th>
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</thead>
<tbody>
<tr>
<td>10/2014</td>
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<td>3/2017</td>
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<td></td>
</tr>
<tr>
<td>6/2017</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Concentration (µM)

Notes:
Dhc = *dehalococcoides*, µm = micromolar, vcrA = vinyl chloride reductase
Groundwater Within Test Area
VOCs and Biomarkers

EKMW-01

Concentration (µM)

Date


Stage 1 Stage 2

Date

0 20 40 60 80 100 120 140 160

0 1.E+03 1.E+04 1.E+05 1.E+06

Dhc / vcrA (cell or gene copies/L)

Ethene cDCE VC TCE PCE

vcrA

PCE

Dhc

vcra

EKMW-01

Stage 1

Stage 2

Groundwater Within Test Area

VOCs and Biomarkers

EKMW-02

<table>
<thead>
<tr>
<th>Date</th>
<th>Concentration (µM)</th>
<th>Dhc / vcrA (cell or gene copies/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/2014</td>
<td>Ethene</td>
<td>10/2014</td>
</tr>
<tr>
<td>9/2016</td>
<td>Ethene</td>
<td>9/2016</td>
</tr>
<tr>
<td>3/2017</td>
<td>Ethene</td>
<td>3/2017</td>
</tr>
<tr>
<td>6/2017</td>
<td>Ethene</td>
<td>6/2017</td>
</tr>
</tbody>
</table>

Stage 1

Stage 2

PCE

Dhc

vcrA

vcrA

VC

cDCE

TCE
Groundwater Within Test Area
VOCs and Biomarkers (End - June 2017)

Geoprobe locations compared to EKMW-01

- Concentration (µM)

- C2: Ethene, VC, cDCE, TCE
- C3: Ethene, VC, cDCE, TCE
- C7: Ethene, VC, cDCE, TCE
- EKMW-01: Ethene, VC, cDCE, TCE
- EKMW-04: Ethene, VC, cDCE, TCE
### Groundwater Within Test Area

**VOCs and Biomarkers (End - June 2017)**

<table>
<thead>
<tr>
<th>Location</th>
<th>PCE</th>
<th>TCE</th>
<th>cDCE ($\mu$g/L)</th>
<th>VC</th>
<th>Ethene</th>
<th>Dhc ($\mu$g/L)</th>
<th>vcrA (gene/L)</th>
<th>TOC (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>C2</strong></td>
<td>11</td>
<td>5</td>
<td>86</td>
<td>1200</td>
<td>1710</td>
<td>5E+06</td>
<td>4E+06</td>
<td>950</td>
</tr>
<tr>
<td><strong>C3</strong></td>
<td>160</td>
<td>430</td>
<td>3700</td>
<td>570</td>
<td>474</td>
<td>2E+05</td>
<td>1E+05</td>
<td>160</td>
</tr>
<tr>
<td><strong>C7</strong></td>
<td>28</td>
<td>29</td>
<td>220</td>
<td>330</td>
<td>1880</td>
<td>2E+07</td>
<td>1E+07</td>
<td>820</td>
</tr>
</tbody>
</table>

---

**Groundwater Within Test Area**

- **VOCs** and **Biomarkers (End - June 2017)**
  - **µg/L**
  - **mg/L**

---

SERDP & ESTCP Webinar Series (#80)
Treatment Results for Soil VOCs

_PCE Concentration Reduction 78%-99%_

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**Soil CVOC (Baseline vs. April 2016 vs. June 2017)**

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Note:
CVOC = chlorinated volatile organic compound

SERDP & ESTCP Webinar Series (#80)
Treatment Results for Soil VOCs
Some Stage 1 → 2 Decrease Outside Treatment Area

Soil CVOC (Baseline vs. April 2016 vs. June 2017)

- CVOC (µmol/kg)
- 2014 2016 2017
- 18.5 feet 21 feet
- C6 C10 (Outside Treatment Area)
- PCE TCE cis-DCE VC
Conclusions

- Complete dechlorination of PCE to ethene
- Substantial increases in dehalorespiring bacteria
- Treatment within clay materials
- Low energy consumption
- Safe implementation
  - Active parking lot, many utilities
- Innovative, fundamentally different solution to a vexing problem!
New EK Frontiers

- EK-TAP for the remediation of chlorinated and recalcitrant compounds in heterogeneous and low permeability zones
- Electrochemical oxidation of AFFF-impacted groundwater using boron-doped diamond anodes
- Alkaline hydrolysis to treat explosives
- EK-SALT – Removal or biodegradation of perchlorate in clay
New EK Frontiers

Electrokinetically-Delivered, Thermally-Activated Persulfate Oxidation (EK-TAP) for the Remediation of Chlorinated and Recalcitrant Compounds in Heterogeneous and Low Permeability Source Zones

Mr. Evan Cox | Geosyntec Consultants
ER-201626

Objective | Technology | Benefits

Objective

This project will demonstrate/validate (Dem/Val) the ability of a novel combined in situ remediation approach, referred to as electrokinetically-delivered, thermally-activated persulfate (EK-TAP), to remediate chlorinated solvents and recalcitrant chemicals (e.g., 1,4-dioxane) in low permeability (K) and heterogeneous geological materials. The technical objectives include: (1) demonstration and quantification of the ability to uniformly distribute persulfate throughout a low-K treatment area using a direct current (DC) electric field; (2) demonstration of activation of the persulfate by heating the treatment area using an alternating current (AC) electric field, and subsequent treatment of the chemicals of concern (COCs); (3) quantification of EK-TAP system operational parameters to develop tools for full-scale system design and optimization; (4) development of costing information for technology evaluation and use by the Department of Defense (DoD) and remediation practitioners; and (5) development of technical guidance to assist with rapid technology transfer.
Acknowledgments

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  - James Wang
  - David Reynolds
  - Rachel Klinger

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  - David Gent

- **Naval Facilities (NAVFAC) Southeast**
  - Michael Singletary
  - Adrienne Wilson
For additional information, please visit https://www.serdp-estcp.org/Program-Areas/Environmental-Restoration/Contaminated-Groundwater/Persistent-Contamination/ER-201325

Speaker Contact Information
ecox@geosyntec.com; 519-514-2235
Q&A Session 2
The next webinar is on October 18, 2018

Restoration of Chlorinated Solvent Contaminated Groundwater Sites: The Value of Information Challenge
Survey Reminder

Please take a moment to complete the survey that will pop up on your screen when the webinar ends