## Fifth International Symposium on Bioremediation and Sustainable Environmental Technologies

# FINAL PROGRAM

April 15-18, 2019 | Baltimore, Maryland
battelle.org/biosymp | #BattelleBioSymp19

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Battelle's environmental engineers, scientists and professionals offer focused expertise to government and industrial clients in the U.S. and abroad. Combining sound science and engineering solutions with creative management strategies, Battelle works with clients to develop innovative, sustainable, and cost-effective solutions to complex problems in site characterization, assessment, monitoring, remediation, restoration, and management. Every day, the people of Battelle apply science and technology to solving what matters most. At major technology centers and national laboratories around the world, Battelle conducts research and development, designs and manufactures products, and delivers critical services for government and commercial customers. Headquartered in Columbus, Ohio, since its founding in 1929, Battelle serves the national security, health and life sciences, and energy and environmental industries.

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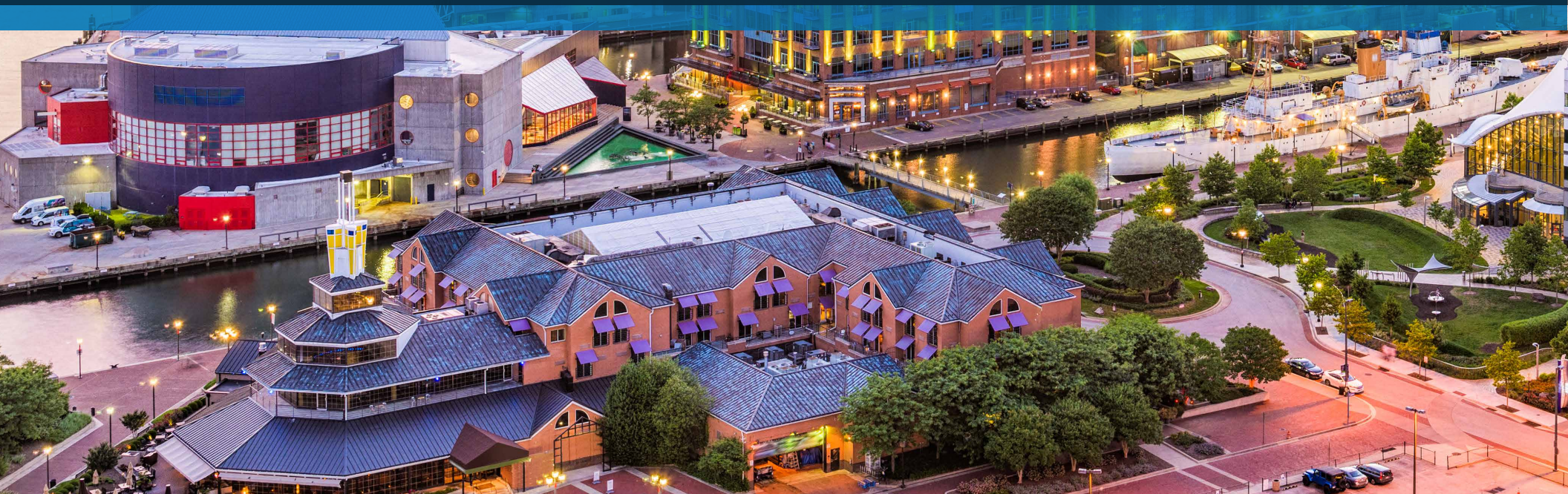

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# Fifth International Symposium on Bioremediation and Sustainable Environmental Technologies

Welcome to Baltimore! Thank you for attending the 2019 Bioremediation Symposium. We believe you will find both the technical program content and the networking opportunities well worth your time.

We're looking forward to a great week, with more than 700 environmental professionals from 28 countries participating in the extensive technical program and other events. We appreciate the participation of the Symposium Sponsors, whose financial support has been an important part of the planning process. In addition, we recognize the efforts of the Technical Steering Committee, the session chairs, and panel organizers who have devoted their time and technical expertise to developing a high-quality program.

Three short courses will be offered on Monday, April 15. From Tuesday through Thursday, 48 technical sessions and 4 panel discussions will be conducted. Consisting of more than 470 platform and poster presentations, the technical program will present information on the development, implementation, use, and results of advanced tools for assessment and monitoring, as well as the challenges of applying bioremediation at various types of complex sites. Several sessions will focus on treatment technologies for emerging contaminants, including per- and polyfluoroalkyl substances (PFAS). Posters will be presented in two groups, on Tuesday and Wednesday evenings. The four panel discussions will present timely topics including PFAS risks and liability, PFAS communications strategy, corporate Green and Sustainable Remediation (GSR) programs, and the increased role of geology in successful remediation. These panels include industry experts presenting the state-of-the-practice in these areas of interest.

The Symposium Registration Desk will open Monday, April 15, at 2:00 p.m. and the Plenary Session, featuring Dr. John Cherry, will commence at 5:30 p.m. Dr. Cherry's presentation will examine the record of groundwater contamination and remediation over past decades, consider what has and has not been accomplished and provide a proposal for the path into the future. The Welcome Reception, immediately following the Plenary, from 7:00-9:00 p.m., will feature the 57 exhibit booths and Group 1 poster display. The technical program will conclude at 4:20 p.m. on Thursday afternoon and will be followed by a closing cocktail reception from 4:30-5:00 p.m.

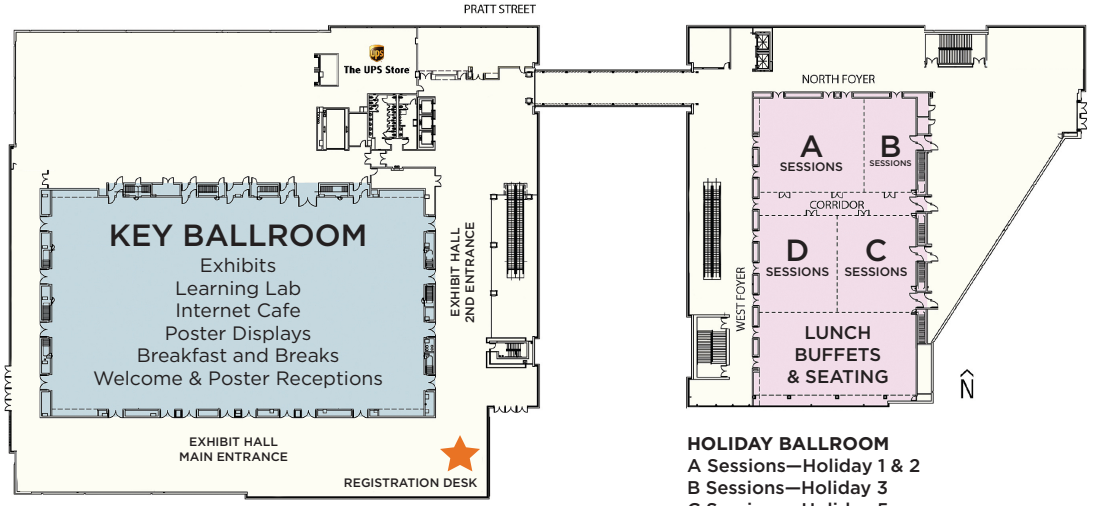
Situated in Baltimore's Inner Harbor, the Hilton is conveniently located within a few minutes' walk to Camden Yards, home of the Baltimore Orioles, M&T Stadium, home of the Baltimore Ravens, the Maryland Science Center, the National Aquarium, four historic ships, and many restaurants, museums, and shops. This beautiful city is full of historic significance and features a wide-variety of tours and attractions to choose from. Famous for its delectable seafood fare, specifically Maryland blue crab, a visit to one of the local Chesapeake restaurants or to one of the hundreds of other unique options is sure to satisfy even the die-hard foodie. Baltimore has a thriving pub-culture that is home to many artisan-crafted brews, with many local breweries offering daily tours.

We hope you enjoy your time at the Symposium.

**Andrew Barton**
**Rick Wice**
Symposium Chairs (Battelle)

**CONTENTS**

# Symposium Floor Plan

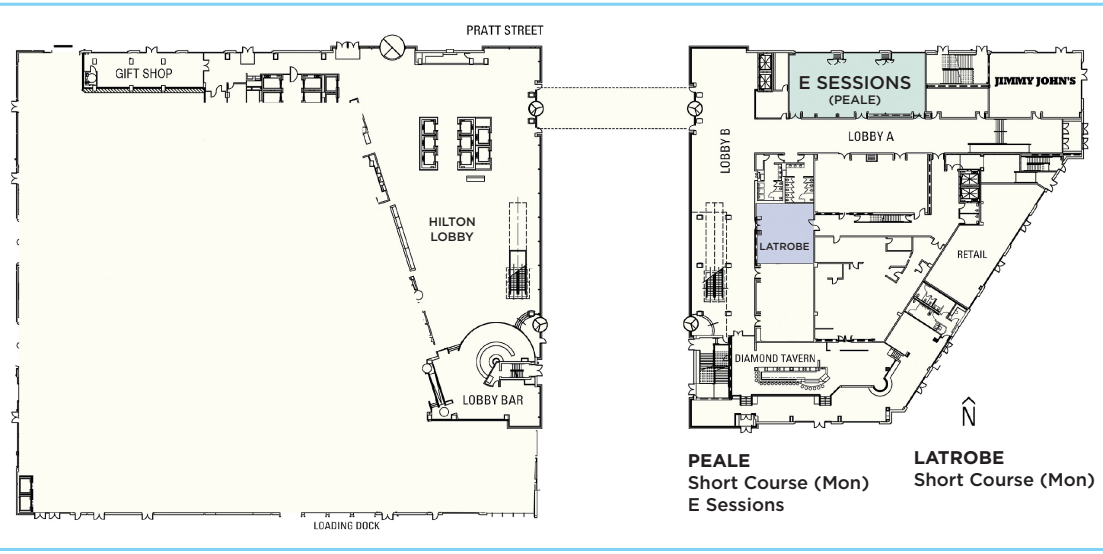



**KEY BALLROOM**
SOUTH FOYER
Symposium Registration Desk
Exhibit Hall Main Entrance
Lunch Buffets & Seating

EAST FOYER
Exhibit Hall 2nd Entrance

**HOLIDAY BALLROOM**
A Sessions—Holiday 1 & 2
B Sessions—Holiday 3
C Sessions—Holiday 5
D Sessions—Holiday 4
Lunch Buffets & Seating—Holiday 6

## HILTON SECOND FLOOR

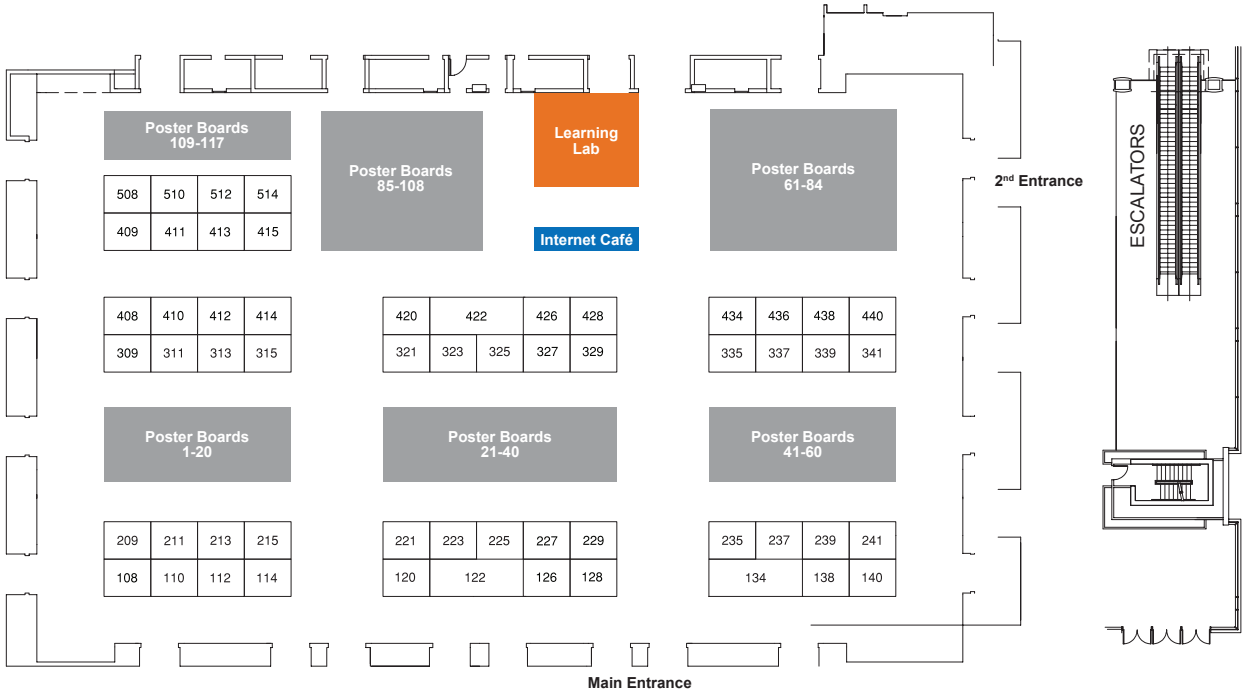



**PEALE**
Short Course (Mon)
E Sessions

**LATROBE**
Short Course (Mon)

## HILTON FIRST FLOOR

# Exhibit Hall Floor Plan




## Exhibit Hall Hours

**Monday, April 15:** 7:00–9:00 p.m.
**Tuesday, April 16:** 7:00 a.m.–7:00 p.m.
**Wednesday, April 17:** 7:00 a.m.–7:00 p.m.
**Thursday, April 18:** 7:00 a.m.–1:00 p.m.

**Symposium Sponsors are shown in bold.**

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# Plenary Session

## Plenary Session Schedule

**Monday, April 15, 5:30-7:00 p.m.**
**(Holiday Ballroom 4 & 5)**

**Welcome and Opening Remarks**

Symposium Chairs:
*Andrew Barton (Battelle)*
*Rick Wice (Battelle)*

**Presentation of Student Paper Awards**

**Groundwater Contamination: Past, Present and Future**

John A. Cherry, Ph.D., PE, FRSC (Director of the University Consortium for Field-Focused Groundwater Research, University of Guelph)

Dr. John Cherry holds geological engineering degrees from the University of Saskatchewan and the University of California, Berkeley as well as a Ph.D. in geology from the University of Illinois. He currently is an Adjunct Professor at the University of Guelph, Canada, where he is Director at the University Consortium for Field-Focused Groundwater Research and Associate Director of the G360 Institute for Groundwater Research. He holds the title of Distinguished Emeritus Professor, University of Waterloo, Canada, where he was based from 1971-2006 and is an Honorary Professor at the University of Hong Kong. He has received many awards and honors from scientific and professional organizations in Canada, the USA, and UK. In 2016, he was awarded the Lee Kuan Yew Water Prize (Singapore) for global contributions to groundwater science and technology.

He is a Foreign Member of the U.S. National Academy of Engineering, Fellow of the Royal Society of Canada and holds an honorary doctorate from the University of Neuchatel. He was the Chair (2012-2014) of the Canadian Expert Panel on Environmental Impacts of Shale Gas Development (fracking). He is an advisor to the Government of Singapore and is Co-chair of the International Scientific Advisory Committee (ISAC) Chinese Research Academy of Environmental Science (CRAES), which is part of the China Ministry of Environmental Protection. His current research involves collaborative studies of: 1) the chemical evolution of natural and contaminated groundwater in unfractured and fractured aquifers and aquitards, 2) advancement of engineered monitoring systems for groundwater flow and hydrogeochemistry, and 3) use of portable drills to create small capacity wells for safe drinking water in developing countries. As a follow-up to the 1979 textbook *Groundwater* (by Freeze and Cherry), he initiated a project in 2017 involving more than 100 experts from 12 countries on five continents to create an online comprehensive groundwater textbook with supporting learning materials for global availability free of charge.

The nature of groundwater contamination has changed immensely since initial recognition of a few types of groundwater contamination in the earliest era in the 1950s and 1960s. In the past 70 years, much has been learned to guide us into the future for better management and protection of groundwater resources. The literature of that earliest era reported on a few contamination issues, notably petroleum, detergents, leachate from municipal landfills and radionuclides released from meltdown of experimental nuclear reactors. Groundwater contamination problems were sparse, and the nature of the contamination supported the general belief that groundwater contaminant plumes generally are small, limited by the assimilation capacity of the soil/groundwater system.

The U.S. Environmental Protection Agency was established in 1970, as was Earth Day. The Safe Drinking Water Act was passed in 1974 and, in the 1970s, recognition of groundwater contamination as a substantial issue began its ascent. The discovery of chlorinated solvents in public water supply wells began to become a recognized problem in 1976 and in the water supply industry by 1979. But it was not until RCRA regulations and CERCLA were established in 1980 that the widespread occurrence of volatile organics began to become recognized as an immense problem. By 1990 the current era of groundwater contamination became established based on the DNAPL paradigm and related understanding of the nature of the problem wherein chlorinated solvents and related chemicals are the primary issue for widespread groundwater contamination of industrial origins. The edict in RCRA and CERCLA was to clean up to drinking water standards. However, because of the limitations imposed by DNAPL and back-diffusion, this degree of cleanup has been proven to be rarely technically/economically feasible. Much beneficial remediation has been accomplished but not to a drinking water standard. Beyond the USA, there has been much less emphasis on site remediation and focus on water treatment at the end of the pipe for the water users. We now know that nearly all freshwater aquifers throughout the industrialized world have some degree of contamination from one or more agricultural, industrial, or municipal activities and now PFAS have been discovered as widespread additions to the groundwater problem. This presentation will examine the record of groundwater contamination and remediation over past decades, consider what has been accomplished and not accomplished and provide a proposal for the path into the future.

# General Information

All Symposium events will be held at the Hilton Baltimore Inner Harbor located at 410 W. Pratt Street, Baltimore, Maryland, 21201.

The 48 breakout sessions and 4 panels are organized into the following thematic tracks:

- **Characterization and Remediation of PFAS** (Sessions A1-A7)
- **Green and Sustainable Remediation (GSR)** (Sessions A8-A10)
- **Bioremediation Implementation Practices** (Sessions B1-B8)
- **Application of Bioremediation to Complex Sites** (Sessions C1-C4)
- **Biodegradation of Emerging Contaminants** (Sessions C5-C7)
- **Sustainable Site Management Strategies** (Sessions C8-C10)
- **Innovations in Bioremediation Technologies** (Sessions D1-D6)
- **Evaluating and Mitigating Vapor Intrusion** (Sessions D7-D9)
- **Advanced Tools for Assessing Bioremediation** (Sessions E1-E7)
- **Managing Petroleum Hydrocarbon-Impacted Sites** (Sessions E8-E11)

## Program Overview

**Monday, April 15**

- **8:00 a.m.–5:00 p.m.** Short Courses
- **2:00–9:00 p.m.** Registration Desk Open
- **5:30–7:00 p.m.** Plenary Session
- **7:00–9:00 p.m.** Welcome Reception, Exhibits, Poster Group 1 Display

**Tuesday, April 16**

- **7:00–8:00 a.m.** Continental Breakfast
- **8:00 a.m.–5:35 p.m.** Platform Presentations
- **9:00–9:30 a.m.** Morning Beverage Break
- **11:30 a.m.–1:00 p.m.** General Lunch
- **2:30–3:00 p.m.** Afternoon Beverage Break
- **5:45–7:00 p.m.** Group 1 Poster Presentations & Networking Reception

**Wednesday, April 17**

- **7:00–8:00 a.m.** Continental Breakfast
- **8:00 a.m.–5:35 p.m.** Platform Presentations
- **9:00–9:30 a.m.** Morning Beverage Break
- **11:30 a.m.–1:00 p.m.** General Lunch
- **2:30–3:00 p.m.** Afternoon Beverage Break
- **5:45–7:00 p.m.** Group 2 Poster Presentations & Networking Reception

**Thursday, April 18**

- **7:00–8:00 a.m.** Continental Breakfast
- **8:00 a.m.–4:20 p.m.** Platform Presentations
- **9:00–9:30 a.m.** Morning Beverage Break
- **11:30 a.m.–1:00 p.m.** General Lunch
- **2:30–3:00 p.m.** Afternoon Beverage Break
- **4:20 p.m.** Symposium Adjourns
- **4:30–5:00 p.m.** Closing Cocktail Reception

See the following pages for additional information:

- Page 11: Short Courses offered on Monday.
- Pages 18 and 28: Sessions in each of the two poster groups.
- Page 44: Overview of the platform sessions and panels to be conducted each day. Times for exhibits, breakfasts, beverage breaks, lunches, and receptions.

## Presentations

Platform and poster presentations scheduled as of March 13, 2019, are listed by day on pages 14-37.

Late revisions in **platform presentations** (speaker changes, withdrawals) will be marked on overview sheets posted in the registration area and on daily lists outside each breakout room.

Talks are scheduled at 25-minute intervals, and each talk is to begin promptly at the time printed in the schedule, except as may be noted at the beginning of the day on the overview sheets and the daily lists. Session chairs will adhere strictly to the schedule, making it possible for registrants to move between breakout rooms to hear the talks most pertinent to them. To minimize distraction, please confine such movement to the short intervals between talks.

Posters will be presented on Tuesday and Wednesday evenings in the Exhibit Hall. During the poster sessions, presenters will be standing at their posters to discuss their work, and light refreshments will be served. See pages 18-23 and 28-33 for details on the poster presentations.

***Audio, video, and still photography are prohibited in session rooms during platform presentations or panel discussions without FIRST securing the speaker(s) permission and notifying the session chair or panel moderator in advance. Video and still photography of poster board presentations is also prohibited without FIRST securing author/speaker permission.***

## Professional Development

**General Certificate of Attendance.** If you would like to receive a general certificate of Symposium attendance, you may sign up at the Registration Desk. General attendance certificates do not require daily sign-in/out and will not include the days or number of hours attended. A PDF certificate will be emailed after the Symposium.

**State of Massachusetts LSP Credits.** Technical program attendance and select short courses have been approved by the State of Massachusetts for LSP credit as seen below.

- 1 Technical credit for every 2 hours of Symposium attendance
- 1 Technical credit for every 1 hour of short course attendance

**Compliance for Massachusetts LSP Credits.** The Symposium Office is required to maintain attendance logs per the State of Massachusetts' requirements. To obtain LSP credits, you are required to sign in at the Registration Desk each day when you arrive at the Symposium and sign out when you leave. You may not complete or sign a previous days' log, even if you have a technical program role, no exceptions. Only those days with complete attendance logs (i.e., sign-in, sign-out, signature, and Registration Desk staff confirmation) will be included on your attendance certificate. Sign-out must be completed prior to the Registration Desk closing each evening.

## Exhibits

Booths will be provided by 57 organizations that conduct remediation activities or supply equipment used in such work. Exhibits will be on display from 7:00 p.m. Monday evening through 1:00 p.m. Thursday afternoon. See page 6 for exhibit hours and the list of exhibitors.

Daily continental breakfasts, breaks, and receptions will be served in the Exhibit Hall.

## Learning Lab Schedule

The Learning Lab, located in the Exhibit Hall, will consist of live demonstrations highlighting specific technologies, tools, and software. The schedule of planned demonstrations is available on the Symposium mobile app and can be seen below. Look for the symbol to the right throughout the platform schedule grids for a reminder when a Learning Lab is scheduled.

### Tuesday, April 16

- **8:50-9:15 a.m.**—3-D Printing of Conceptual Site Models (Presented by: Geosyntec Consultants)
- **1:50-2:15 p.m.**—3-D Visualization & Analysis Software Demonstration (Presented by: CDM Smith, Inc.)
- **3:05-3:30 p.m.**—Using Unmanned Aerial Vehicle (UAV) Water Sampling Systems Improve Safety and Environmental Management while Reducing Costs (Presented by: Golder)

### Wednesday, April 17

- **8:50-9:15 a.m.**—Design Verification Program: Lessons Learned from Pre-Application Assessments at In Situ Remediation Sites (Presented by: Regenesis)
- **10:05-10:30 a.m.**—The Search for Meaning: How to Use Microbial Insights' Databases to Interpret Your CSIA, qPCR and QuantArray® Results (Presented by: Microbial Insights, Inc.)
- **2:15-2:40 p.m.**—Best Practices for Mixing and Injecting Colloidal In Situ Remediation Amendments (Presented by: Regenesis)
- **3:30-3:55 p.m.**—Remediation Geology: Solving Complex Sites through the Intersection of Geology/Hydrogeology/Remediation Engineering (Presented by: Burns & McDonnell)

### Thursday, April 18

- **8:25-8:50 a.m.**—Automated Continuous Vapor Intrusion Monitoring and Response - Streamlining Deployment Logistics (Presented by: Groundswell Technologies, Inc.)
- **9:15-9:40 a.m.**—The Use of Passive $CO_2$ Traps to Measure Rates of Natural Source Zone Depletion (NSZD) at LNAPL-Contaminated Sites (Presented by: E-Flux)
- **9:40-10:05 a.m.**—Natural Source Zone Depletion (NSZD) and Soil Temperatures: Tools to Measure the Relationships between Soil Temperatures and NSZD (Presented by: E-Flux)

**Learning Lab Sponsor.** We appreciate the participation of Burns & McDonnell, whose contribution has been applied toward the Learning Lab experience.

## Ad Hoc Meeting Rooms, Speaker Prep Room, Internet Café & Wi-Fi

**Ad Hoc Meetings.** Small meeting rooms may be available for ad hoc meetings. Check at the Symposium Registration Desk for room details and to sign up for a meeting time.

**Speaker Prep Room.** A speaker prep room will be available for presenters' use. Check at the Symposium Registration Desk to sign up for a practice time.

**Internet Café.** Computers and charging outlets are available to participants who wish to check email during Symposium hours Monday–Thursday in the Internet Café, located near the Learning Lab area of the Exhibit Hall.

## Mobile App & Abstract Collection

Due to the size of the program—four panel discussions and more than 470 platform talks and poster presentations—it is recommended that attendees review the schedule and abstracts available on the Symposium app prior to the event. **Abstracts are available only through the mobile app.** The app may also be accessed on the web.

Abstracts are included for all platform and poster presentations and panel discussions. The app may be used to build a personal schedule, take notes on presentations, and favorite exhibitors. In addition, you have the option of creating a personal profile to enhance networking opportunities with other participants, including sending private messages.

## Meals, Breaks, & Receptions

For the convenience of Symposium participants, the following meals, breaks, and light receptions will be provided at no additional cost to program registrants and exhibit booth staff during the food service times listed. Food service for breakfasts, morning and afternoon beverage breaks, and receptions will be in the Exhibit Hall. Buffet lunches will be served in Holiday Ballroom 6 and the Key Ballroom South Foyer.

For other meals and refreshments not provided by the Symposium, Diamond Tavern, The Coffee Bean & Tea Leaf (open daily from 6:00 a.m.-6:00 p.m.), and Lobby Bar are located in the Hotel and many other options are available nearby.

**Guest Tickets.** If registrants wish to bring guests to meals or receptions, guest tickets can be purchased at the Symposium Registration Desk; guest tickets will be priced equal to the cost incurred by the Symposium for each meal.

## Food Service Times

***Breaks between sessions may not directly correspond with food service times. If you wish to attend specific functions, please plan your schedule accordingly.***

**Continental Breakfasts**
**Tuesday-Thursday, 7:00-8:00 a.m.**

**Morning Beverage Breaks**
**Tuesday-Thursday, 9:00-9:30 a.m.**

**Buffet Lunches (Holiday Ballroom 6)**
**Tuesday-Thursday, 11:30 a.m.-1:00 p.m.**

**Afternoon Beverage Breaks**
**Tuesday-Thursday*, 2:30-3:00 p.m.**
**Thursday afternoon break held in Key Ballroom South Foyer.*

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**Receptions**

**Welcome Reception**
**Monday, 7:00-9:00 p.m.**

**Poster Group 1 Presentations & Reception**
**Tuesday, 5:45-7:00 p.m.**

**Poster Group 2 Presentations & Reception**
**Wednesday, 5:45-7:00 p.m.**

**Closing Cocktail Reception (Key Ballroom Foyer)**
**Thursday, 4:30-5:00 p.m.**

## WIFI

Complimentary wireless Internet access is available in the Exhibit Hall and session rooms.
**SSID: Hilton Mtg**
**Password: Bio2019**

## Short Courses

The following courses are being offered. Check at the Short Course Registration Desk at least one hour before the starting time to see if openings remain in any course.

**Short Course Registration Desk**
(Lobby, 1st Floor, Near Peale & Latrobe Rooms)

- 7:00 a.m.—Morning and all-day course participants may pick up their course badge
- 12:00 p.m.—Afternoon course participants may pick up their course badge
- 2:00 p.m.—Symposium registration opens (Key Ballroom Foyer, 2nd Floor)

Separate check-in at the Symposium registration desk is required to pick up your Symposium badge.

## Student/Young Professional Participation & Events

University students, through Ph.D. candidates, and young professionals, will find participation in the Symposium valuable to their career development. In addition to the technical information gained by attending presentations and visiting exhibits, students will be able to meet and talk with environmental professionals representing a wide range of work experience and employers. Recruitment is a major focus of many participating Exhibitors and Sponsors and the Symposium will provide enhanced networking opportunities for student job-seekers. Be sure to check the Message Board near the Registration Desk where job postings may be available from participating companies.

## Student Paper Competition Winner

The winning paper is scheduled for presentation at the Symposium. The winner was awarded a complimentary registration and will receive a financial award at the Plenary Session to help cover travel and related costs.

**Hongyu Dang** (Michigan State University/USA)

*The Application of Shotgun Sequencing to More Fully Define the Functional Abilities of Microorganisms at Contaminated Sites*

(Session E6, Poster Group 2, Board #89)

**Congratulations!**

**Student/Young Professional Networking Reception.** To help students, young professionals (5 years or less in their field), and invited mentors get acquainted, a Networking Reception will be held Tuesday evening in the Latrobe Room (1st Floor), following the Group 1 poster presentations.

**Student Event Sponsors.** We appreciate the participation of the following companies, whose contributions have been applied toward the student paper award and student events.


erm.com


jacobs.com


ramboll.com | Booth #335

## Proceedings

All presentations given at the Symposium will be represented in the proceedings. Each platform and poster presenter has been invited to submit a short paper expanding upon his or her presentation. If no paper is submitted, the one-page abstract will be included in the proceedings supplemented with the slide files for platform presentations. After the Symposium, the proceedings will be compiled and published only online. Approximately two months after the Symposium, an access link and password will be distributed to all registrants who paid standard or student rates.

## Messages, Job Postings, Lost & Found

A message board will be available near the Symposium Registration Desk for the use of attendees wishing to contact one another. Notices about jobs available or wanted can be posted here. This board also will be used for messages taken by the registration staff for attendees. Please turn any found items into the Registration Desk. Lost items may be picked up with a detailed description of the item.

# Session Chairs & Panel Moderators

## Program Committee

### Symposium Chairs

Andrew Barton (Battelle)
Rick Wice (Battelle)

### Technical Steering Committee

Stewart Abrams (Langan)
Les Clarke, PMP (Battelle)
Stephanie Fiorenza, Ph.D. (BP)
Arun Gavaskar (NAVFAC)
Frank Loeffler, Ph.D. (University of Tennessee)
Andy Martin (USACE, ERDC)
Carlos Pachon (U.S. EPA)
Heather Rectanus, Ph.D., PE (Geosyntec Consultants)
Charles Schaefer, Ph.D. (CDM Smith)
Russell Sirabian PE, PMP, LEED Green Associate (Battelle)
David Woodward (Wood)

## TUESDAY PLATFORM SESSIONS

**A1. GAC-Based PFAS Treatment Technologies**
Sarah Slagle (Ramboll)
Rick Wice (Battelle)

**A2. Fate and Transport of PFAS**
Eliza Kaltenberg (Battelle)
Kristen Thoreson (REGENESIS)

**A3. PFAS Program Management in a Rapidly Changing Regulatory Environment**
Scott Grieco (Jacobs)
Dave Woodward (Wood)

**B1. Combined Remedies**
Natalie Capiro (Auburn University)
Tamzen Macbeth (CDM Smith, Inc.)

**B2. Successes and Continuing Challenges for Bioaugmentation and Biostimulation**
Paul Hatzinger (APTIM)
Ryan Wymore (CDM Smith, Inc.)

**C1. Munitions Response Site Management Strategies**
Les Clarke (Battelle)
Jared Johnson (U.S. Army Engineer Research and Development Center)

**C2. Impacts of Mixed Contaminants on Biodegradation**
Elizabeth Edwards (University of Toronto)
Jovan Popovic (U.S. Navy)

**C3. Amendment Delivery in Bedrock and Complex Geologic Environments**
Dan Bryant (Woodard & Curran)
George Walters (U.S. Air Force)

**C4. Biodegradation in Complex Geological Settings**
Rick Cramer (Burns & McDonnell)
Charles Schaefer (CDM Smith, Inc.)

**D1. Enhanced Methods for Biodegradation of Organic and Inorganic Contaminants**
Upal Ghosh (University of Maryland, Baltimore County)
Venus Sadeghi (AECOM)

**D2. Advances in Amendment Formulation**
Paul Erickson (REGENESIS)
Michael Lee (Terra Systems, Inc.)

**D3. Phytoremediation/Mycoremediation**
Tesema Chekol (Battelle)
Timothy Mattes (University of Iowa)

**E1. Advances in Monitoring and Optimization Techniques**
John Connor (GSI Environmental, Inc.)
John Wilson (Scissortail Environmental Solutions, LLC)

**E2. Compound-Specific Isotope Analysis**
Patrick McLoughlin (Pace Analytical)
Neil C. Sturchio (University of Delaware)

**E3. High-Resolution Site Characterization**
Seth Pitkin (Tetra Tech)
Steve Posten (Wood)

## WEDNESDAY PLATFORM SESSIONS

**A4. Innovative Treatment Technologies for PFAS**
Chris S. Griggs (U.S. Army Engineer Research and Development Center)
Ramona Iery (U.S. Navy)

**A5. PFAS Risk Assessment**
Pamela Rodgers (Battelle)
Shalene Thomas (Wood)

**A6. PFAS Source and Forensic Considerations**
Tim Peck (U.S. Army Corps of Engineers)
James Tarr (U.S. Navy)

**B3. Innovative and Efficient Amendment Delivery Strategies**
Maureen Dooley (REGENESIS)
Christine Fogas (Ramboll)

**B4. Strategies for Bioremediation Performance Assessment**
Brad Elkins (EOS Remediation, LLC)
Laurie LaPat-Polasko (Matrix New World Engineering)

**B5. Bioremediation of Heavy Metals**
Arul Ayyaswami (Tetra Tech, Inc.)

**C5. 1,4-Dioxane Treatment Technologies**
Dora Chiang (CDM Smith, Inc.)
Rebecca Mora (AECOM)

**C6. Combined Treatment of Emerging Contaminants with CVOCs**
Stewart Abrams (Langan)
Anthony Danko (U.S. Navy)

**C7. Addressing Emerging Contaminants**
Rula Anselmo Deeb (Geosyntec Consultants)
Christopher Hook (Tetra Tech, Inc.)

**D4. Aerobic and Anaerobic Biodegradation of Contaminants**
Adria Bodour (U.S. Air Force)
Neal Durant (Geosyntec Consultants)

**D5. Advances in Heat-Enhanced Bioremediation**
Mark Kluger (TRS Group, Inc.)
Kurt Pennell (Brown University)

**D6. Abiotic Transformation Processes**
Michelle Scherer (University of Iowa)
Richelle Allen-King (University of Buffalo, SUNY)

**E4. Modeling and Monitoring Approaches to Improve Remedy Design and Implementation**
Mandy Michalsen (U.S. Army Corps of Engineers)
Heather Rectanus (Geosyntec Consultants)

**E5. Conventional Molecular Biological Tools in Site Assessment and Monitoring**
Alison Cupples (Michigan State University)
Kate Kucharzyk (Battelle)

**E6. Big Data and Integration of Molecular Tools in Site Assessment: Advanced Omics**
Raymond Lees (Langan)
Dora Taggart (Microbial Insights, Inc.)

**E7. Advances in Tools and Techniques for Assessing MNA**
Mark Harkness (Ramboll)
Kent Sorenson (CDM Smith, Inc.)

## THURSDAY PLATFORM SESSIONS

**A7. Best Practices and Approaches for Analyzing PFAS**
Kavitha Dasu (Battelle)
Sean Gormley (Wood)

**A8. Best Practices in GSR**
Richard Raymond (Terra Systems, Inc.)
Gerlinde Wolf (AECOM)

**A9. Incorporating Sustainability Considerations into Remediation Projects**
Matthew Ambrusch (Langan)
Scott Lutz (Northrop Grumman Corporation)

**A10. Sustainable Remediation Assessment Tools**
Paul Favara (Jacobs)
Sam Moore (Battelle)

**B6. Biobarrier Installation and Management**
Ulysses Mourão (Geoklock)
Rubens Spina (Geoklock)

**B7. Advances in Biological Wastewater Treatment Processes**
Francisco Barajas (AECOM)
Edith Martinez-Guerra (U.S. Army)

**B8. Natural Source Zone Depletion**
Charles Newell (GSI Environmental, Inc.)
Stephen Rosansky (Battelle)

**C8. Impacts of Climate Change and Extreme Weather Events on Remedial Design**
Carlos Pachon (U.S. Environmental Protection Agency)
John Simon (Nathan, Inc.)

**C9. Optimizing Existing Systems**
Michael Singletary (U.S. Navy)
Russell Sirabian (Battelle)

**C10. Adaptive Management Strategies**
Gunarti Coghlan (U.S. Navy)
Kathleen Stetser (GEI Consultants, Inc.)

**D7. Vapor Intrusion Design and Mitigation Methods**
Mark Kram (Groundswell Technologies, Inc.)
Omer Uppal (Langan)

**D8. VOC Vapor Intrusion**
Pamela Chang (Battelle)

**D9. Innovative Tools for Evaluating Vapor Intrusion Risk**
Lisa Goode (Geosyntec Consultants)
Thomas Szocinski (Land Science)

**E8. Aerobic Processes for the Remediation of Petroleum Hydrocarbon Sites**
Brad Koons (AECOM)
Raphi Mandelbaum (LDD Advanced Technologies, Ltd.)

**E9. Combined Approaches for the Remediation of Petroleum Hydrocarbons**
Matthew Alexander (Texas A&M University-Kingsville)
Victor Vanin Sewaybricker (GEOKLOCK)

**E10. Remediation and Management of Petroleum-Hydrocarbon Contaminated Sites**
Fritz Hostrop (Terra Systems, Inc.)
Matthew Lahvis (Shell Global Solutions)

**E11. Biodegradation and Remediation of Crude Oil and Petroleum Hydrocarbons in Cold Regions**
David Tsao (BP)

## Panel Moderators

### TUESDAY

(Track A, 1:00-2:40 p.m.)
**How Are We Going to Effectively Manage PFAS Risks and Liability?**
Dave Woodward (Wood)

### WEDNESDAY

(Track C, 8:00-9:40 a.m.)
**Green and Sustainable Remediation: The Why and How of Establishing a Corporate Program**
Matthew Ambrusch
(Langan Engineering and Environmental Services, Inc.)
John Simon (Nathan Associates, Inc.)

### THURSDAY

(Track D, 8:00-9:40 a.m.)
**Remediation Geology: The Increasing Role of Geology in Successful Remediation**
Rick Cramer, M.Sc., PG (Burns & McDonnell)
Herb Levine, M.Sc., PG (U.S. EPA, Region IX)

(Track C, 10:05-11:45 a.m.)
**What Does a Successful Risk Communication Strategy for PFAS Sites Look Like?**
Melissa Harclerode, Ph.D., BCES (CDM Smith)

# Tuesday Platform Sessions—8:00am–10:05am

| | A SESSIONS (Holiday Ballroom 1&2) | B SESSIONS (Holiday Ballroom 3) | C SESSIONS (Holiday Ballroom 5) | D SESSIONS (Holiday Ballroom 4) | E SESSIONS (Peale, 1st Floor) |
|---|---|---|---|---|---|
| 8:00 | **From DETS to PETS, the Development of Mobile Aqueous Treatment Reactor for Perfluorinated Alkyl Substances: The PFAS Effluent Treatment System.** *V.F. Medina, S.A. Waisner, and C.S. Griggs.* Chris S. Griggs (U.S. Army Engineer Research and Development Center/USA) | **Combined ISCR and Bioaugmentation: New Insights for Sulfidated ZVI.** *D. Fan, J. Wang, N. Durant, K. Rügge, T. Højbjerg Jørgensen, M. Tropp Hag, and N. Tuxen.* Dimin Fan (Geosyntec Consultants/ USA) | **Application of Stable Isotopic and Omics Methods for Assessment of RDX Natural Attenuation in Groundwater.** *M.E. Fuller, P.G.K. van Groos, K.H. Kucharzyk, and N.C. Sturchio.* Mark Fuller (APTIM/USA) | **Verified Carbon Tetrachloride and Chloroform Transformation via Biotic, Abiotic, and Reactive Iron Sulfide Mechanisms.** *S.D. Justicia-Leon, J. Martin Tilton, M. Schnobrich, C. Divine, S. Ulrich, D. Liles, and D. Taggart.* Shandra Justicia-Leon (Arcadis/USA) | **Bioremediation Monitoring Optimization to Key Bioremediation Indicators: KBI on a Large-Scale Recirculation System for a Thermal-Enhanced Anaerobic Process.** *M. Souza, M. Singer, T. Mello, E. Tsuruoka, P. Bennett, and M. Einarson.* Martim Souza (ERM/Brazil) |
| 8:25 | **A Screening Tool for Selection of Treatment Systems for Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous Solutions.** *N.W. Hagelin, F. Boodoo, D. Woodward, and B. Malyk.* Dave Woodward (Wood/USA) | **Antimethanogenic ISCR Approaches for Urban Dry Cleaner Sites: Source Mass Destruction and Dissolved Phase Dehalogenation.** *K. Gaskill, G. Booth, and J. Mueller.* Keith Gaskill (EnviroForensics, LLC/ USA) | **Evaluation of RDX Biodegradation Using Compound-Specific Stable Isotope Analysis (CSIA) and Stable Isotope Probing (SIP).** *P.B. Hatzinger, M.E. Fuller, L. Heraty, N.C. Sturchio, and K.-H. Chu.* Paul Hatzinger (APTIM/USA) | **Methanotrophic Cometabolic Enhanced Natural Attenuation at a Confidential Southeastern Pennsylvania TCE Superfund Site.** *T. Cornuet, C. Fogas, M. Hencken, N. DiMarcello, J. Garvey, and M. Maloney.* Tom Cornuet (Ramboll/USA) | **Estimation of Sorbed-Phase Biodegradation Rate in Activated Carbon Barriers Using Microbial Diagnostics, CSIA and In Situ Microcosms.** *J. Birnstingl, S. Rosolina, and M. Burns.* Jeremy Birnstingl (REGENESIS/United Kingdom) |
| 8:50 | **Colloidal Activated Carbon for In Situ Remediation of PFAS: A Review of Multiple Case Studies.** *K. Thoreson, M. Dooley, and P. Erickson.* Kristen Thoreson (REGENESIS/USA) | **Anaerobic Biodegradation of Chlorobenzene, Dichlorobenzene and Benzene in Shallow Saturated Soils.** *A. Oka, S. Florkiewicz, H. Nichols, S. Abrams, and E. Seelman.* Amita Oka (Langan/USA) | **Measuring In Situ Degradation by Tracer Stable Isotope-labeled RDX Groundwater Release.** *T.J. Boyd, C. Tobias, J. Popovic, R.H. Cuenca, Y. Hagimoto, and M.M. Michalsen.* Mandy Michalsen (U.S. Army Corps of Engineers/USA) | **Sulfate, Magnetite, Sheep, and Chlorinated Solvent Bioremediation: Biodegradation of TCE in a High Sulfate Fractured Bedrock Environment.** *M. Harkness, P. Hare, P. Freyer, and L. Scheuing.* Mark Harkness (Ramboll/USA) | **Real-Time Total Petroleum Hydrocarbon (TPH) Measurement Enables the Rapid Environmental Remediation Workflow.** *D. Kong, S. Mcmillen, D. Hendrawati, Y. Kurniawan, A. Respati, K. Sustrisno, R. Kamath, and T. Wisono.* Deyuan Kong (Chevron Corporation/ USA) |
| 9:15 | **Installation, Operation and Startup of World's First Regenerable Resin System for PFAS Removal.** *R. Singer and S. Woodard.* Rob Singer (Wood/USA) | **A Field Comparison of Biogeochemically-Enhanced, Biological and Chemical Reduction for Treatment of Chlorinated Organics.** *D. Leigh* Daniel Leigh (PeroxyChem, LLC/USA) | **Development and Evaluation of an Underwater Advanced Time-Domain Electromagnetic System for Munitions Response Classification.** *S. Bancroft, T. Bell, and S. Saville.* Steve Saville (Jacobs/USA) | **New Integrated Biogeochemical/ Electrochemical Method for Remediation of Contaminated Groundwater.** *E. Elgressy, G. Elgressy, R. Mandelbaum, G. Mandelbaum, and J. Mueller.* Jim Mueller (Provectus Environmental Products, Inc./USA) | **Mass Discharge Calculation for Rehabilitation of Industrial Site.** *N.O. Arato, V.S. Vanin, and R.O. Coelho.* Natália Arato (Geoklock/Brazil) |
| 9:40 | **Regeneration of Granular Activated Carbon (GAC) Used for Per- and Polyfluorinated Substance (PFAS) Remediation.** *R.R. James and K. Dasu.* Ryan James (Battelle/USA) | **Chlorinated Solvent Source Area Remediation: Combining Biotic and Abiotic Enhanced Reduction Approaches.** *F.P. Wilson, M.S. Apgar, B.E. Gillett, D. Leigh, and J. Valkenburg.* Fernanda Paes Wilson (Fishbeck, Thompson, Carr & Huber, Inc./USA) | SESSION BREAK | **Current Advances in Bioelectrochemical Treatment of Persistent Groundwater Contaminants.** *J. Blotevogel and S. Mahendra.* Jens Blotevogel (Colorado State University/USA) | **A Machine Learning Approach to Estimate Plume Discharge from Electrical Geophysical Measurements.** *N. Terry, F.D. Day-Lewis, J.W. Lane, J.L. Trost, I.M. Cozzarelli, and B.A. Bekins.* Neil Terry (U.S. Geological Survey/USA) |
| 10:05 | SESSION BREAK | SESSION BREAK | C2. **Biotic and Abiotic Degradation of 1,1,2-Trichloro-1,2,2-Trifluoroethane (CFC-113): Implications for Detoxification of Chlorinated Ethenes.** *J. Im, E.E. Mack, E.S. Seger, and F.E. Loeffler.* Jeongdae Im (Kansas State University/USA) | SESSION BREAK | SESSION BREAK |

A1. GAC-Based PFAS Treatment Technologies

B1. Combined Remedies

C1. Munitions Response Site Management Strategies

D1. Enhanced Methods for Biodegradation of Organic and Inorganic Contaminants

E1. Advances in Monitoring and Optimization Techniques

# Tuesday Platform Sessions—10:30am–12:35pm

| | A SESSIONS (Holiday Ballroom 1&2) | B SESSIONS (Holiday Ballroom 3) | C SESSIONS (Holiday Ballroom 5) | D SESSIONS (Holiday Ballroom 4) | E SESSIONS (Peale, 1st Floor) |
|---|---|---|---|---|---|
| 10:30 | **Spatio-Temporal Data Analysis as a Tool for Understanding Complex PFAS Plumes.** *E. Ribeli.*<br>Erik Ribeli (NIRAS Sweden AB/Sweden) | **Active Management of Superfund Remedies.** *K. Biggs, L. Fiedler, J. Gilbert, M. Jefferson, and C. Pachon.*<br>Carlos Pachon (U.S. Environmental Protection Agency/USA) | **Biodegradation of Chlorobenzenes and Nitrotoluenes at an Industrial Site in South America.** *M. Lemes, D.L. Freedman, P. Barreto, J. Henderson, and E. Mack.*<br>Maria C. Lemes (CDM Smith/USA) | **Combined In Situ Bioremediation Treatment for Perchlorate Pollution in the Vadose Zone and Groundwater.** *I. Levakov, Z. Ronen, and O. Dahan.*<br>Ilil Levakov (Ben-Gurion University of the Negev/Israel) | **Case Studies: Source Delineation Using CSIA.** *S. Rosolina and D. Taggart.*<br>Sam Rosolina (Microbial Insights, Inc./USA) |
| 10:55 | **Building a Robust Fate and Transport Model for PFAS Using Vertical Aquifer Profiling and a Novel Linear-to-Branched Ratio Approach.** *D. Bogdan, J.M. Cuthbertson, B.J. Harding, and R. Kennedy.*<br>Dorin Bogdan (AECOM/USA) | **Removal of Tetrachloroethylene (PCE) from Groundwater by Coupled NZVI@MgAl-LDHs Composite and PCE-Degrading Microbial Consortium**. *Q. Wang, X. Song, and S.Y. Tang.*<br>Qing Wang (Institute of Soil Science, Chinese Academy of Sciences/China) | **Bioaugmentation for Enhanced Anaerobic Degradation of a Mixed cVOC Plume on a Commercial Property.** *J. Roberts, P. Miller, J. Rossi, S. Maher, and D. Alden.*<br>Jeff Roberts (SiREM/Canada) | **Enhanced Bioremediation of a Consortium of Contaminants at a Historic Chemical-Production Facility.** *E.M. Jennings, C. Walecka-Hutchison, M. Whaley, T. Tambling, N. Anderson, R. Wenzel, R. Stuetzle, and J. Bunton.*<br>Eleanor Jennings (Parsons/USA) | **Using CSIA to Distinguish Abiotic and Biotic Degradation Mechanisms in ISCR-Assisted Bioremediation Systems.** *J. Freim, P. Erickson, and S. Rosolina.*<br>Paul Erickson (REGENESIS/USA) |
| 11:20 | **Investigation of the Effect of Prior Remedial Treatment on the Fate and Transport of Per- and Polyfluoroalkyl Substances (PFAS) Present at AFFF-Impacted Sites.** *K. Dasu and J. Kornuc.*<br>Kavitha Dasu (Battelle/USA) | **Enhanced In Situ Bioremediation and Solar-Irrigated Phytoremediation to Treat a Salty PCE Plume.** *J. Leu, D.R. Griffiths, L. McGlochlin, M. Schulman, and K. Garon.*<br>Jim Leu (Parsons Corporation/USA) | **Combining Biotic and Abiotic Treatment Processes to Overcome Challenges of a Mixed Chlorinated Solvent Plume.** *D. Smolko, A. Chemburkar, A. Breckenridge, and D. Leigh.*<br>Darrell Smolko (ERM/USA) | **Technical Approaches to Evaluate the Surfactant-Enhanced Biodegradation of Biodiesel and Vegetable Oils.** *R.N. Montagnolli, C.R. Mendes, G. Dilarri, J.R. Moraes Junior, and E.D. Bidoia.*<br>Renato Nallin Montagnolli (Federal University of São Carlos/Brazil) | **Applying Compound-Specific Isotope Analysis to Sites with Low Concentrations of 1,4-Dioxane.** *K.N. Morrison, P.J. Bennett, M.Y. Chu, R. Aravena, H.T. El Mugammar, C.A. Smith, M.R. Hyman, and M. Nickelsen.*<br>Katharine North Morrison (Haley & Aldrich, Inc./USA) |
| 11:45 | **PFAS Composition Observed in Surface Water Ecologies as a Result of AFFF Use.** *A. Mitchell, S.A. Richards, and C. O'Farrell.*<br>Andrew Mitchell (RPS Group/ Australia) | **Bioaugmentation after Thermal Conductive Heating in Overburden and Bedrock.** *L. Zeng, S. Abrams, M. Wenrick, L. Antonetti, and J. Smith.*<br>Lingke Zeng (Langan/USA) | SESSION BREAK | **Impact of Hydrogen Peroxide on Horizontal Transfer of Naphthalene-Degrading Genes.** *A. Fox and K. Millerick.*<br>Anastasia Fox (Texas Tech University/ USA) | **Use of CSIA and Molecular Biological Tools to Demonstrate TBA Degradation under Methanogenic Conditions.** *D. Collins and D. Chheda.*<br>David Collins (Stantec/USA) |
| 12:10 | SESSION BREAK | **Innovative Applications of Surfactants for Successful Combined Remedy Remediation.** *P.M. Dombrowski, M. Temple, F. Hostrop, and K. Ramanand.*<br>Paul Dombrowski (In-Situ Oxidative Technologies [ISOTEC]/USA) | | SESSION BREAK | SESSION BREAK |
| 12:35 | | SESSION BREAK | **Innovative and Sustainable Fractured Bedrock Remediation via a Surfactant-Enhanced Aquifer Remediation *Approach.*** *B.S. Langan, J.A. Bennett, D. Alden, and S. Bang.*<br>Bonani Langan (Wood/USA) | | |

A2. Fate and Transport of PFAS

B1. Combined Remedies

C2. Impacts of Mixed Contaminants on Biodegradation

C3.

D1. Enhanced Methods for Biodegradation of Organic and Inorganic Contaminants

E2. Compound-Specific Isotope Analysis

# Tuesday Platform Sessions—1:00pm–3:05pm

| | A SESSIONS (Holiday Ballroom 1&2) | B SESSIONS (Holiday Ballroom 3) | C SESSIONS (Holiday Ballroom 5) | D SESSIONS (Holiday Ballroom 4) | E SESSIONS (Peale, 1st Floor) |
|---|---|---|---|---|---|
| 1:00 | | SESSION BREAK | **LNAPL Remediation in Complex Geologic Setting Using an Activated Carbon-Based Injectate.** *B. Witman, M. Steele, and N. Thacker.* Mark Steele (Kleinfelder/USA) | **Optimizing EVO Formulations.** *M.D. Lee, F. Hostrop, and R.L. Raymond.* Michael Lee (Terra Systems, Inc./USA) | **Integration of High-Resolution Site Characterization Direct Sensing Tools.** *M. Jordan.* Michael Jordan (Cascade Technical Services/USA) |
| 1:25 | **PANEL DISCUSSION**<br>**How are We Going to Effectively Manage PFAS Risks and Liability?**<br>**Moderator**<br>Dave Woodward (Wood)<br>**Panelists**<br>Jenn Guelfo (Texas Tech University)<br>Rachael Casson (AECOM)<br>John Collins (AquaBlok, Inc.) | B2. Successes and Continuing Challenges for Bioaugmentation and Biostimulation<br>**A Consideration of the Benefits of Various Field Procedures When Applying Enhanced Reductive Dechlorination.** *D.P. Leigh.* Daniel Leigh (PeroxyChem, LLC/USA) | C3. Amendment Delivery in Bedrock and Complex Geologic Environments<br>**Lessons Learned Performing Amendment Injections into Low-Permeability Media.** *M. Harkness.* Mark Harkness (Ramboll/USA) | D2. Advances in Amendment Formulation<br>**Use of Rendered Animal Co-Products as Electron Donors in Environmental Remediation.** *K.T. Finneran.* Kevin Finneran (Clemson University/USA) | E3. High-Resolution Site Characterization<br>**Using the Combined UV Optical Image Profiler and Hydraulic Profile Tool with Modeling Tools to Visualize Complex Petroleum LNAPL Migration.** *J.V. Fontana, D. Pipp, and W. McCall.* John Fontana (Vista GeoScience/USA) |
| 1:50 | | **Successes and Challenges of Bioaugmentation DNAPL in a Low-Permeability Aquifer.** *S. Abrams, L. Zeng, M. Wenrick, M. Papperman, and N. Rivers.* Stewart Abrams (Langan/USA) | **A Comparison of Cost and Performance between Permeability Enhancement Technology and Conventional Injection Techniques at Low Permeability Sites.** *N.T. Smith, K.S. Sorenson, D.D. Nguyen, and R.A. Wymore.* Nathan Smith (CDM Smith, Inc./USA) | **Pilot Study on In Situ Bioremediation of a Former Wastewater Treatment Pond Containing High Levels of PCBs.** *K.R. Sowers, U. Ghosh, and R.B. Payne.* Kevin Sowers (University of Maryland, Baltimore County/USA) | **Managing Unknown and Uncertain Chemistry Results with High-Resolution Investigation.** *T. Darby, C. Bell, M. Petersen, C. Bertz, and J.F. Strunk.* Thomas Darby (Arcadis/USA) |
| 2:15 | | **In Situ Bioreactor: A New Tool to Help Improve Biostimulation and Bioaugmentation.** *D. Taggart, S. Rosolina, K. Clark, K. Sublette, and E. Raes.* Kate Clark (Microbial Insights, Inc./USA) | **High-Resolution Site Characterization for the Design of an In Situ Bioremediation System in Dual-Porosity Bedrock.** *P.J. Mark, R.J. Fiacco, M.H. Daly, and L.J. Mastera.* Johannes Mark (ERM/USA) | **CAT 100® Applied at Indiana Industrial DNAPL Site.** *M. Grove, B. Iden, and G. Simpson.* Gary Simpson (AST Environmental/USA) | **High-Resolution Site Characterization at an Industrial Site in Parana, Brazil.** *B.C.I.F. Pinto.* Bruno Carlos Iatallese Ferreira Pinto (GEOKLOCK/Brazil) |
| 2:40 | SESSION BREAK | **An Unintended Consequence of Biostimulation for Treatment of Chlorinated Solvents: Biologically-Mediated Toluene Production.** *W.M. Moe, S.J. Reynolds, M.A. Griffin, and J.B. McReynolds.* William Moe (Louisiana State University/USA) | SESSION BREAK | **Performance of a New Activated Carbon Amendment for Bioremediating Petroleum-Impacted Sites.** *K. Thoreson, P. Erickson, T. Herrington, B. Hicks, S. Sittler, D. Taggart, and K. Clark.* Kristen Thoreson (REGENESIS/USA) | **Leveraging PRISM™ to Refine High-Resolution Site Characterization (HRSC) Techniques at a Complex Geologic Site, Washington, DC.** *J. Sadeque, R. Samuels, S. Chatterjee, K. VanGelder, and D.G. Collins.* Junaid Sadeque (AECOM/USA) |
| 3:05 | A3. **Investigation and Remedial Activities at PFAS Sites in a Changing Regulatory Environment.** *R.M. Appelt and L.L. Kammer.* Lisa L. Kammer (Weston Solutions, Inc./USA) | **Successful Bioremediation of Carbon Tetrachloride.** *J. Roberts, S. Dworatzek, P. Dennis, and M. Deflaun.* Jeff Roberts (SiREM/Canada) | C4. **Upscaling of Chlorinated Solvent and 1,4-Dioxane Degradation Data from Detailed Fluvial/Alluvial Stratigraphy to a Site Conceptual Model for Monitored Natural Attenuation.** *J.P. Brandenburg, C. Payne, M.D. Einarson, P.J. Bennett, and M.Y.J. Chu.* J.P. Brandenburg (Haley & Aldrich, Inc./USA) | SESSION BREAK | SESSION BREAK |

# Tuesday Platform Sessions—3:30pm–5:10pm

| | A SESSIONS (Holiday Ballroom 1&2) | B SESSIONS (Holiday Ballroom 3) | C SESSIONS (Holiday Ballroom 5) | D SESSIONS (Holiday Ballroom 4) | E SESSIONS (Peale, 1st Floor) |
|---|---|---|---|---|---|
| 3:30 | **Per- and Poly-Fluorinated Alkyl Substances (PFAS): Lessons Learned during the Evolution of Global Regulations.** *J. Byrd, M. Leahy, and D. Nelson.*<br>Maureen Leahy (ERM/USA) | SESSION BREAK | **Deciding When to Use Environmental Sequence Stratigraphy (ESS) and Application to Perfluorinated Compounds Sites.** *S.K. Kline, W. Nolan, and T. Andrews.*<br>Simon Kline (Jacobs/USA) | **Remediating Salt-Contaminated Sites in Canada Using Phytotechnologies.** *B. Zeeb, L. Morris, A. Litalien, K. Yun, and A. Rutter.*<br>Barbara Zeeb (Royal Military College of Canada/Canada) | **High-Resolution Site Characterization of a Glacial Aquifer System Using Environmental Sequence Stratigraphy (ESS) and Geophysical Logging of Existing Monitoring Well Network.** *C.P. Plank, M.R. Shultz, G. Kenoyer, and R. Bayless.*<br>Colin Plank (Burns & McDonnell/USA) |
| 3:55 | **Statewide PFAS Sampling of Public Water Supplies in Michigan.** *J.M. Cuthbertson and D. Bogdan.*<br>John Cuthbertson (AECOM/USA) | **Aerobic Biodegradation of Aromatic, Chlorinated Aliphatic, and Ether Contaminants by *Pseudonocardia* sp. Strain ENV478 and Native Populations.** *C. Walecka-Hutchison, M. Whaley, T. Tambling, M. LaFramboise, T. King, P.B. Hatzinger, and S. Vainberg.*<br>Claudia Walecka Hutchison (The Dow Company/USA) | **Applying Environmental Sequence Stratigraphy (ESS) to Optimize Monitoring and Remediation Design for Groundwater Contamination in Glaciated Settings: A Former Nike Missile Site.** *M.R. Shultz, C.P. Plank, S. Carney, and R.S. Cramer.*<br>Colin Plank (Burns & McDonnell/USA) | **Implementation of a Two-Year Phytoextraction Pilot Study at a Wood Treatment, Chromated Copper Arsenate Site.** *B. Harding, S. Aufdenkampe, A. Moore, and D. Huff.*<br>Barry Harding (AECOM/USA) | **Optimizing a Uranium Sediment and Groundwater Remedy through Cost-Effective Investigation, Three-Dimensional Modeling, and Geologic Interpretation.** *J.R. Hesemann.*<br>John Hesemann (Burns & McDonnell/USA) |
| 4:20 | **Army National Guard: Uncertainty in PFAS Site Inventory and Release Screening.** *B. Packer and R. Gwinn.*<br>Bonnie Packer (Army National Guard/USA) | **Downgradient Chlorinated Ethene Bulk Attenuation Rates and Extent of Mass Reduction at 40 ERD Sites.** *J.M. Tillotson, J.M. Tilton, and M. Schnobrich.*<br>Jason Tillotson (Arcadis/USA) | **In Situ Bioremediation of Aged Low-K DNAPL Source Zone in Complex Geological Settings by Groundwater Circulation Wells for Efficient Amendment Delivery and Contaminant Mobilization.** *M. Petrangeli Papini, M. Majone, L. Pierro, M. Sagliaschi, S. Sucato, E. Alesi, E. Bartsch, S. Rossetti, and B. Maturro.*<br>Marco Petrangeli Papini (University of Rome "La Sapienza"/Italy) | **Phytoremediation for Petroleum Hydrocarbons in Soil: Green Remediation Technology.** *D. Hendrawati, R. Kamath, S. Mcmillen, D. Kong, T. Wisono, A. Herlambang, and T. Suryati.*<br>Deni Hendrawati (Chevron Pacific Indonesia/Indonesia) | **Analysis and Interpretation of Geochemical, Isotopic, Hydrogeologic and Direct-Sensing Data to Support CSM Development for a Complex Site.** *B.T. Clement and D.C. Horne.*<br>Benjamin Clement (Burns & McDonnell/USA) |
| 4:45 | **Programmatic Approach to Management of PFAS: One State's Strategy to Protect Human Health and the Environment.** *S. Thomas and E. Kaufenberg.*<br>Shalene Thomas (Wood/USA) | **Case Study: Longevity of Multiple Amendments Used in Treatment of Chlorinated Solvents in Groundwater.** *M.L. Alexander.*<br>Matthew Alexander (Texas A&M University-Kingsville/USA) | **Long-Term Performance Assessment at a Highly Characterized and Instrumented DNAPL Source Area following Bioaugmentation.** *C.E. Schaefer, G.M. Lavorgna, and M.D. Annable.*<br>Charles Schaefer (CDM Smith, Inc./USA) | **Lessons Learned: Application of Phytoremediation in Place of Conventional Pump-and-Treat Approach at a Hydrocarbon-Impacted Site.** *B. Searcy, D. Oram, R. Haughy, and T. Key.*<br>Brent Searcy (ETIC/USA) | **Aquifer Plume Persistence Following Full-Scale Source Zone Remediation Due to Aquitard Back Diffusion with Insights on Degradation Effects.** *S.W. Chapman, B.L. Parker, P. Wanner, R. Aravena, and E.E. Mack.*<br>Steven Chapman (University of Guelph/Canada) |
| 5:10 | **Managing the Defence Portfolio of PFAS-Contaminated Sites in an Evolving Regulatory Environment.** *L. Mcleod, G. Avakian, and C. Birrer.*<br>Chris Birrer (Department of Defence/Australia) | **In Situ and On-Site Bioremediation of MTBE.** *J. Dijk, J. van den Boogaart, M. Slooijer, and L. Bastiaens.*<br>John Dijk (Greensoil Group/Belgium) | **Attenuation of a Large Dilute Plume after Source Treatment Protecting a Municipal Supply Well.** *D. Giaudrone, T. Macbeth, M. Gamache, K. Lynch, and C. Cora.*<br>Dominic Giaudrone (CDM Smith, Inc./USA) | **Application Potential of *Cyperus brevifolius* and Bacterial Consortia for Biodegradation of Polycyclic Aromatic Hydrocarbon (PAHs)-Polluted Soils of Assam, India**. *H. Deka.*<br>Hemen Deka (Gauhati University/India) | **High-Resolution Site Characterization (HRSC) and Three-Dimensional Data Visualization: A Path to Streamlined Closure.** *J. Orris and J. Ruf.*<br>Joshua Orris (Antea Group/USA) |

A3. PFAS Program Management in a Rapidly Changing Regulatory Environment

B2. Successes and Continuing Challenges for Bioaugmentation and Biostimulation

C4. Biodegradation in Complex Geological Settings

D3. Phytoremediation/Mycoremediation

E3. High-Resolution Site Characterization

# Group 1 Posters

**Display: Monday 7:00 p.m.–Tuesday 7:00 p.m.**
**Presentations/Reception: Tuesday 5:45–7:00 p.m.**

The following posters will be on display Monday evening through Tuesday afternoon in the Exhibit Hall. Presenters will be at their displays during the presentations and reception Tuesday evening. The poster board number assigned to each presentation appears below.

**GROUP 1 POSTER PRESENTERS**

Please remove your poster Tuesday evening, April 16, as soon as the Group 1 Poster Reception ends. Posters left up past their scheduled removal times will be discarded.



## A1. GAC-Based PFAS Treatment Technologies

**1. Effective Use of Granular Activated Carbon (GAC) Treatment for Removal of Hexafluoropropylene Oxide Dimer Acid (HFPO-DA) from Drinking Water.**
*B. Cuento, K.L. Davis, and A.S. Hartten.*
Bjorn Cuento (AECOM/USA)

**2. In Situ Remedy for PFAS-Contaminated Source Zone, Groundwater and Sediment.**
*M. Geary and J.M. Allen.*
Matt Geary (CETCO/USA)

**3. Evaluation of PFAS Removal Efficacy Using Commercially-Available GACs and IX Resins: A Bench-Scale Treatability Study**.
*D.D. Nguyen, C.E. Schaefer, A.G. LeBlanc, and J. Im.*
Dung Nguyen (CDM Smith/USA)

**4. Eliminating Risk of Exposure to PFAS in Groundwater: Full-Scale In Situ Remediation with Colloidal Activated Carbon.**
*S. Wilson and J. Birnstingl.*
Scott Wilson (REGENESIS/USA)

## A2. Fate and Transport of PFAS

**5. Factors Influencing Fate and Transport of Perfluoroalkyl Acids in Groundwater: An Empirical Demonstration.**
*J.R. Hale, D. Skinner, B. Grant, and S. Gelsthorpe.*
Jeffrey Hale (Kleinfelder/USA)

**6. Demarcation of Pollution by Perfluoroalkyl Substances (PFAS) in Soil at Former Firefighting Training Area Using Different Sampling Strategies.**
*S.J.M. Holmström, M. Filipovic, and J. Edvinsson.*
Sara Holmström (Swedish Geotechnical Institute/Sweden)

**7. Fate and Transport of PFAS in Indoor and Outdoor Air.**
*J. Roth, C. Holton, C. Lutes, and J. Hatton.*
Julia Roth (Jacobs/USA)

**8. Substrate-Mediated Biotransformation and Biodefluorination of 6:2 FTOH by *Mycobacterium* and *Rhodococcus* Species.**
*C. Wu, D. Deng, L. Clark, and M. Li.*
Chen Wu (New Jersey Institute of Technology/USA)

## A3. PFAS Program Management in a Rapidly Changing Regulatory Environment

**9. The Next Frontier on PFAS Contamination, Sediment, Surface Water and Fish Tissue.**
*H. Behzadi.*
Harry Behzadi (SGS North America/USA)

**10. U.S. Air Force's Programmatic Approach to Protecting Human Health and Environment from PFAS.**
*M. Self and M. Helton.*
Melissa Helton (Wood/USA)

**11. Advances and Lessons Learned in Site Characterization and Remediation at Multi-Contaminant Sites Including PFAS.**
*L.L. Kammer and J. Gerhard.*
Lisa Kammer (Weston Solutions/USA)

**12. The "Outside-In" Approach: A New Paradigm for Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) Site Investigation, Risk Assessment and Risk Management.**
*A.M. Rodolakis and A.R. Quintin.*
Antony Rodolakis (Wood/USA)

## A4. Innovative Treatment Technologies for PFAS

**13. Development of Efficient Ion Exchange and Resin Regeneration Approaches for Treatment of PFAS-Contaminated Groundwater.**
*M.E. Fuller, P.B. Hatzinger, E.R. McKenzie, R. Suri, and F. Boodoo.*
Mark Fuller (APTIM/USA)

**14. PFAS FTA Source Zone In Situ Stabilization: Long-Term, Field-Scale Leachability Evaluation.**
*A. Gupta, J. McDonough, D. Liles, A. Baumeister, P. Storch, I. Ross, and E. Houtz.*
Ankit Gupta (Arcadis/USA)

**15. PFAS Source Determination in a Community with Public and Private Water Supply Impacts.**
*S. LaRosa and F. Riccardi.*
Steve LaRosa (Weston & Sampson, Inc./USA)

**16. Sorptive Removal of F-53B by Organo-Layered Double Hydroxide: Sorption Performance and Mechanism.** *D. Ding and X. Song.*
Xin Song (Chinese Academy of Sciences/China)

## A5. PFAS Risk Assessment

**17. Potential Human Exposure to Per- and Polyfluoroalkyl Substances (PFAS) via Consumption of Fish from U.S. and International Sources.**
*D. Bogdan, B. Ruffle, U. Vedagiri, and M. Maier.*
Dorin Bogdan (AECOM/USA)

**18. The Science behind the PFAS Drinking Water Health Advisory and How It Affects Risk Management Decision Making.**
*D. Marquez and B. Hoye.*
Diana Marquez (Burns & McDonnell/USA)

## A6. PFAS Source and Forensic Considerations

**19. Perfluoroalkyl Substances Source Tracking at the Former Pease Air Force Base.**
*C. Buerkle, M.G. Quinlan, B.L. Porter, R. Rawcliffe, and P. Forbes.*
Christian Buerkle (APTIM/USA)

**20. Removal of Elevated Concentrations of PFAS and PFAS⁺ Compounds.**
*J. Buhl.*
Jurgen Buhl (Cornelsen Umwelttechnologie GmbH/ Germany)

## B1. Combined Remedies

**21. Combined Remedial Approaches for CVOC Treatment in Soil and Groundwater: Excavation, MPE, and ISCR.**
*S.S. Aluani, M.C.F. Spilborghs, E. Pujol, F. Tomiatti, J.G. Mueller, J.G. Booth, T. Xavier, and R. Moura.*
Sidney Aluani (SGW Services/Brazil)

**22. Combined Remedy Treatment of Multi-Chemical Solvent Plume in Fine-Grained, Low-Permeability Sediments.**
*B.L. Brab and K.E. Thompson.*
Bill Brab (AST Environmental, Inc./USA)

**23. Treatment Train for Remediation of Groundwater Impacts to Achieve Remedial Goals in Surface Water and Sediment.**
*D.W. Hawkins, M.T. Jordan, and M.B. Dail.*
David Hawkins (Terracon/USA)

**24. Combined Klozur® CR and Klozur® One: Chemical Oxidation and Bioremediation Pilot-Scale Demonstration.**
*P.M. Hicks and B.A. Smith.*
Patrick Hicks (PeroxyChem, LLC/USA)

**25. Application of Multifunctional Permeable Reactive Barrier and Enhanced In Situ Bioremediation for Chlorinated Solvents Remediation.**
*M.H. Ko, C.C. Wang, C.H. Cheng, and C.C. Kao.*
Mao-Hui Ko (Sinotech Environmental Technology, LTD/ Taiwan)

**26. Combining Remedial Technologies and Implementation Methods to Address Chlorinated Solvent Impacts at Complex Sites.**
*M. Mazzarese.*
Mike Mazzarese (AST Environmental, Inc./USA)

**27. Effective Use of Performance Assessments to Optimize Combined Remedial Strategies.**
*P.G. Robertson, S. Haitz, M. Burns, and C. Myers.*
Pamela Robertson (WSP/USA)

**28. Concurrent Implementation of Combined Remedies Incorporating Enhanced Reductive Dechlorination and Electrical Resistance Heating Reduces Shallow Solvent Plume by Three Orders of Magnitude.**
*J. Helge, J. Alexander, K. Emery-Tonkovich, J. Wilson, J. Whearty, and C. Sandefur.*
Craig Sandefur (REGENESIS/USA)

**29. Reducing Vapor Intrusion Concerns with a Combined Remedy in a Low Permeability Formation.**
*D. Rao.*
Dinesh Rao (CDR Group/USA)

## B2. Successes and Continuing Challenges for Bioaugmentation and Biostimulation

**30. Site and Pilot Test Bioaugmentation Challenges to Mitigate Vapor Intrusion Concern.**
*D. Rao.*
Dinesh Rao (CDR Group/USA)

**31. Case Study: Longevity of Multiple Amendments Used in Treatment of Chlorinated Solvents in Groundwater.**
*M.L. Alexander.*
Matthew Alexander (Texas A&M University-Kingsville/ USA)

**32. Bioaugmentation to Increase Reduction of Residual VC**.
*B. Collins, M. Perlmutter, M. Louth, D. Cleland, and C. Delaney.*
Betsy Collins (Jacobs/USA)

**33. Optimization of a Passive Enhanced In Situ Bioremediation (EISB) Remedy by Biobarrier and Source Injection Approach.**
*C.A. Fogas, M.P. McDonald, and M.S. Kozar.*
Christine Fogas (Ramboll/USA)

**34. Bench Tests for Evaluation of Nitrate Reduction in Soil and Groundwater from a Brazilian Nitrogen Fertilizer Plant.**
*I.J.S. Mello, F. Belloni, D.H. Teixeira, E. Leite, S. Crepaldi, and C. Goncalves.*
Igor Mello (CPEA/Brazil)

**35. Evaluating Enhanced Biological Dechlorination Performance Using a Mixed Substrate over a 7-Year Period.**
*M.S. Sieczkowski.*
Michael Sieczkowski (JRW Bioremediation, LLC/USA)

**36. Influences of Geological and Environmental Factors on Biostimulation at a PCE-Contaminated Site in Taiwan.**
*P.-H. Chen, Y.-C. Su, K.-F. Chan, B.-N. Wang, J.-H. Wu, P.-H. Wang, E. Edwards, Y.-T. Wu, I.-H. Chen, and C.-M. Chen.*
Bing-Nan Wang (SINOTECH Environmental Technology, Ltd./Taiwan)

**37. Secondary Geochemical Impacts of Bioremediation Observed in Glacial Till and Passaic Formation.**
*L. Zeng and S. Abrams.*
Lingke Zeng (Langan/USA)

## B3. Innovative and Efficient Amendment Delivery Strategies

**38. 10 Years of In Situ Chemical Reduction in Tropical Environments: Lessons Learned and Conclusions So Far.**
*S.S. Aluani, M.C.F. Spilborghs, E. Pujol, F. Tomiatti, J.G. Mueller, and J.G. Booth.*
Sidney Aluani (SGW Services/Brazil)

**39. Substrate Delivery by Recirculation.**
*B.D. Grove.*
Benjamin Grove (Stantec/USA)

**40. Enhanced Anaerobic Dechlorination of TCE via Recirculation and Batch Injection Pilot Systems near Sao Paulo, Brazil.**
*M.M. Mejac, G. De Mello, G. Borges, Y. Sutter, and M. Stein.*
Mark Mejac (Ramboll/USA)

**41. Effective Application Dosage of Nutrient Amendments Used for Remediation of Hydrocarbon-Impacted Soil.**
*C.K. Wachukwu, C.A. Azike, and E.G. Nwokah.*
Confidence Kinikanwo Wachukwu (Rivers State University/Nigeria)

**42. The Use of Innovative Characterization Technologies and Novel Amendment Injection Approaches at a Superfund Site.**
*R.A. Wymore, N. Smith, T. Macbeth, and M.B. Smith.*
Ryan Wymore (CDM Smith, Inc./USA)

**43. Rapidly Reducing Chlorinated Solvents in Multiple Media without Upsetting the Neighbors.**
*P. Zawadzkas and E. Bishop.*
Peter Zawadzkas (Haley & Aldrich, Inc./USA)

## B4. Strategies for Bioremediation Performance Assessment

**44. In Situ Bioremediation of the Source Zone for Chlorinated Solvents in Groundwater: Successes and Challenges.**
*L. LaPat-Polasko and L. Conlan.*
Laurie LaPat-Polasko (Matrix New World Engineering/ USA)

**45. Sustained Anaerobic Bio-Augmentation via In Situ Bioreactors.**
*E. Raes. K. Sublette, D. Taggart, K. Clark, and B. Baldwin.*
Eric Raes (Engineering & Land Planning Assoc., Inc./USA)

## B5. Bioremediation of Heavy Metals

**46. Advances in the Use of Passive Treatment Systems for Treatment of Selenium-Impacted Minewater.**
*J.S. Bays, R.C. Thomas, T. Harrison, and D. Evans.*
James Bays (Jacobs/USA)

**47. Analysis of Composition and Metabolic Potential of the Microbial Community for In Situ Bioremediation of a Long-Term Hexavalent Chromium-Polluted Site.**
*F.A. Flores, V. Jiménez, P. Lara, and K. Juárez-López.*
Fanny Arminda Flores (Universidad Nacional Autónoma de México/Mexico)

**48. Injection of Emulsified Vegetable Oil for Full-Scale In Situ Treatment of Hexavalent Chromium: Four Years Later.**
*H. Holbrook and R. Mora.*
Holly Holbrook (AECOM/USA)

**49. Remediation Technologies for Chromium Contaminated Soils by Leather Tanning Industries.**
*S. Kanmani.*
Sellappa Kanmani (Anna University/India)

**50. In Situ Bioremediation of Hexavalent Chromium, Perchlorate, and Chlorate in Saline Conditions: Bench-Scale Study to Field Implementation.**
*C. Lenker, A. Ayyaswami, and J. Batista.*
Carl Lenker (Tetra Tech, Inc./USA)

**51. Bioremediation Potentials of "Sheet-Flow" System Generated during Intrusion of Pristine Soil with Coal Mine-Derived AMD.**
*S. Sharma, L. Sun, R. Mahanke, and J.M. Senko.*
Shagun Sharma (The University of Akron/USA)

## C1. Munitions Response Site Management Strategies

**52. Considerations for Preparing a Conceptual Site Model for Underwater Munitions Sites.**
*L. Clarke.*
Les Clarke (Battelle/USA)

**53. Field-Scale Treatability Study to Evaluate In Situ Bioremediation via Soil Mixing of EVO and ZVI to Reduce Munitions Constituents.**
*S.T. Downey, R. Mayer, and R.L. Meadows.*
Steven Downey (APTIM/USA)

**54. Case Studies in Data Management from Two Large-Scale Munitions Response Project Sites.**
*M. Elwaseif and S. Saville.*
Mehrez Elwaseif (Jacobs/USA)

**55. Molecular Analysis of Microbial Communities Associated with ATO Biodegradation.**
*D.K. Taylor, M. Brooks, and M.J. Krzmarzick.*
David Taylor (Oklahoma State University/USA)

## C2. Impacts of Mixed Contaminants on Biodegradation

**56. In Situ Treatment of a Commingled Carbon Tetrachloride and Trichloroethene Groundwater Plume in Fractured Bedrock.**
*E. Ehret, T. Macbeth, M. Harclerode, R. Wood, N. Dung, T. Cook, K. Scheller, C. Ota, D. Janda, and M. Fattahipour.*
Emma Ehret (CDM Smith, Inc./USA)

**57. Full-Scale Application of EHC® Liquid Technology for the ISCR and ERD Treatment of an Aquifer Contaminated with Tetrachloromethane and Chloroform in Italy.**
*L. Collina, A. Leombruni, F. Lakhwala, and D. Leigh.*
Mike Mueller (PeroxyChem, LLC/Austria)

## C3. Amendment Delivery in Bedrock and Complex Geologic Environments

**58. Full-Scale In Situ Treatment of TCE in a Fractured Bedrock and Overburden through Reagent Injections that Promoted Biotic and Abiotic Dechlorination.**
*K. Ramanand, T. Chaturgan, P. Randazzo, and K.D. Dyson.*
Thakur Chaturgan (Brown and Caldwell/USA)

**59. Integrating Geologic Investigations into Remedial Design to Enhance Amendment Delivery to Solvents in Bedrock.**
*P.M. Dombrowski, D. Bytautas, C. Weeden, and M. Snyder.*
Paul Dombrowski (In-Situ Oxidative Technologies [ISOTEC]/USA)

**60. A Pilot Study to Determine the Feasibility of Biological Degradation and Chemical Reduction to Turn Off an Extraction System.**
*R. Mayer and C. Byers.*
Robert Mayer (APTIM/USA)

**61. Post Bioremediation Chemical Reduction to Achieve Treatment Standards for Carbon Tetrachloride/Chloroform at an Industrial Site in Brazil.**
*J. Sheldon and J. Orris.*
Jack Sheldon (Antea Group/USA)

## C4. Biodegradation in Complex Geological Settings

**62. Combining Remediation Technologies for Complex Hydrogeological Sites Impacted by Chlorinated Solvents (Brazil).**
*S.S. Aluani, M.C.F. Spilborghs, E. Pujol, F. Tomiatti, J.G. Mueller, J.G. Booth, and N.C. Nascimento.*
Sidney Aluani (SGW Services/Brazil)

**63. Evaluation of the Natural Attenuation Processes for the Organic Pollutants Plume from the Industrial Area of the Former Chemical Plant "Zachem" (Bydgoszcz, North Poland).**
*M. Czop and E. Kret.*
Mariusz Czop (AGH University of Science and Technology/Poland)

**64. Contamination of Baltimore Harbor Sediment with PCBs Has Increased over the Last Century: Is Bioremediation Possible?**
*D. Kaya, B.V. Kjellerup, and K.R. Sowers.*
Devrim Kaya (University of Maryland College Park/USA)

**65. Application of Biofilm-Based Inoculum Delivery System for Organohalide Respiration of Polychlorinated Biphenyls (PCBs) in Sediments.**
*R. Jing, S. Capozzi, and B.V. Kjellerup.*
Birthe Kjellerup (University of Maryland/USA)

**66. An Adaptive Approach to Treat Chlorinated Ethenes in Fractured Bedrock at a Redevelopment Site.**
*F. Lakhwala, R. Srirangam, R. Harwood, E. Mertz, M. Meriney, and L. Dodge.*
Fayaz Lakhwala (PeroxyChem, LLC/USA)

**67. Bioestimulation of a Vinyl Chloride Dissolved Plume at 35m Deep in a Low-K Zone.**
*R.C.M. Nobre, M.M.M. Nobre, and P.A. Pereira.*
Rosane Nobre (Federal University of Alagoas/Brazil)

**68. An Adaptive Approach Facilitates Successful In Situ Remediation of a Mile-Long Solvent Plume and Source Area.**
*N.T. Smith, D.D. Nguyen, N.L. Smith, K.J. Waage, M.R. Lamar, R.A. Wymore, K.S. Sorenson, S. Garcia, and I. Bowen.*
Nathan Smith (CDM Smith, Inc./USA)

## C5. 1,4-Dioxane Treatment Technologies

**69. In Situ Remediation of a 1,4-Dioxane Plume in a Heterogeneous Aquifer, Pilot Study ISB with Bioaugmentation.**
*P.R. Hsieh, T. Gray, Y. He, and M. Silva.*
Patrick Hsieh (Dalton Olmsted & Fugelvand, Inc./USA)

**70. 1,4-Dioxane Contamination Survey at River Estuaries and Wastewater Treatment Plants in Northern New Jersey.**
*F. Li, D. Deng, and M. Li.*
Fei Li (New Jersey Institute of Technology/USA)

**71. Enhancement of Intrinsic, Cometabolic 1,4-Dioxane Biodegradation.**
*A. Madison, T. Richards, R. Illes, Y. Miao, and S. Mahendra.*
Andrew Madison (Golder Associates/USA)

**72. Treatment of 1,4-Dioxane with Permanganate.**
*J. Byrd, E. Hollifield, and P. Dugan.*
Denice Nelson (ERM/USA)

**73. 1,4-Dioxane Biodegradation Potential in Aerobic and Methanogenic Microcosms.**
*V. Ramalingam and A.M. Cupples.*
Vidhya Ramalingam (Michigan State University/USA)

**74. Aerobic Cometabolism of 1,4-Dioxane and Chlorinated Solvent Mixtures: Experimental and Modeling Analysis of Multiple Primary Substrates.**
*H. Rolston, K. Krippaehne, J. Laurance, M. Azizian, and L. Semprini.*
Hannah Rolston (Oregon State University/USA)

## D1. Enhanced Methods for Biodegradation of Organic and Inorganic Contaminants

**75. Exploiting the Synergism of a Tripartite Association of *Pinus patula*, Ectomycorrhizal Fungi and Rhizosphere Bacteria for the Biodegradation of Soil Phenanthrene and Fluoranthene.**
*R.A. Adeleke, M.P. Maila, M.M. Bello-Akinosho, and M. Thantsha.*
Rasheed Adeleke (North-West University/South Africa)

**76. Full-Scale Application of Abiotic and Biotic Reductive Dechlorination to Treat Dissolved Trichloroethene and Daughter Products.**
*A. Cuellar and L. Sweet.*
Angel Cuellar (Tetra Tech, Inc./USA)

**77. Anaerobic Degradation of Chlorinated Propanes and Methanes by a New Microbial Consortium.**
*S. Vainberg and P.B. Hatzinger.*
Paul Hatzinger (APTIM/USA)

**78. Combined Abiotic and Biotic TCE Reduction Bench Study Using Local Organic Carbon and Iron Sources Conducted in Sao Paulo, Brazil.**
*K.A. Morris, M. Singer, and B. Gil.*
Kevin Morris (ERM/USA)

**79. In Situ Remediation of a Barium-Contaminated Site with Drainage Trenches and Effluent Recirculation.**
*M.M.M. Nobre, R.C.M. Nobre, and P.A. Pereira.*
Manoel Nobre (Maia Nobre Engenharia/Brazil)

**80. Phased Remedial Approach Following the BATNEEC Principle to Address Off-Site Migration Risks.**
*M. Ohse, P. Valle, O. Vounaki, and L. Crucifix.*
Martin Ohse (ERM/Belgium)

**81. Characterization of Free and Immobilized Laccase from *Cyberlindnera fabianii* and Application in Degradation of Bisphenol A.**
*F.M. Olajuyigbe, O.Y. Adetuyi, and C.O. Fatokun.*
Folasade M. Olajuyigbe (Federal University of Technology Akure, Nigeria/Nigeria)

**82. Sorption and Elution Behavior of Slow Release Electron Donor Used to Support Biodegradation of Chlorate and Perchlorate.**
*J. Gonzales, S. Shrestha, N. Martin, J. Batista, and R. Britto.*
Yasaman Saedi (University of Nevada, Las Vegas/USA)

**83. Successful Denitrification Using Food-Grade Lecithin.**
*J. Sheldon, K. Smail, and J. Molin.*
Jack Sheldon (Antea Group/USA)

**84. Is It Time to Revisit PCB Remediation Practices?**
*R. Tehrani and B. Van Aken.*
Rouzbeh Tehrani (Temple University/USA)

## D2. Advances in Amendment Formulation

**85. Optimizing In Situ Remediation Amendments Using Innovative Surfactant System Formulations and Pharmaceutical Techniques.**
*G. Birk, S. Bang, and D.F. Alden.*
David Alden (Tersus Environmental, LLC/USA)

**86. Advances in AMR Technology to Control Excessive Methanogenesis.**
*J. Mueller, W. Moody, J.G. Booth, M. Scalzi, and K. Finneran.*
Jim Mueller (Provectus Environmental Products, Inc./USA)

## D3. Phytoremediation/Mycoremediation

**87. Treatment of Benzene Contamination Using Rhizoremediation at a Petrochemical Facility in Brazil.**
*F. Coelho.*
Flavio Coelho (ERM Brasil Ltda./Brazil)

**88. Sustainable PHYTO-INTEGRATED® Remediation System to Treat Chlorobenzene-Contaminated Groundwater in a Saprolite/PWR Aquifer in South Carolina.**
*E.B. Hollifield and E.G. Gatliff.*
Edward B. Hollifield (Environmental Resources Management/USA)

**89. Selection of Fungi and Bacteria by Antagonism Test for Construction of a Mixed Microbial Consortium for Bioremediation of Soil Contaminated with Bisphenol A.**
*G. López, D.V. Cortes-Espinosa, and A.E. Absalón.*
Gerardo López (Instituto Politécnico Nacional/Mexico)

**90. Phytoremediation and Rhizodegradation Pilot Studies at a 73-Acre Former Wastewater Pond in Northern California.**
*B. LePage, B. Gray, D. Lind, J. Warner, and R. Dyer.*
Kevin Morris (ERM/USA)

**91. Assessing Performance of an Endophyte-Enhanced Hybrid Poplar Phytoremediation Program for TCE at an Arid, Fractured Bedrock Site.**
*D. Rowe, C. Serlin, E. Pearson, J. Freeman, and C. Cohu.*
Devon Rowe (Ramboll/USA)

**92. Metabolite Responses and Correlations between Phytochelatin and Metabolites in *Amaranthus hypochondriacus* under Cadmium Stress.**
*W.Q. Chen, M.D. Xie, and X.C. Lai.*
Mengdi Xie (Sichuan University, China/China)

## E1. Advances in Monitoring and Optimization Techniques

**93. Benefits of High-Resolution Fluid Interface Data Collection for LNAPL Sites.**
*D. Buckley, M. Gajjar, S. Gaito, and B. Koons.*
Daniel Buckley (AECOM/USA)

**94. Combined Method of Aspect Ratio and Passive Flux Meter Data to Determine More Accurate Groundwater Velocities.**
*C. Sandefur and C. Lee.*
Craig Sandefur (REGENESIS/USA)

**95. Use of Mass Flux Site Characterization Approach to Support Bioremediation System Optimization.**
*Z. Wahl, J. Nail, C. Divine, and S. Lloyd.*
Zachary Wahl (Arcadis/USA)

**96. Making the Transition from Active Remedy to MNA.**
*J. Wilson.*
John Wilson (Scissortail Environmental Solutions, LLC/USA)

## E2. Compound-Specific Isotope Analysis

**97. Compound-Specific Isotope Analysis and Microbial Molecular Data for Effective Monitoring of a Bioremediation Pilot Trial at a Heavily Contaminated 1,2-DCA Area: Laboratory and Field Results.**
*I. Pietrini, F. DeFerra, G. Carpani, L. Zaninetta, M. Marchesi, L. Alberti, and O. Shouakar-Stah.*
Massimo Marchesi (Politecnico di Milano/Italy)

**98. Quality Assurance and Quality Control System and Documentation for Compound Specific Isotope Analysis.**
*P.W. McLoughlin.*
Patrick McLoughlin (Pace Analytical/USA)

**99. Is it All from Biodegradation? Forensics with Tetrachloroethene $\delta 13^C$ Values and Concentrations of Tetrachloroethene Biodegradation Products.**
*P.W. McLoughlin.*
Patrick McLoughlin (Pace Analytical/USA)

**100. How Not to Overinterpret Your CSIA Data.**
*S. Rosolina and D. Taggart.*
Sam Rosolina (Microbial Insights, Inc./USA)

## E3. High-Resolution Site Characterization

**101. Success in Optimized Accelerated Anaerobic Bioremediation Using High-Resolution Site Characterization at Source Area WP21, Dover Air Force Base, Delaware.**
*A. Bloom, W. Ahler, D. Williams, H. Brown, L. Stenberg, and R. Lyon.*
Holly Brown (AECOM/USA)

**102. Applications of the Combined OI-HPT Logging System for HRSC (Optical Imaging-Hydraulic Profiling Tool).**
*W. McCall, T.M. Christy, D.A. Pipp, B. Jaster, J. Castle, J. Pascale, B. Courtney, K. Brown, and D. Wardwell.*
Wesley McCall (Geoprobe Systems/USA)

**103. Use of High-Resolution Tool to Refine Data for Application in Remediation Project.**
*M.N. Paula, V.V. Sewaybricker, C. Genthner, and B.C.I.F. Pinto.*
Mychelle Nunes de Paula (Geoklock/Brazil)

**104. Delineation of Residual Free-Phase Product Using OIP Tool.**
*M.N. Paula, V.V. Sewaybricker, and A.L. Canale.*
Mychelle Nunes de Paula (Geoklock/Brazil)

**105. New Perspectives on Horizontal Wells for Assessment and Remediation.**
*E.R. Piatt, S.S. Koenigsberg, L.I. Robinson, and W. Wiley.*
Erik Piatt (EN Rx, Inc./USA)

**106. The Role of Outcrop and Surface Geomorphological Investigations in Developing High-Resolution Conceptual Site Models.**
*J. Sadeque and R. Samuels.*
Junaid Sadeque (AECOM/USA)

**107. Flexibility in the Field Leads to Success.**
*T. Sorrells.*
Tree Sorrells (Alpine Remediation, Inc./USA)

**108. Unexpected Contaminant Transport Pathways Can be Explained by "Hidden" Stratigraphy.**
*L. Wallace and M. Duley.*
Lindsay Wallace (NewFields/USA)

NOTES

# Wednesday Platform Sessions—8:00am–10:05am

| | A SESSIONS (Holiday Ballroom 1&2) | B SESSIONS (Holiday Ballroom 3) | C SESSIONS (Holiday Ballroom 5) | D SESSIONS (Holiday Ballroom 4) | E SESSIONS (Peale, 1st Floor) |
|---|---|---|---|---|---|
| 8:00 | **Electrochemical Oxidation Pilot Reactor Demonstration Project, Coupling Technology for PFAS Destruction.** *R. Casson, S. Liang, and R. Mora.* Rachael Casson (AECOM/Australia) | **Pneumatically-Enhanced Amendment Injections for Combined Bioaugmentation and In Situ Chemical Reduction.** *E. Tyler, B. Moran, and A. Alvaro.* Edward (Ted) Tyler (Kleinfelder/USA) | **PANEL DISCUSSION**<br><br>**Green and Sustainable Remediation: The Why and How of Establishing a Corporate Program**<br><br>**Moderators**<br>Matthew Ambrusch (Langan Engineering and Environmental Services, Inc.)<br>John Simon (Nathan Associates, Inc.)<br><br>**Panelists**<br>Scott Lutz (Northrop Grumman Corporation)<br>Stephanie Fiorenza, Ph.D. (BP)<br>Paul Favara (Jacobs)<br>Thomas Potter (Massachusetts Department of Environmental Protection)<br>Shawn Tollin (Whirlpool Corporation) | **Influence of Activated Carbon on Microbial Transformation of Chlorinated Solvents and Explosives.** *K.T. Finneran.* Kevin Finneran (Clemson University/ USA) | **Improved Methods for Estimating K with the Hydraulic Profiling Tool (HPT).** *K.Y. Cha, R.C. Borden, B. Yuncu, and G. Liu.* Ki Young Cha (Draper Aden Associates/USA) |
| 8:25 | A4. Innovative Treatment Technologies for PFAS<br>**Electrochemical Treatment of Perfluoroalkyl Acid (PFAA) Precursors and PFAAs in Groundwater Impacted with Aqueous Film Forming Foams.** *C.E. Schaefer, S. Choyke, P.L. Ferguson, C. Andaya, A. Maizel, T.J. Strathmann, and C.P. Higgins.* Charles Schaefer (CDM Smith, Inc./USA) | B3. Innovative and Efficient Amendment Delivery Strategies<br>**Sulfate Delivery Using Permeable-Filled Borings for Hydrocarbon Biodegradation.** *T. Buscheck, D. Mackay, C. Paradis, R. Schmidt, N. de Sieyes, and D. Patten.* Timothy Buscheck (Chevron Corporation/USA) | | D4. Aerobic and Anaerobic Biodegradation of Contaminants<br>**Microbial and Isotopic Evidence of Concurrent Aerobic and Anaerobic Biodegradation of Chlorinated Benzenes in Wetland Sediments and a Bioaugmented-Activated Carbon Reactive Barrier.** *M.M. Lorah, D. Akob, S. Chow, E.J. Bouwer, A.R. Wadhawan, and N.D. Durant.* Michelle Lorah (U.S. Geological Survey/USA) | E4. Modeling and Monitoring Approaches to Improve Remedy Design and Implementation<br>**Techniques for Evaluating the In Situ Injection Process.** *T. Sorrells.* Tree Sorrells (Alpine Remediation, Inc./USA) |
| 8:50 | **An Electro-coagulation and Electro-oxidation Treatment Train to Degrade Perfluoroalkyl Substances in Groundwater and Liquid Waste.** *S. Liang, Q. Huang, J. Zhou, and D. Chiang.* Shangtao Liang (AECOM/USA) | **Pneumatic Fracturing and Proppant Injection Enables Successful Enhanced Biological Recirculation System for BTEX, MTBE, TBA, 2-Methylnaphthalene and Naphthalene Remediation in Groundwater.** *G. Tyers, B. Gilchrist, J. Midwig, I. Bush, and E. Moskal.* Eric Moskal (Cascade/USA) | | **Coupled Biodegradation of Chlorinated Benzenes at Anaerobic-Aerobic Interfaces.** *S.J. Chow, E.J. Bouwer, M.M. Lorah, A.R. Wadhawan, and N.D. Durant.* Steven Chow (Johns Hopkins University/USA) | **Using Factor Analysis to Assess Bioremedation Efforts at a Contaminated Site in South America.** *S.L. Capozzi, C. Merjan, P. Voese, M.M. Chitsaz, L.A. Rodenburg, and E.E. Mack.* Staci Capozzi (Geosyntec Consultants/USA) |
| 9:15 | **New Efficient Treatment of 2,3,3, 3-Tetrafluoro-2-(Heptafluoropropoxy) Propanoic Acid (GenX) by Electrochemical Degradation on a Boron-Doped Diamond Electrode.** *M. Abolhassani, S.L. Foster, S. Ivandic, and L.F. Greenlee.* Mojtaba Abolhassani (University of Arkansas/USA) | **New Application of a Geotechnical Technology to Remediate Low-Permeability Contaminated Media.** *S.D. Richardson, J.A. Long, M.L. Schofield, L. Rocha, and C.J. Newell.* Stephen Richardson (GSI Environmental, Inc./USA) | | **Air Treatment Methods as Possible Alternatives to Activated Carbon.** *M. De Camillis, J. Dijk, and M. Slooijer.* Michela De Camillis (GreenSoil Group/ Netherlands) | **Improving Decision Making for Vadose Zone Remediation of Volatile Contaminants.** *C.D. Johnson, M.J. Truex, G.D. Tartakovsky, J. Song, J. Segura, R. Hinchee, and D.J. Becker.* Chris Johnson (Pacific Northwest National Laboratory/USA) |
| 9:40 | SESSION BREAK | **Phased Amendment Delivery at Urban Brownfield to Address Mixed Plume.** *J.F. Good, J. Hayes, L. Zeng, S. Abrams, and A. Miller.* Joseph Good (Langan/USA) | SESSION BREAK | **Dechlorination of PCBs during Anaerobic Sludge Digestion.** *D. Kaya, B.V. Kjellerup, and K.R. Sowers.* Devrim Kaya (University of Maryland College Park/USA) | **Must See TV: A Post-Treatment Study Like None Other.** *B. Brab and S. Noland.* Bill Brab (AST Environmental, Inc./USA) |
| 10:05 | A4.<br>**Bench-Scale Evaluation of PFAS Removal from Landfill Groundwater by Adsorptive Media Containing Biochar.** *F.J. Barajas, D. Beck, and M. Shayan.* Francisco Barajas (AECOM/USA) | SESSION BREAK | C5.<br>**Current Knowledge of Bioaugmentation Cultures for 1,4-Dioxane Biodegradation.** *S.-Y.D. Chiang and C. Walecka-Hutchison.* Dora Chiang (CDM Smith, Inc./USA) | SESSION BREAK | SESSION BREAK |

# Wednesday Platform Sessions—10:30am–12:35pm

| | A SESSIONS (Holiday Ballroom 1&2) | B SESSIONS (Holiday Ballroom 3) | C SESSIONS (Holiday Ballroom 5) | D SESSIONS (Holiday Ballroom 4) | E SESSIONS (Peale, 1st Floor) |
|---|---|---|---|---|---|
| 10:30 | **Advanced Oxidation/Reduction for PFAS in Co-Contaminated Groundwater.** *S. Grieco and J. Persons.* Jessica Persons (Jacobs/USA) | **Adjusting Amendment Delivery Vertically and Horizontally Based on Targeted Compounds: Translating Assumptions to Field Implementation.** *A. Karachalios and M. Scalzi.* Mike Scalzi (Innovative Environmental, Inc./USA) | **Comparison of Catalytic Behaviors between Two 1,4-Dioxane-Degrading Monooxygenases.** *F. Li, D. Deng, and M. Li.* Fei Li (New Jersey Institute of Technology/USA) | **Application of Passive Sampling to Predict PCB Microbial Dechlorination Kinetics in Sediment.** *T. Needham, U. Ghosh, and K. Sowers.* Trevor Needham (U.S. Geological Survey/USA) | **Conceptual Site Model Development and Environmental Molecular Diagnostics Use for PlumeStop® Liquid Activated Carbon™ Application at a Trichlorofluoromethane Groundwater Plume.** *R. Thompson and J. Sheldon.* Robert Thompson (Antea Group USA/USA) |
| 10:55 | **Combined In Situ/Ex Situ Treatment of Per- and Polyfluoroalkyl Substance (PFAS)-Contaminated Groundwater.** *M. Crimi, T.M. Holsen, S. Mededovic Thagard, D. Siriwardena, J. Guelfo, S. Woodward, N. Hagelin, D. Woodward, and J. Heath.* Michelle Crimi (Clarkson University/USA) | **Lessons Learned: In Situ Bioremediation in a Heterogeneous Aquifer Using Recirculation Wells Inside Hydraulic Containment.** *P.R. Hsieh and T. Gray.* Patrick Hsieh (Dalton Olmsted & Fugelvand, Inc./USA) | **Microcosm Study of Isobutane and Isobutene Utilizing Microorganisms for the In Situ Bioremediation of 1,4-Dioxane, 1,1-Dichloroethene and Trichloroethene.** *K. Krippaehne, J. Laurance, L. Semprini, D. Lippincott, P. Hatzinger, M. Hyman, and A. Danko.* Jon Laurance (Oregon State University/USA) | **Anaerobic Microbial Dechlorination of Chlordecone in Microcosms from Guadeloupe Soil.** *L. Lomheim, A. Starostine, R. Flick, A. Li, L.A. Puentes Jácome, E.A. Edwards, S. Rambinaising, L. Laquitaine, C. Jean-Marius, R. Ranguin, and S. Gaspard.* Sarra Gaspard (Université des Antilles/France) | **Alternative Electron Donor Utilization in the Reductive Dechlorination Processes by Organisms in the Class *Dehalococcoidia.*** *T.A. Key and W.M. Moe.* Trent Key (Exxon Mobil Corporation/USA) |
| 11:20 | **PFAS Treatment Method Optimization for a Large Public Water Utility.** *B. Martin and K. Hay.* Kyle Hay (Weston & Sampson, Inc./USA) | **Field-Scale Demonstration of Enhanced DNAPL Dissolution Using Recirculation-Based Bioremediation.** *A.D. Fure.* Adrian Fure (Haley & Aldrich, Inc./USA) | **Bench-Scale Evaluation of 1,4-Dioxane Biodegradation via Alkane Gas-Mediated Cometabolism in the Presence and Absence of 1,1-DCE and 1,1-DCA.** *F.J. Barajas, C. Letts, and V. Sadeghi.* Francisco Barajas (AECOM/USA) | **Biostimulation of Trichloroethene Dechlorination by Organohalide-Respiring Bacteria.** *X. Wang, M. Brooks, and M. Krzmarzick.* Xuewen Wang (Oklahoma State University/USA) | **Use of MBTs to Define Technical and Economic Efficacy.** *M. Burns, P.G. Robertson, C. Myers, and D. Taggart.* Matthew Burns (WSP/USA) |
| 11:45 | **A Study of the Effectiveness of Colloidal Activated Carbon as an In Situ Treatment to Mitigate PFAS Migration in Groundwater at a Michigan Army National Guard Site.** *P.B. Lyman and R. Moore.* Patricia Lyman (Michigan Department of Military & Veterans Affairs/USA) | **Low-Pressure Injection of a Mixed Suspension of Colloidal ZVI and EVO into Fractured Clay at Niagara Falls ARS.** *N. Kranes, B. Young, J. Freim, I. Doliana, and S. Barnes.* Ben Young (EA Engineering/USA) | **Bench Tests of Biofilm Reactors as an Alternative Ex Situ Treatment Technology for 1,4-Dioxane.** *C. Zhou, Y. Xiong, Y. Tang, B. Petty, and A. Barnes.* Chao Zhou (Geosyntec Consultants/USA) | **Transport of *Pseudonocardia* through Soil for Bioremediation of 1,4-Dioxane.** A.A. Ramos-Garcia and D.L. Freedman. David Freedman (Clemson University/USA) | **Influence of Activated Carbon on Biological Oxidation in Sediments: From Surface Chemistry to Microbial Diversity.** *K. Millerick, A. Redwan, G. Pagnozzi, and D. Reible.* Kayleigh Millerick (Texas Tech University/USA) |
| 12:10 | SESSION BREAK | **Diversified Horizontal Injection Methods Effectively Deliver Amendments for Large Plume Coverage or Precise Target Areas.** *M. Sequino and K. Carlton.* Mike Sequino (Directional Technologies, Inc./USA) | **Stable Carbon and Hydrogen Isotope Ratios for Assessing the Fate and Transport of 1,4-Dioxane.** *M.-Y.J. Chu and P. Bennett.* Peter Bennett (Haley & Aldrich, Inc./USA) | SESSION BREAK | **Molecular Genomic Approaches for Tracking In Situ Anaerobic Benzene Degradation.** *C.R.A. Toth, F. Luo, S. Dworatzek, N. Bawa, J. Webb, S. Guo, C. Chen, C. Shyi, J. Xiao, E. Magnuson, Y. Guo, K. Bradshaw, and E.A. Edwards.* Courtney Toth (University of Toronto/Canada) |
| 12:35 | | SESSION BREAK | SESSION BREAK | | SESSION BREAK |

A4. Innovative Treatment Technologies for PFAS

B3. Innovative and Efficient Amendment Delivery Strategies

C5. 1,4-Dioxane Treatment Technologies

D4. Aerobic and Anaerobic Biodegradation of Contaminants

E5. Conventional Molecular Biological Tools in Site Assessment and Monitoring

# Wednesday Platform Sessions—1:00pm–3:05pm

| | A SESSIONS (Holiday Ballroom 1&2) | B SESSIONS (Holiday Ballroom 3) | C SESSIONS (Holiday Ballroom 5) | D SESSIONS (Holiday Ballroom 4) | E SESSIONS (Peale, 1st Floor) |
|---|---|---|---|---|---|
| 1:00 | **Comparison of Published Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) Fish Consumption Advisories in Australia and the USA.** *A.R. Quintin and T. Rodolakis.*<br>Amy Quintin (Wood/USA) | SESSION BREAK | SESSION BREAK | **Electrical Resistance Heating and Bioremediation: Compatibility, Effectiveness, and Post-Heating Bio-Polishing.** *C. Brown, D. Taggart, K. Clark, J. Helge, R. D'Anjou, and M. Dodson.*<br>Casey Brown (Microbial Insights, Inc./USA) | SESSION BREAK |
| 1:25 | **Human Intake of PFAS from Locally-Sourced Foods in Environments Impacted by 3M Lightwater™.** *S. Richards, K. Teague, A. Mitchell, and M. Bowersox.*<br>Sarah Richards (Coffey/Australia) | **Evaluating the Remedial Effectiveness of Four Emulsified Substrates in Anaerobic In Situ Bioreactors.** *E. Raes. K. Sublette, D. Taggart, K. Clark, and B. Baldwin.*<br>Eric Raes (Engineering & Land Planning Assoc., Inc./USA) | **Development of a Quantitative Framework for Evaluating Natural Attenuation of 1,4-Dioxane, 1,1,1-TCA, 1,1-DCA, and 1,1-DCE.** *D.T. Adamson, A. Danko, J. Wilson, C. Lebron, and D. Freedman.*<br>David Adamson (GSI Environmental, Inc./USA) | **Use of MBTs for Decision-Making Following Thermal Remedy.** *E.J. Bishop, S. Gupta, and D. Conley.*<br>Elizabeth Bishop (Haley & Aldrich, Inc./USA) | **Omics: How Not to Make Your Site a Science Project.** *D. Taggart, S. Rosolina, and K. Clark.*<br>Dora Taggart (Microbial Insights, Inc./USA) |
| 1:50 | **A Framework to Evaluate Potential Risks to Listed Species from Per- and Polyfluoroalkyl Substances.** *J.G. Suski, E. Yan, K. Cerny-Chipman, and C.J. Salice.*<br>Jamie Suski (EA Engineering, Science, Technology, Inc., PBC/USA) | **Evaluation of Factors that Influence the Long-Term Success or Failure of Chlorinated Solvent Source Zone Bioremediation.** *P.B. Hatzinger, M. Annable, A. Haluska, F.E. Loeffler, and H. Anderson.*<br>Paul Hatzinger (APTIM/USA) | **Concurrent Biodegradation of 1,4-Dioxane and 1,1-Dichloroethylene by a Gram-Negative Propanotroph *Azoarcus* sp. DD4.** *D. Deng, F. Li, C. Wu, and M. Li.*<br>Mengyan Li (New Jersey Institute of Technology/USA) | **Thermally-Enhanced Bioremediation for Xylene: Using Conductive Heating to 35°C.** *G. Heron, A. Bonnarigo, J. Wattu, J. King, D. Keane, and M. Marley.*<br>Alyson Fortune (Cascade/USA) | **Use of Metagenomic and Metatranscriptomic Approaches to Elucidate Microbial Processes In Situ.** *S.K. De Long and K. Rossmassler.*<br>Susan De Long (Colorado State University/USA) |
| 2:15 | **What Biota Data Can Be Adequately Approximated from Risk Assessment Tools for PFAS?** *A. Lee, L. Mcleod, G. Avakian, and C. Birrer.*<br>Amanda Lee (Australian Department of Defence/Australia) | **What Are the Key Data Needs to Demonstrate Effective In Situ Bioremediation of Chlorinated Solvents?** *L. LaPat-Polasko and G. Waters.*<br>Laurie LaPat-Polasko (Matrix New World Engineering/USA) | **1,4-Dioxane Bioaugmentation during and after Anaerobic Degradation.** *L. Zeng, S. Abrams, A. Oka, M. Li, and F. Li.*<br>Lingke Zeng (Langan/USA) | **Heat-Enhanced In Situ Degradation for Treatment of Energetic Compounds Impacting Groundwater.** *T.W. Macbeth, M. Burbank, D. Drennan, E. Crownover, and R. Lamendella.*<br>Tamzen Macbeth (CDM Smith, Inc./USA) | **Application of Selective Reaction Monitoring (SRM) Proteomics to Quantify Reductive Dehalogenase Peptides (RDases) in Microbial Consortium SDC-9.** *K.H. Kucharzyk , J. Meisel, L. Mullins, M. Michelson, P.B. Hatzinger, F.E. Loeffler, F.K. Murdoch, J.T. Wilson, and J. Istock.*<br>Kate Kucharzyk (Battelle/USA) |
| 2:40 | **Risk Assessment Challenges Associated with Atmospheric Transport of PFAS**. *L.J. Trozzolo.*<br>Laura Trozzolo (TRC Companies, Inc./USA) | **Evaluation of Sulfolane Biodegradation Enhanced Using Biosparging in a Fractured Rock Aquifer.** *S. Hains, J. Harder, E. Bergeron, M. Longpre-Girard, A. Madison, D. Jouen, and T.A. Key.*<br>Sylvain Hains (Golder Associates/Canada) | **Biodegradation of Bis(2-chloroethoxy) methane by Two Bacterial Cultures in Support of a Field Pilot at a Historic Chemical Production Facility.** *M. Whaley, C. Walecka-Hutchison, T. Tambling, N. Anderson, R. Wenzel, R. Stuetzle, P. Hatzinger, S. Vainberg, E.M. Jennings, and J. Bunton.*<br>Matt Whaley (The Dow Chemical Company/USA) | SESSION BREAK | **Expansion of the Molecular Biological Tool Box: Environmental Proteomics Predicts In Situ Degradation Rates.** *M.M. Michalsen, K.H. Kucharzyk, J. Meisel, L. Mullins, P.B. Hatzinger, F.E. Loeffler, F.K. Murdoch, J.T. Wilson, and J.D. Istok.*<br>Mandy Michalsen (U.S. Army Corps of Engineers/USA) |
| 3:05 | **Addressing Uncertainties in PFAS Risk Assessment.** *W.R. Rish and G.P. Brorby.*<br>William Rish (ToxStrategies, Inc./USA) | **Abiotic/Biotic Reduction of Trichloroethene and Perchlorate: Laboratory Treatability Study for a Superfund Site.** *A.G. Delgado, S. Mohana Rangan, S. Rao, A. Mouti, R. Krajmalnik-Brown, G.V. Lowry, H. Brenton, and L. LaPat-Polasko.*<br>Anca Delgado (Arizona State University/USA) | SESSION BREAK | **In Situ Chemical Reduction (ISCR): The Role of Reactive Mineral Intermediate Phases and Sulfidation.** *P.G. Tratnyek, R.L. Johnson, C. Kocur, and Y. Lan.*<br>Paul Tratnyek (Oregon Health & Science University/USA) | SESSION BREAK |

A5. PFAS Risk Assessment

B4. Strategies for Bioremediation Performance Assessment

C6. Combined Treatment of Emerging Contaminants with CVOCs

D5. Advances in Heat-Enhanced Bioremediation

D6.

E6. Big Data and Integration of Molecular Tools in Site Assessment: Advanced Omics

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# Wednesday Platform Sessions—3:30pm–5:10pm

| | A SESSIONS (Holiday Ballroom 1&2) | B SESSIONS (Holiday Ballroom 3) | C SESSIONS (Holiday Ballroom 5) | D SESSIONS (Holiday Ballroom 4) | E SESSIONS (Peale, 1st Floor) |
|---|---|---|---|---|---|
| 3:30 | SESSION BREAK | SESSION BREAK | **Dioxin Degraders and Sydney Harbour.** *C.A. O'Farrell, K. Osborne, G. Liang, M. Lee, and M. Manefield.* Casey O'Farrell (Coffey/Australia) | **Abiotic Dechlorination of Trichloroethene by Naturally-Occurring Ferrous Minerals under Aerobic and Anaerobic Conditions.** *C.E. Schaefer, P. Ho, E. Berns, and C. Werth.* Charles Schaefer (CDM Smith, Inc./USA) | **In Situ Biodegradation Rates in Contaminated Sediments via a Novel High Resolution Isotopic Approach: A Field and Modelling Study.** *M. Shayan, T. Gilevska, E. Passeport, B. Sherwood Lollar, E. Seger, E.J. Lutz , K.A. West, S.A. Morgan, and E. Mack.* Mahsa Shayan (AECOM/Canada) |
| 3:55 | A6. PFAS Source and Forensic Considerations: **Source Differentiation of Per- and Polyfluoroalkyl Substances in Environmental Source Inputs.** *A.E. Robel, J.A. Field, and C.P. Higgins.* Alix Robel (Oregon State University/USA) | B5. Bioremediation of Heavy Metals: **Bioelectrochemical Systems for In Situ Treatment of Groundwater Contaminated by Hexavalent Chromium.** *L. Pedrali, G. Beretta, A. Mastorgio, S. Saponaro, and E. Sezenna.* Gabriele Beretta (Politecnico di Milano/Italy) | C7. Addressing Emerging Contaminants: **Treatment of 1,4-Dioxane by Extreme Soil Vapor Extraction.** *C. Bell, E. Gates, E. Kalve, and C. Spooner.* Caitlin Bell (Arcadis/USA) | D6. Abiotic Transformation Processes: **Abiotic Degradation of PCE and TCE by Magnetite and Clay Minerals.** *M.M. Scherer, D.E. Latta, J. Culpepper, T. Robinson, A. Neumann, J. Entwistle, R. Deep, E. Suchomel, and L. Kane.* Michelle Scherer (University of Iowa/USA) | E7. Advances in Tools and Techniques for Assessing MNA: **Confirming In Situ Benzene Biodegradation under Anaerobic Conditions Using Stable Isotope Probing.** *K. Clark, K. Hebbard, and D. Taggart.* Kate Clark (Microbial Insights, Inc./USA) |
| 4:20 | **Non-Traditional Sources of Per- and Polyfluorinated Alkyl Substances (PFAS).** *R. Bennett, A.P.T. Macdonald, and S. Marconetto.* Ross Bennett (Golder Associates/USA) | **In Situ Chemical Precipitation of Cobalt for Long-Term Groundwater Remediation.** *D. Williamson, B. Schroth, and G. Kiffe.* Dean Williamson (Jacobs/USA) | **Factors Affecting Enhanced In Situ Biological Reduction of 1,2,3-Trichloropropane in Groundwater: Case Studies from Central California.** *S. Varadhan, E. Suchomel, M. Asher, and S. Dworatzek.* Srinivasa Varadhan (Geosyntec Consultants/USA) | **Naturally-Occurring and Biologically-Mediated Abiotic Transformation of Trichloroethene in Low-Permeability Formations.** *D.L. Freedman, H. Wang, R. Yu, R. Iery, L. Slater, D. Adamson, F. Day-Lewis, and A. Danko.* David Freedman (Clemson University/USA) | **Achieving Monitored Natural Attenuation Remedy Using Electrical Hydrogeology.** *T. Halihan, S. McDonald, and B. Thomas.* Todd Halihan (Oklahoma State University/USA) |
| 4:45 | **Are Wastewater Treatment Plants and Biosolids a Significant Source of PFAS?** *D. Bogdan, J.M. Cuthbertson, B.J. Harding, and R. Kennedy.* Dorin Bogdan (AECOM/USA) | **Biological Reduction of Chromate, Nitrate, Chlorate and Perchlorate in the Presence of High Levels of Salinity.** *N. Martin, S. Shrestha, J. Batista, A. Ayyaswami, and C. Lenker.* Nicole Martin (University of Nevada Las Vegas/USA) | **Isolation, Adaptation, and Preparation of Bacterial Strains for 1,4-Dioxane Bioaugmentation.** *J.M. Mathieu, M.B. da Silva, Y. He, and P.J. Alvarez.* Jacques Mathieu (Rice University/USA) | **Documenting In Situ Reactive Iron Mineral Formation without Drilling: A New Monitoring Well-Based Sampling Approach.** *J. Martin Tilton, J. Ford, S.M. Ulrich, D. Liles, S. Justicia-Leon, C. Divine, D. Taggart, and K. Clark.* Jennifer Martin Tilton (Arcadis/USA) | **Metabolomics, Lipidomics, and Metagenomics: Multiple Lines of Evidence for Monitored Natural Attenuation.** *S.R. Campagna, D. Taggart, and S. Rosolina.* Dora Taggart (Microbial Insights, Inc./USA) |
| 5:10 | **Forensic Approach for PFAS Source Identification at Contaminated Sites.** *K. Dasu, L. Mullins, D. Friedenberg, and J. Thorn.* Kavitha Dasu (Battelle/USA) | **Arsenic Fate, Transport, and In Situ Bioremediation at a Large Former Industrial Site.** *G.A. Ulrich, K. Dean, G. Vondra, R. Palachek, K. Thompson, J. Shaw, S. Valvigi, and C. Bartlett.* Glenn Ulrich (Parsons Corporation/USA) | **What Will Emerge Next? A Data-Based Analysis to Anticipate Emerging Contaminants.** *D. Nelson, K. Sellers, and N. Weinberg.* Denice Nelson (ERM/USA) | **Field Test Yields Aerobic Abiotic Trichloroethene Degradation Rate, Sorption and Diffusion Coefficients for Low Permeability Fractured Rock.** *R.M. Allen-King, R. Kiekhaefer, and R. Dishman.* Richelle Allen-King (University at Buffalo, SUNY/USA) | **A Comprehensive Evaluation of MNA Mechanisms for TCE and DCE in a Large, Dilute Plume.** *K.S. Sorenson, R.L. Olsen, M.K. Williams, and D.L. Brown.* Kent Sorenson (CDM Smith, Inc./USA) |

# Group 2 Posters

**Display: Wednesday, 7:00 a.m.–Thursday, 1:00 p.m.**
**Presentations: Wednesday, 5:45–7:00 p.m.**

The following posters will be on display from Wednesday morning through Thursday afternoon. During the Presentations period Wednesday evening, presenters will be at their displays to discuss their work. The poster board number assigned to each presentation appears below.

**GROUP 2 POSTER PRESENTERS**
Please remove your poster Thursday, April 18, between 12:30-1:00 p.m. Access to the Exhibit Hall will be restricted to booth staff after 1:00 p.m. for Exhibitor move-out and remaining posters will be discarded.

**A7.** Best Practices and Approaches for Analyzing PFAS
**A8.** Best Practices in GSR
**A9.** Incorporating Sustainability Considerations into Remediation Projects
**A10.** Sustainable Remediation Assessment Tools
**B6.** Biobarrier Installation and Management
**B7.** Advances in Biological Wastewater Treatment Processes
**B8.** Natural Source Zone Depletion
**C6.** Combined Treatment of Emerging Contaminants with CVOCs
**C7.** Addressing Emerging Contaminants
**C8.** Impacts of Climate Change and Extreme Weather Events on Remedial Design
**C9.** Optimizing Existing Systems
**C10.** Adaptive Management Strategies
**D4.** Aerobic and Anaerobic Biodegradation of Contaminants
**D5.** Advances in Heat-Enhanced Bioremediation
**D6.** Abiotic Transformation Processes
**D7.** Vapor Intrusion Design and Mitigation Methods
**D8.** VOC Vapor Intrusion
**D9.** Innovative Tools for Evaluating Vapor Intrusion Risk
**E4.** Modeling and Monitoring Approaches to Improve Remedy Design and Implementation
**E5.** Conventional Molecular Biological Tools in Site Assessment and Monitoring
**E6.** Big Data and Integration of Molecular Tools in Site Assessment: Advanced Omics
**E7.** Advances in Tools and Techniques for Assessing MNA
**E8.** Aerobic Processes for the Remediation of Petroleum Hydrocarbon Sites
**E9.** Combined Approaches for the Remediation of Petroleum-Hydrocarbons
**E10.** Remediation and Management of Petroleum Hydrocarbon-Contaminated Sites
**E11.** Biodegradation and Remediation of Crude Oil and Petroleum Hydrocarbons in Cold Regions

## A7. Best Practices and Approaches for Analyzing PFAS

**1. Assessment of Freely Dissolved Per- and Polyfluoroalkyl Substances (PFAS) Using Newly Developed Passive Sampler.**
*E.M. Kaltenberg, K. Dasu, and F. Pala.*
Eliza Kaltenberg (Battelle/USA)

**2. Lessons Learned from the Application of Total Oxidizable Precursors (TOP) Assay on Environmental Samples.**
*C.J. Neslund.*
Charles Neslund (Eurofins Lancaster Laboratories Environmental, LLC/USA)

**3. Updates on a Holding Time Evaluation Study for the Analysis of PFAS in Aqueous Samples.**
*C.J. Neslund.*
Charles Neslund (Eurofins Lancaster Laboratories Environmental, LLC/USA)

## A8. Best Practices in GSR

**4. Sustainable Remediation Utilizing a Combined Waste Stream with a Green Technology to Obtain Cost-Effective Closure at a Brownfields Site.**
*K.M. Gaskill, M. Shah, and R. Coffman.*
Keith Gaskill (EnviroForensics, LLC/USA)

**5. Sustainability as a Key Driver in Selecting a Site Remedial Strategy: Installing a Reactive Zone to Mitigate Off-Site Migration.**
*P. Valle, C. Rao, M. Ohse, M. Verbeeck, and D. Nuynes.*
Paulo Valle (ERM/Belgium)

## A9. Incorporating Sustainability Considerations into Remediation Projects

**6. Combining Enhanced Reductive Dechlorination and Solar-Powered Soil Vapor Extraction to Sustainably Remediate VOCs in Groundwater and Soil.**
*D.W. Brown, N. Ume, M. Perlmutter, and M. Louth.*
Daniel Brown (Jacobs/USA)

**7. In Situ Sustainable CrVI Soil Remediation Implemented in Barranquilla, Colombia.**
*K.A. Morris, C. Hernandez, D. Sanchez, and J. Henderson.*
Kevin Morris (ERM/USA)

**8. Electrochemical and Corrosion-Induced Hydrogen Generation to Stimulate Bioremediation of Perchlorate in Groundwater.**
*C.J. Ritchie and S.D. Warner.*
Christopher Jackson Ritchie (Ramboll/USA)

**9. A Top-Down Approach for the Development and Implementation of GSR in Taiwan: Progress and Challenges.**
*K.-F. Chen, C.-Y. Li, Y.-L. Tu, P.-H. Chen, Y.-C. Su, B.-N. Wang, I.-H. Chen, and Y.-T. Wu.*
Bing-Nan Wang (SINOTECH Environmental Technology, Ltd./Taiwan)

## A10. Sustainable Remediation Assessment Tools

**10. The Risks and Rewards of Using Social Media.**
*C.G. Deffenbaugh.*
Chris Deffenbaugh (Burns & McDonnell/USA)

**11. ENVIRO.wiki: Tech Transfer in the 21st Century.**
*B. Yuncu, J. Hurley, and R.C. Borden.*
Bilgen Yuncu (Draper Aden Associates/USA)

## B6. Biobarrier Installation and Management

**12. Permeable Reactive Barriers: A Non-Traditional Technology to Meet Estuary Nitrogen TMDLs.**
*P.M. Dombrowski, M. Lee, F. Hostrop, D. Raymond, J. Begley, T. Parece, J. Marrion, and B. Shreve.*
Paul Dombrowski (In-Situ Oxidative Technologies [ISOTEC]/USA)

**13. To AMR or Not to AMR?: That Is the Question.**
*V. Hosangadi, R. Robitalle, P.L. Chang, and M. Pound.*
Vitthal Hosangadi (NOREAS, Inc./USA)

**14. Liquid Activated Carbon Used in Barrier Application for a Large Chlorinated Plume in Place of P&T Hydraulic Control and ERD with Modeling Results.**
*J. Snyder, T. McMillan, C. Lee, and C. Ortiz.*
Jay Snyder (EA Engineering, Science, and Technology, Inc., PBC/USA)

**15. Improving the Efficiency of Remediation of TCE-Contaminated Groundwater Using Permeable Reactive Barriers.**
*S.S. Ghandehari, D. Ronin, B. Hensel, A. Torrents. C. Hapeman, and B.V. Kjellerup.*
Birthe Kjellerup (University of Maryland/USA)

## B7. Advances in Biological Wastewater Treatment Processes

**16. The Potentials for Bioremediation of Polychlorinated Biphenyls in Effluents from a Large Advanced Wastewater Treatment Plant.**
*R. Jing, S. Capozzi, and B.V. Kjellerup.*
Birthe Kjellerup (University of Maryland/USA)

**17. Occurrence and Removal of Polychlorinated Biphenyls (PCBs) in Urban Stormwater.**
*S. Cao, A. Davis, S. Capozzi, and B.V. Kjellerup.*
Birthe Kjellerup (University of Maryland/USA)

**18. The Removal of Trace Organic Contaminants (TOrCs) in Urban Stormwater by Bioretention Processes.**
*N.J.M. Fitzgerald, C.P. Higgins, B. Kranner, A.B. Boehm, H. Piza, and A.R.M.N. Afrooz.*
Nicole Fitzgerald (Colorado School of Mines/USA)

**19. Comparative Study on Removal of Cadmium and Chromium from Wastewater Using Nanocellulose.**
*A. Gupta.*
Asha Gupta (Guru Jambheshwar University of Science & Technology/India)

**20. Treatment of Urban Toxic Contaminants in Stormwater.**
*D. Kaya, K. Croft, C. Yuan, and B.V. Kjellerup.*
Devrim Kaya (University of Maryland College Park/USA)

**21. Analysis of Physical and Biological Degradation of PBDEs in Historical Limed Biosolids and THP-AD Treated Biosolids.**
*T. Motley, S. Fischer, B. Kjellerup, N. Andrade, and A. Torrents.*
Taylor Motley (University of Maryland/USA)

**22. Managed Aquifer Recharge: Experimental Evaluation of Water Quality Impacts.**
*P. Pradhan, G. Salazar-Benites, C. Bott, and M. Widdowson.*
Prarthana Pradhan (Virginia Tech/USA)

## B8. Natural Source Zone Depletion

**23. Estimates of Hydrocarbon NAPL Depletion from Compositional Change over Time.**
*G.E. DeVaull and I. Rhodes.*
George DeVaull (Shell Global Solutions/USA)

**24. Effects of Soil Heterogeneity on the Thermal Gradient Method for NSZD Rate Measurement.**
*J.A. Zimbron, J. DiMarzio, and J. Walton.*
Julio Zimbron (E-Flux/USA)

**25. Quantifying Methane in Soil Gas Efflux during NSZD Assessments.**
*E. Gates, R. Ahlers, and A. Pennington.*
Ellyn Gates (Arcadis/USA)

**26. One Year Study of Natural Source Zone Depletion (NSZD) at a Paved Former Service Station Site in Spain.**
*A. Sayas, M. Marti, B. Beuthe, and L. Barreales.*
Andrew Kirkman (BP/USA)

**27. Temperature-Dependence of Biodegradation from Two Perspectives: Big-Data and Site-Specific.**
*P.R. Kulkarni, T.E. McHugh, D.C. King, C.J. Newell, and H. Hopkins.*
Poonam Kulkarni (GSI Environmental, Inc./USA)

**28. Natural Attenuation Rates of Benzene and Total Petroleum Hydrocarbons (TPH) at Petroleum Release Sites.**
*M.A. Lahvis.*
Matthew Lahvis (Shell Global Solutions/USA)

**29. Analytics on an NSZD Measurement Database.**
*T. Palaia.*
Tom Palaia (Jacobs/USA)

**30. Incorporating Natural Source Zone Depletion Concepts in Remediation of a Jet Fuel Plume.**
*P. Parmentier, N. Irish, and J. Studer.*
Paul Parmentier (Apex Companies, LLC/USA)

**31. Intensive Biogeochemical Characterization of Sediment Core Provides Unique Insights on Natural Source Zone Depletion.**
*J. Studer, N. Irish, and P. Parmentier.*
James Studer (InfraSUR, LLC/USA)

**32. Finding LNAPL Natural Source Zone Depletion in a Fractured Rock Environment.**
*M. Rousseau, T. Brown, A. King, and D. Morgan.*
Matthew Rousseau (GHD/Canada)

**33. Quantifying Natural Source Zone Depletion Rates for Confined LNAPL.**
*J.M. Hawthorne, L.A. Reyenga, C. Carter, and M. Salameh.*
Marwan Salameh (GEI Consultants, Inc./USA)

**34. Benefits of a Multiple Lines of Evidence Approach for NSZD.**
*J. Smith, S. Gaito, and B. Koons.*
Jonathon Smith (AECOM/USA)

**35. Integrating Natural Source Zone Depletion in Remediation Optimization at LNAPL Sites.**
*J. Wang, C. Landin, B. Revell, N. Durant, and S. Rosansky.*
James Wang (Geosyntec Consultants/USA)

## C6. Combined Treatment of Emerging Contaminants with CVOCs

**36. Insights into Variability of Cometabolic Degradation Kinetics of 1,4-Dixoane and Co-contaminants under Prolonged Starvation Conditions.**
*M.-Y.J. Chu.*
Min-Ying Jacob Chu (Haley & Aldrich, Inc./USA)

## C7. Addressing Emerging Contaminants

**37. Dioxin Degraders and Sydney Harbour.**
*C.A. O'Farrell, K. Osborne, G. Liang, M. Lee, and M. Manefield.*
Casey O'Farrell (Coffey/Australia)

## C8. Impacts of Climate Change and Extreme Weather Events on Remedial Design

**38. Focusing Remedy Transition at a Former Fuel Terminal Located in a Cold Weather Climate on Using Green and Sustainable Strategies.**
*K.A. Waldron, C. Schultz, C. Cohu, J. Freeman, K. Holland, and J. Ricker.*
Kyle Waldron (Marathon Petroleum Company/USA)

## C9. Optimizing Existing Systems

**39. Pump and Treat Can Still Yield Extraordinary Results.**
*H.V.B. de Oliveira, V.V. Sewaybricker, and R.O. Coelho.*
Henrieth Viviane Borgo de Oliveira (Geoklock/Brazil)

**40. Integrated Data Management Practices for Effective Decision Making.**
*M. Dragan, J.P. Davit, and I. Hers.*
Massimo Dragan (Golder Associates/Italy)

**41. Applying Lean Six Sigma Principles to Remediation Systems: Optimization of a Bioventing System.**
*V. Gamez Grijalva, B. Foehr, and T. Wu.*
Victor Gamez Grijalva (Jacobs/USA)

**42. Drone-Based Vegetation Mapping Supporting Plant-Assisted Bioremediation at a Fuel Pipeline Spill in Sagebrush Steppe, South-Central Idaho.**
*B. Harding, K. Waldron, and J. Bradley.*
Barry Harding (AECOM/USA)

**43. Remote Monitoring and Control for Optimization of Remediation Systems.**
*J.L. Lawrence and L.D. Steele.*
Leslie Steele (Kleinfelder/USA)

**44. Groundwater Pump & Treat System Optimization Evaluation.**
*L. Zeng, H. Nichols, M. Wenrick, I. Khan, and S. Abrams.*
Lingke Zeng (Langan/USA)

## C10. Adaptive Management Strategies

**45. An Adaptive Remediation Strategy to Mitigate Biofouling in a Hydraulic Containment and Ex Situ Treatment System.**
*K. Johnson, J. Baldock, A. Thomas, C. Couves, M. Eversman, and K. Morris.*
James Baldock (ERM/United Kingdom)

**46. Adaptive Site Management Strategies for a Large and Complex Fractured Sandstone Site.**
*P. Favara and K. Thomsen.*
Paul Favara (Jacobs/USA)

**47. Investing in Data Visualization to Develop Adaptive Environmental Liability Management Strategies to Streamline Site Closure.**
*J. Orris and J. Ruf.*
Joshua Orris (Antea Group/USA)

## D4. Aerobic and Anaerobic Biodegradation of Contaminants

**48. Selection and Identification of Microorganisms Highly Tolerant to Different Pesticides for Their Application in Soil Bioremediation.**
*R. Arenas, D.V. Cortes, and A.E. Absalón.*
Rosa Arenas (Instituto Politecnico Nacional/Mexico)

**49. Evaluation of PAHs Degradation by a Fungal Consortium Using Different Agroindustrial Waste as Texturizer for Bioremediation Soils.**
*A. Hernández, A.E. Absalón, and D.V. Cortés-Espinosa.*
Diana V. Cortes-Espinosa (Instituto Politécnico Nacional/Mexico)

**50. Development and Testing of a 1,4-Dioxane Bioaugmentation Culture.**
*S. Dworatzek, P. Dennis, A. Hill, and C. Zhou.*
Sandra Dworatzek (SiREM/Canada)

**51. Anaerobic Benzene Catabolism.**
*K. Lee and A. Ulrich.*
Korris Lee (University of Alberta/Canada)

**52. Sustained Microbial Oxidation of Vinyl Chloride under Low Oxygen Flux Conditions.**
*T.E. Mattes and P.M. Richards.*
Timothy Mattes (University of Iowa/USA)

**53. Field Demonstration of Bioaugmentation for Bioremediation of Trichloroethene-Contaminated Groundwater in Japan.**
*N. Okutsu, K. Enomoto, W. Tamura, T. Kikuchi, and T. Shiotani.*
Noriya Okutsu (Kurita Water Industries, Ltd./Japan)

**54. Soil Respiration Rates under Natural Attenuation versus Enhanced Biodegradation.**
*S. Dore, D. Pope, R. Thomas, J. Wasielewski, and A. Weston.*
Donald Pope (GHD/USA)

**55. Modeling of Reductive Dechlorination of Chloethenes by *Desulfitobacterium* and *Dehalococcoides*.**
*M. Yoshikawa and M. Zhang.*
Miho Yoshikawa (National Institute of Advanced Industrial Science and Technology/Japan)

## D5. Advances in Heat-Enhanced Bioremediation

**56. Steam-Enhanced Biodegradation of VOC-TPH LNAPL Mixture under an Active Building Using Horizontal Wells at Naval Air Station North Island.**
*V. Hosangadi, M. Losi, P.L. Chang, and M. Pound.*
Vitthal Hosangadi (NOREAS, Inc./USA)

**57. Can Microbes Reduce Thermal Remediation Timeframes and Implementation Costs? A Retrospective Look at Thermal Sites.**
*D. Nelson, J. Byrd, J. Dablow, and J. Baldock.*
Denice Nelson (ERM/USA)

**58. Thermal In Situ Sustainable Remediation (TISR™): Linking Renewable Energy to Sustainable Site Restoration.**
*D.S. Randhawa, C. Flanders, D. Rosso, and P.W. Visser.*
Davinder Randhawa (Arcadis/USA)

## D6. Abiotic Transformation Processes

**59. Abiotic and Biotic Treatment underneath an Active Shopping Center.**
*S. Abrams, L. Zeng, M. Wenrick, and K. Tyson.*
Stewart Abrams (Langan/USA)

**60. Long-Term Performance Monitoring of Zero-Valent Iron Sites.**
*L. Cook, K. Kirchner, J. Popovic, D. Williamson, R. Wilkin, and R. Johnson.*
Laura Cook (Jacobs/USA)

**61. Reduction of Chromate and Chlorate Using Zero Valent Iron (ZVI) and Bio-ZV.**
*K. Greenhalph, J. Gonzales, and J. Batista.*
John Michael Gonzales (University of Nevada Las Vegas/USA)

**62. Rhamnolipid Biosurfactant Coated Zero-Valent Iron Nanoparticle: A Credible Approach towards Potential Petroleum Hydrocarbon Remediation.**
*K. Patowary, A. Konwar, M. Das, D. Chowdhury, S. Deka, and N.C. Talukdar.*
Kaustuvmani Patowary (Institute of Advanced Study in Science and Technology [IASST]/India)

## D7. Vapor Intrusion Design and Mitigation Methods

**63. Vapor Intrusion in an Automobile Manufacturing Plant in Brazil.**
*C.F.F.S. Calderon, T.F. Noccetti, G. Garofano, G.B. Machado, and I.G.D. Thobias.*
Carlos Felipe Ferreira da Silva Calderon (Geoklock Consultoria e Engenharia Ambiental Ltda./Brazil)

**64. Vapor Intrusion: Rapid Assessment and Mitigation Implementation in a University Building.**
*R. Spina, R. Kumamoto, A. Yoshinari, and E. Freire.*
Renato Kumamoto (Geoklock /Brazil)

**65. Design and Implementation of Vapor Extraction and Recirculation Systems for Environmental Remediation in an Active Industrial Area.**
*T.F. Noccetti, D.D. Savio, and V.V. Sewaybricker.*
Talita Favaro Noccetti (Geoklock/Brazil)

**66. Using Pneumatic Permeability Analyses of Sub-Slab Media for Sizing Vacuum Blowers Used for Vapor Mitigation Systems.**
*R.J. Roth.*
Robert Roth (Terracon/USA)

**67. Vapor Intrusion Mitigation and Remediation of Mercury-Impacted Soil and Groundwater.**
*D.J. Russell and C. Wong.*
David Russell (AECOM/USA)

**68. Horizontal Vapor Extraction Wells: Investigating the Zone of Influence and Optimizing Well Spacing.**
*B.D. Younkin and D. Ombalski.*
Brian Younkin (Directed Technologies Drilling, Inc./USA)

## D8. VOC Vapor Intrusion

**69. Vapor Intrusion at Former Manufactured Gas Plants: Do the Petroleum Hydrocarbon Site Exclusion Criteria Apply?**
*D.Y. Marquez and A. Christensen.*
Diana Marquez (Burns & McDonnell/USA)

**70. Evidence for TCE Degradation in the Vadose Zone: Relevance for Vapor Intrusion (VI) Site Management.**
*J. Roth, C. Holton, L. Lund, and C. Lutes.*
Julia Roth (Jacobs/USA)

## D9. Innovative Tools for Evaluating Vapor Intrusion Risk

**71. Effective Characterization of Building Susceptibility to Vapor Intrusion with Building Pressure Cycling.**
*H. Dawson, W. Wertz, T. McAlary, and T. Gabris.*
Maggie Allen (Geosyntec Consultants/USA)

**72. Improved Soil Screening Levels for Volatile Petroleum Chemicals: Including Volatilization in Surficial Soils Criteria.**
*G.E. DeVaull.*
George DeVaull (Shell Global Solutions/USA)

**73. Automated Continuous Real-Time Vapor Intrusion Monitoring and Response: Acute Exposure Prevention and More.**
*B. Hartman, M. Kram, and C. Frescura.*
Blayne Hartman (Hartman Environmental Geoscience/ USA)

**74. Measuring Indoor Air Concentrations for Multi-Week Periods to Provide a More Accurate and Definitive VI Risk Assessment.**
*H. O'Neill and S. Thornley.*
Harry O'Neill (Beacon Environmental Services, Inc./USA)

**75. Assessing Volatile Organic Chemicals in Soils via Passive Sampling.**
*R. Borrelli, A. Oldani, F. Vago, J. MacFarlane, P.M. Gschwend, and L. Zaninetta.*
Luciano Massimo Zaninetta (ENI-Syndial/Italy)

## E4. Modeling and Monitoring Approaches to Improve Remedy Design and Implementation

**76. Quantification of Competitive Sorption of Chemical Species onto Activated Carbon: Unlocking the Modelling of Complex Mixtures.**
*J. Birnstingl, P. Erickson, and K. Thoreson.*
Jeremy Birnstingl (REGENESIS/United Kingdom)

**77. Case Study: Use of Lines of Evidence to Identify Multiple Sources of a Chlorinated Solvents Plume.**
*F. Biaggioni, M. Scarance, N. Brandsch, and V. Vanin.*
Filipe Biaggioni Quessada Gimenes (Geoklock/Brazil)

**78. What Microbial Growth Looks Like in the Subsurface: Electrical Imaging of Impacted Sites.**
*T. Halihan, S. McDonald, and M. White.*
Todd Halihan (Oklahoma State University/USA)

**79. High-Resolution Quantification of LNAPL Transmissivity in Fractured Media.**
*J.M. Hawthorne and L.A. Reyenga.*
J. Michael Hawthorne (GEI Consultants, Inc./USA)

**80. High-Resolution Mobile NAPL Interval Identification and Transmissivity Calculations for DNAPL.**
*J.M. Hawthorne and L.A. Reyenga.*
J. Michael Hawthorne (GEI Consultants, Inc./USA)

**81. Numerical Modelling of Pollutant Migration and Groundwater Remediation in the Complex Hydrodynamical Conditions for the Industrial Waste Site of the Former "Stalowa Wola" Steelworks.**
*E. Kret and M. Czop.*
Ewa Kret (AGH University of Science and Technology/ Poland)

**82. Application of Principal Component Analysis to Improve Conceptual Site Models.**
*L.C.M. Paula, P. Voese, S.L. Capozzi, M.M. Chitsaz, L.A. Rodenburg, J.K. Henderson, and E.E. Mack.*
Luiz Cesar Merjan de Paula (Protel/Brazil)

**83. Leveraging PRISM™ to Assess Contaminant Flow Pathways: Magothy Aquifer, New York.**
*R.C. Samuels, J. Sadeque, B. Caldwell, and P. Shattuck.*
Ryan Samuels (AECOM/USA)

## E5. Conventional Molecular Biological Tools in Site Assessment and Monitoring

**84. Complete Dechlorination of Chlorinated Ethenes and Chloroform in a Brackish Environment.**
*J. Dijk, M. De Camillis, H. Tak, and M. Slooijer.*
John Dijk (Greensoil Group/Belgium)

**85. Model Cultures versus Field Molecular Tools: Are the Cells We Use in the Lab the Cells We "See" in the Field.** *K.T. Finneran.*
Kevin Finneran (Clemson University/USA)

**86. Cross-Comparison of Organohalide-Respiring (OHR) Bacteria in Human Fecal and Wastewater Samples.**
*R. Jing and B.V. Kjellerup.*
Birthe Kjellerup (University of Maryland/USA)

**87. Vinyl Chloride Reductase (*vcrA*) Identified on Extrachromosomal Circular Element in *Dehalococcoides mccartyi*.**
*O. Molenda, N. Morson, and E.A. Edwards.*
Nadia Morson (University of Toronto/Canada)

**88. Growth of Dechlorinating Bacteria in Enrichment Cultures, Derived from Contaminated Soil and Sediment from Guadeloupe, that Dechlorinate Hexachlorocyclohexane Isomers.**
*S. Rambinaising, L.A. Puentes Jàcome, L. Lomheim, E.A. Edwards, and S. Gaspard.*
Suly Rambinaising (Université des Antilles/Guadeloupe)

## E6. Big Data and Integration of Molecular Tools in Site Assessment: Advanced Omics

### Student Paper Winner

**89. The Application of Shotgun Sequencing to More Fully Define the Functional Abilities of Microorganisms at Contaminated Sites.**
*H. Dang, Y.H. Kanitkar, R.D. Stedtfeld, S.A. Hashsham, A.M. Cupples, and P.B. Hatzinger.*
Hongyu Dang (Michigan State University/USA)

**90. Assessment of Methyl Tert-Butyl Ether (MTBE) Degradation Using Metagenomics and Metaproteomics.**
*S. Fiorenza, K.H. Kucharzyk, J. Nyvall, and S. Lummus.*
Stephanie Fiorenza (BP/USA)

**91. Utilization of Molecular Biological Tools to Assess Performance of Biosparge Pilot System for Sulfolane Degradation.**
*T.A. Key, D. Jouen, P. Dennis, S. Hains, J. Harder, E. Bergeron, and A. Madison.*
Trent Key (Exxon Mobil Corporation/USA)

**92. Application of Metagenomic-Guided Proteomics to Assess Degradation of RDX in Pure Cultures and Groundwater from Contaminated Sites.**
*K.H. Kucharzyk, J. Meisel, L. Mullins, A. Minard-Smith, V. Lal, M. Michalsen, M. Fuller, and M. Gander.*
Kate Kucharzyk (Battelle/USA)

**93. Application of Metagenomic-Guided Proteomics to Assess Degradation of Chlorinated Ethenes in Pure Cultures and Groundwater from Contaminated Sites.**
*K.H. Kucharzyk, J. Meisel, L. Mullins, A. Minard-Smith, and V. Lal.*
Kate Kucharzyk (Battelle/USA)

## E7. Advances in Tools and Techniques for Assessing MNA

**94. A New Modeling Tool to Estimate Cleanup Rates in Highly Heterogeneous Aquifers with Matrix Diffusion and Time-Dependent Source Mass Flux.**
*D.K. Burnell and J. Xu.*
Daniel Burnell (Tetra Tech, Inc./USA)

**95. The Use of Advanced Characterization Tools in Combination Improve Our Understanding of Biodegradation at Crude Oil Release Sites.**
*C. Espino Devine, R. Mohler, K. O'Reilly, N. Sihota, S. Ahn, T. Patterson, L. Kristofco, R. Magaw, and D. Zemo.*
Catalina Espino Devine (Chevron Corporation/USA)

**96. What Happened to MTBE in California Groundwater?**
*T.E. McHugh and S.R. Rauch.*
Thomas McHugh (GSI Environmental, Inc./USA)

**97. Molarity Provides Better Clarity: Using Molar-Based Data for Evaluating Chlorinated Volatile Organic Compound-Impacted Sites.**
*J.A. Ricker, T.O. Goist, and D. Winchell.*
Joseph Ricker (Earthcon Consultants, Inc./USA)

## E8. Aerobic Processes for the Remediation of Petroleum Hydrocarbon Sites

**98. In Situ Aerobic Biostimulation of Groundwater at a National Priority Site in Italy.**
*A. Mastorgio, G. Beretta, S. Saponaro, E. Sezenna, R. Pecoraro, C. Usai, M. Benedettini, and S. Micheli.*
Gabriele Beretta (Politecnico di Milano/Italy)

**99. Horizontal Biosparging of Jet Fuel Plumes within Glacial Deposits Expedites DoD Site Remediation.**
*G. Atik, D. Forse, M. Sequino, and K. Carlton.*
Kyle Carlton (Directional Technologies, Inc./USA)

**100. Air Sparging: New Thoughts and Controls for an Old Remedial Technique.**
*B.D. Grove.*
Benjamin Grove (Stantec/USA)

## E9. Combined Approaches for the Remediation of Petroleum Hydrocarbons

**101. Successful Self-Activating ISCO/Enhanced Bioremediation for BTEX Remediation: Soil Mixing Brazil Site.**
*S.S. Aluani, M.C.F. Spilborghs, E. Pujol, F. Tomiatti, J.G. Mueller, and J.G. Booth.*
Sidney Aluani (SGW Services/Brazil)

**102. Oil Waste Processing Using Combination of Physical Pre-treatment and Bioremediation: Case Study.**
*P. Najmanová and R. Raschman.*
Petra Najmanova (DEKONTA, Inc./Czech Republic)

**103. Using Multiple Lines of Evidence to Evaluate NAPL Mobility.**
*B. Sarkar, T.R. Andrews, W. Nolan, and J. Fitzgibbons.*
Wyatt Nolan (Jacobs/USA)

**104. Microbial Augmentation with Heating for the Degradation of Total Petroleum Hydrocarbons and Other Organic Contaminants in Soils.**
*R. Sambrotto, A. Rance, M. Chin, F. James, P. Lane, and H. Sanchez.*
Raymond Sambrotto (Allied Microbiota/USA)

**105. Combined In Situ Sulfate-Enhanced Bioremediation and Bioventing for Soil and Groundwater Treatment of Petroleum Contamination.**
*K. Wyatt, B. Henry, E. Heyse, and B. Blicker.*
Kylah Wyatt (Parsons Corporation/USA)

## E10. Remediation and Management of Petroleum-Hydrocarbon Contaminated Sites

**106. Degradation of Polycyclic Aromatic Hydrocarbons in Crude Oil Sludge by a Bacterial Consortium during Composting.**
*O. Ubani and H.I. Atagana.*
Harrison I. Atagana (University of South Africa/South Africa)

**107. Bioremediation of Petroleum Pollution in Complex Geological Soils.**
*T. Hsu, D. Chang, and P. Yu.*
Daniel Chang (Shenzhen WuSe Remediation Technology Co., LTD/China)

**108. Post-Remediation Performance Assessment at a Petroleum-Impacted Site.**
*J. Segura, A. Gavaskar, T. Danko, R. Hinchee, and M. Dreyer.*
Anthony Danko (U.S. Navy/USA)

**109. Re-evaluation of LNAPL Conceptual Site Model throughout the Project Life Cycle.**
*S. Drummond.*
Sharon Drummond (AECOM/USA)

**110. Groundwater Gauging during Local Flooding as a Proxy for Aquifer Pumping Tests to Demonstrate Hydraulic Connectivity.**
*R.D. Francis.*
Ryan Francis (Golder Associates/USA)

**111. Remediating 46 Acres of Jet Fuel LNAPL with a Bioventing System: Endpoint Strategy and Regulatory Closure Process.**
*V. Gamez Grijalva, R. Frank, and R. Hinchee.*
Victor Gamez Grijalva (Jacobs/USA)

**112. Identification of New Potential Petroleum Hydrocarbon-Degrading Microbial Populations in Petroleum-Contaminated Coastal Marine Sediment.**
*H.Z. Hamdan and D.A. Salam.*
Hamdan Hamdan (American University of Beirut/ Lebanon)

**113. Using Tracer Gases (Sulfur Hexafluoride and Helium) to Assess Radius of Influence of Biosparge Pilot Systems.**
*W.C. Nolan and T.R. Andrews.*
Wyatt Nolan (Jacobs/USA)

**114. Bioremediation of Soil Contaminated with Crude Oil by a Consortium Immobilized in Corn Stover.**
*R.K. Pacheco-Cabañas, D.V. Cortés-Espinosa, and A.E. Absalón.*
Rita Karen Pacheco-Cabanas (Instituto Politecnico Nacional /Mexico)

## E11. Biodegradation and Remediation of Crude Oil and Petroleum Hydrocarbons in Cold Regions

**115. Microbial Community Structure in Eroding Crude Oil Asphalt and Emulsion in Shallow Marsh Embayments.**
*W. Coronel, V. Elango, and J. Pardue.*
Vijaikrishnah Elango (Louisiana State University/USA)

**116. Bioremediation Successes in Cold-Weather Climates.**
*K. Hoffmann and K. Rapp.*
Katie Hoffmann (Pinnacle Engineering/USA)

**117. Petroleum Metabolites: Hydrocarbon Degradation Intermediates or Typical Microbial Products?**
*K.T. O'Reilly, S. Ahn, R.E. Mohler, R.I. Magaw, C. Espino Devine, and D.A. Zemo.*
Kirk O'Reilly (Exponent, Inc./USA)

# Thursday Platform Sessions—8:00am–10:05am

| | A SESSIONS (Holiday Ballroom 1&2) | B SESSIONS (Holiday Ballroom 3) | C SESSIONS (Holiday Ballroom 5) | D SESSIONS (Holiday Ballroom 4) | E SESSIONS (Peale, 1st Floor) |
|---|---|---|---|---|---|
| 8:00 | **Observations at a PFAS-Contaminated Site: Variability and Precursor Occurrence**. *C. Acheson, J. Carriger, R. Herrmann, M. Mills, L. Zintek, D. Kleinmaier, S. Halstead, S. Bonina, A. Burkes, and R. Venkatapathy.* Carolyn M. Acheson (U.S. EPA/USA) | **Remediation of Chlorinated Groundwater Plumes: A Technology Development Project.** *D. Harrekilde, L. Bennedsen, N. Tuxen, M. Broholm, C.B. Ottosen, and G. Leonard.* Dorte Harrekilde (Ramboll/Denmark) | **Developing a Robust Design for Consideration of Climate Change Impacts: Hunters Point Sediment Case Study.** *M. Harclerode, S. Ohannessian, D. Janda, E. Blischke, R. Mathew, P. Kulis, T. Macbeth, and M. Fattahipour.* Melissa Harclerode (CDM Smith, Inc./USA) | **PANEL DISCUSSION**<br><br>**Remediation Geology: The Increasing Role of Geology in Successful Remediation**<br><br>**Moderators**<br>Rick Cramer, M.Sc., PG (Burns & McDonnell)<br>Herb Levine, M.Sc., PG (U.S. EPA, Region IX)<br><br>**Panelists**<br>John Cherry, Ph.D. PE, FRSC (University of Guelph)<br>Murray Einarson, M.Sc., PG (Haley & Aldrich)<br>Todd Halihan, Ph.D. (Oklahoma State University)<br>John Hesemann, M.S., PE (Burns & McDonnell)<br>Scott Potter, Ph.D., PE (ARCADIS)<br>Craig Sandefur, M.Sc. (Regenesis) | **Rethinking Bioventing: It's Not Just for BTEX and TPH in Soil.** *S. Gaito, B. Koons, J. Smith, and A. Kirkman.* Steven Gaito (AECOM/USA) |
| 8:25 | **What Total Oxidizable Precursor Assay Can and Can't Tell Us about PFAS Precursors.** *D. Chiang, A. Robel, and J. Field.* Dora Chiang (CDM Smith, Inc./USA) | **Leveraging Warm Water from Source Area Thermal Remedy for Synergistic Biotic and Abiotic Degradation of a Downgradient CVOC Plume.** *D. Bryant, D. Collins, and J. House.* Dan Bryant (Woodard & Curran/USA) | **Climate Change and Cleanup: A Vulnerability Assessment and Adaptation Strategy for Washington State's Contaminated Sites.** *C.E. Asher.* Chance Asher (Washington State Department of Ecology/USA) | | **Mass Balance Confirmation of Bioventing Operations of Aerobically Degradable Hydrocarbons.** *F.T Barranco, J. McNew, and S. Saalfield.* Jason McNew (EA Engineering, Science, and Technology, Inc., PBC/USA) |
| 8:50 | **Development of an Organofluoride Method to Quantify Total Per- and Polyfluoroalkylated Substances (PFAS).** *K. Dasu, C. Cucksey, and E. Lucas.* Kavitha Dasu (Battelle/USA) | **Design and Performance of a Biobarrier for Perchlorate Treatment.** *R. Royer, J. Wood, B. Longino, G. Hamer, F. Szerdy, A. Amini, and M. Behrooz.* Richard Royer (Arcadis/USA) | **Remedy Resiliency to Extreme Weather Events.** *R. Thun.* Roy Thun (GHD/USA) | | **Calculation of Biodegradation Rates above and below the Water Table.** *A. Kirkman, J. Montoy, and K. Hewton.* Jorge Montoy (Sovereign Consulting/USA) |
| 9:15 | **Total Fluorine, Extractable Organofluorine, Per/Polyfluoroalkyl Substances and Total Oxidizable Precursor Assay on Contaminated Soil.** *M. Filipovic, P. van Hees, P. Karlsson, and L. Yeung.* Marko Filipovic (NIRAS Sweden AB/Sweden) | **Destruction of a Source Area through Establishment of Biobarriers and Optimized Delivery of Emulsified Vegetable Oil.** *M.D. Colvin, M.S. Apgar, P.A. Lepczyk, and K. Chiang.* Michael Colvin (Fishbeck, Thompson, Carr & Huber, Inc./USA) | **Evaluation of Resiliency of U.S. EPA Superfund Remedies in the 2017 Hurricane Season.** *R. Josiam, H. Thornton, C. Pachon, and S. Vaughn.* Carlos Pachon (U.S. Environmental Protection Agency/USA) | | **Biodegradation of Cyclohexane under Different Reclamation Scenarios.** *G. Okpala, L. Gjini, A. Kuznetsova, A. Ulrich, P.Y.K. Choi, and T. Siddique.* Tariq Siddique (University of Alberta/Canada) |
| 9:40 | SESSION BREAK | SESSION BREAK | SESSION BREAK | SESSION BREAK | SESSION BREAK |
| 10:05 | A8. **Two Innovative Approaches to Implementing Green and Sustainable Remediation (GSR) Best Management Practices (BMPs) per ASTM E2893-16.** *B. Collins, M. Fulkerson, J. Gamlin, P. Favara, M. Louth, D. Cleland, and C. Delaney.* Betsy Collins (Jacobs/USA) | B6. **In Situ Enhanced Bioremediation Using Biobarriers and Biological Grid to Treat a Large, Dilute Trichloroethene Plume.** *S. Suryanarayanan, P. Srivastav, S. Watson, and R.E. Mayer.* Sowmya Suryanarayanan (APTIM/USA) | **PANEL DISCUSSION** | D7. **Considerations for Long-Term Monitoring of a Sewer Ventilation System for Ongoing Assessment of the Vapor Intrusion Pathway.** *J.H. Persons, K. Hallberg, L. Lund, and D. Cleland.* Jessica Persons (Jacobs/USA) | E9. **Combining Strategies for Remediation of Different Gas Work DNAPL and LNAPL Groundwater Contaminants.** *J. Bergman, H. Nord, and M. Sundesten.* Helena Nord (RGS Nordic/Sweden) |

A7. Best Practices and Approaches for Analyzing PFAS

B6. Biobarrier Installation and Management

C8. Impacts of Climate Change and Extreme Weather Events on Remedial Design

E8. Aerobic Processes for the Remediation of Petroleum Hydrocarbon Sites

# Thursday Platform Sessions—10:30am–12:35pm

| | A SESSIONS (Holiday Ballroom 1&2) | B SESSIONS (Holiday Ballroom 3) | C SESSIONS (Holiday Ballroom 5) | D SESSIONS (Holiday Ballroom 4) | E SESSIONS (Peale, 1st Floor) |
|---|---|---|---|---|---|
| 10:30 | **A8. Best Practices in GSR**<br>**Sustainable Constructed Wetland for Pharmaceutical Waste Leachate and Groundwater Management and Treatment.** *S. Fisher, M. Kurosaka, A. Chemburkar, A. Kafle, and L. Hosmer.*<br>Arun Chemburkar (ERM, Inc./USA) | **B6. Biobarrier Installation and Management**<br>**Evaluation of a Sustainable Cometabolic Biobarrier to Treat Large Dilute Chlorinated VOC Groundwater Plumes.** *D.R. Lippincott, G.M. Lavorgna, R.T. Rezes, P.G. Koster van Groos, and J.F. Begley.*<br>David Lippincott (APTIM/USA) | **PANEL DISCUSSION**<br>**What Does a Successful Risk Communication Strategy for PFAS Sites Look Like?**<br>**Moderator**<br>Melissa Harclerode, Ph.D., BCES (CDM Smith)<br>**Panelists**<br>Kristi Herzer (VT DEC, Brownfields Response Program)<br>Melissa Forrest (Navy and Marine Corps Public Health Center)<br>Edward Emmett, MD, MS (Perelman School of Medicine University of Pennsylvania)<br>Shalene Thomas, PMP (Wood E&IS) | **D7. Vapor Intrusion Design and Mitigation Methods**<br>**Long-Term Performance Data for Horizontal SVE System to Mitigate Elevated Indoor Air VOCs and High-Strength Sub-Slab VOCs at an Active Military Building, Naval Air Station North Island.** *V. Hosangadi, R. Mennis, P.L. Chang, and M. Pound.*<br>Michael Pound (Naval Facilities Engineering Command Southwest/USA) | **E9. Combined Approaches for the Remediation of Petroleum Hydrocarbons**<br>**Validation of Anaerobic Benzene Bioaugmentation Approaches through Bench-Scale Treatability Studies.** *S. Dworatzek, J. Webb, J. Roberts, E. Edwards, N. Bawa, S. Guo, C. Toth, and K. Bradshaw.*<br>Sandra Dworatzek (SiREM/Canada) |
| 10:55 | **Public Private Partnership Stimulating Sustainable Biodegradation of Chlorinated Compounds.** *A.K. Stenger, M.T. Jordan, and C.M. Portela.*<br>Allison Stenger (Terracon/USA) | **Influence of Sulfate Reduction and Biogenic Reactive Minerals on Long-Term PRB Performance in a Sulfate Rich, High Flow Aquifer.** *J. Molin, J. Valkenburg, D. Leigh, and A. Seech.*<br>Josephine Molin (PeroxyChem, LLC/USA) | | **TCE Vapor Intrusion Mitigation through Adaptive Design at a 174,300 Square Foot Aircraft Maintenance Hangar.** *B.R. Hoye, D.Y. Marquez, and L. Duke.*<br>Brian Hoye (Burns & McDonnell/USA) | **Comparative Study for ZVI/Peroxide versus Ferric Iron Oxide Persulfate Activation Followed by Intrinsic Facultative, Biologically-Mediated Processes.** *A. Karachalios.*<br>Antonis Karachalios (Innovative Environmental Technologies, Inc./USA) |
| 11:20 | **10 Years of SURF: Have We Reprogrammed?** *A. McNally and J. Torrens.*<br>Amanda McNally (Geosyntec Consultants/USA) | **Long-Term Challenges for EVO Biobarrier Performance.** *V. Hosangadi, P.L. Chang, and M. Pound.*<br>Vitthal Hosangadi (NOREAS, Inc./USA) | | **Vapor Intrusion Mitigation: A Different Spin on HVAC Systems.** *M. Ambrusch, O. Uppal, A. Quinn, R. Andersen, C. Barnes, and S. Abrams.*<br>Matthew Ambrusch (Langan/USA) | **Coupled Chemical Pre-oxidation and Aerobic Biodegradation of Buried MC252 Oil across a Headlands Beach Profile.** *O. Bramlet, V. Elango, and J. Pardue.*<br>Olivia Bramlet (Geosyntec Consultants/USA) |
| 11:45 | SESSION BREAK | SESSION BREAK | SESSION BREAK | SESSION BREAK | SESSION BREAK |
| 12:10 | | | | | |
| 12:35 | **A9.**<br>**Developing Greener Cleanup Metrics at U.S. EPA.** *K. Giacalone, C. Pachon, J. Santiago, K. Scheuermann, and H. Thornton.*<br>Carlos Pachon (U.S. Environmental Protection Agency/USA) | **B7.**<br>**Closing the Nitrogen Cycle: Utilizing Molecular Biological Tools to Address Nitrogen Transformation in Wastewater Treatment.** *A. Azimi, K. Clark, and D. Taggart.*<br>Dora Taggart (Microbial Insights, Inc./USA) | **C9.**<br>**How to Avoid "Kick the Can": Get More Out of Your Annual Performance Assessments.** *P. Favara, K. Thomsen, C. Holbert, and K. Brown.*<br>Paul Favara (Jacobs/USA) | **D8.**<br>**Vapor Intrusion of 1,4-Dioxane: Regulatory Myth or Real Issue?** *C. Bell, S. Sager, E. Kalve, and S. Offenberger.*<br>Caitlin Bell (Arcadis/USA) | **E10.**<br>**In Situ LNAPL Treatment Following Pipeline Transmission Rupture.** *W.L. Brab.*<br>Bill Brab (AST Environmental, Inc./USA) |

# Thursday Platform Sessions—1:00pm–3:05pm

| | A SESSIONS (Holiday Ballroom 1&2) | B SESSIONS (Holiday Ballroom 3) | C SESSIONS (Holiday Ballroom 5) | D SESSIONS (Holiday Ballroom 4) | E SESSIONS (Peale, 1st Floor) |
|---|---|---|---|---|---|
| 1:00 | A9. Incorporating Sustainability Considerations into Remediation Projects<br>**Sustainable Remediation Strategies for Treating Perchlorate in Soil and Groundwater.** *D. Keady, C. Lenker, and A. Ayyaswami.*<br>Daniel Keady (Tetra Tech, Inc./USA) | B7. Advances in Biological Wastewater Treatment Processes<br>**Effective Removal of Contaminants of Emerging Concern by Biologically-Active Filters.** *D. Pham, S. Zhang, L. Axe, and M. Li.*<br>Mengyan Li (New Jersey Institute of Technology/USA) | C9. Optimizing Existing Systems<br>**Constructed Wetland Bioremediation of Chlorinated Organic Compounds in a Groundwater Capture and Reinjection System.** *W. Pepe, R. Sellen, S. Wallace, E. Kolodziej, and I. Gyorffy.*<br>William Pepe (Stantec/USA) | D8. VOC Vapor Intrusion<br>**Evaluation of Flux Chamber Test Procedures for Management of Contaminated Areas.** *L. Akiko Araki, A. Yoshinari, R. Franklin, and R. Cesar de Araujo Cunha.*<br>Lina Akiko Araki (GEOKLOCK/Brazil) | E10. Remediation and Management of Petroleum-Hydrocarbon Contaminated Sites<br>**Use of Big Data to Understand Remedy Effectiveness at California Petroleum Sites.** *T.E. McHugh, S.R. Rauch, C.J. Newell, and S. Garg.*<br>Thomas McHugh (GSI Environmental, Inc./USA) |
| 1:25 | **Comparing Microbial to Physical-Chemical Remediation Technologies and Associated Water Chemistry Amendments in GSR Assessments.** *P.B. Butler, M. McBride, G. Wolf, and E. Ghedia.*<br>Gerlinde Wolf (AECOM/USA) | **Evaluation of Bioelectrochemical Systems for Wastewater Treatment and Energy Recovery at DC Water Blue Plains.** *A. Leininger, M. Ramirez, and B.V. Kjellerup.*<br>Birthe Kjellerup (University of Maryland/USA) | **Why Only Some Conceptual Site Models Are Useful: A New Way to Look at the CSM Process.** *M. Cobb, S. Burnell, J. Martin Tilton, N. Welty, J. Higinbotham, C. Campbell, and R. Dahmer.*<br>Michael Cobb (Arcadis/USA) | **Vertical Separation Distance Criteria to Evaluate Vapor Intrusion Risk from Lead Scavengers (1,2-DCA and EDB).** *R.V. Kolhatkar, H. Luo, C. Gaule, and J. Watterson.*<br>Ravi Kolhatkar (Chevron Corporation/USA) | **Enhanced Marine SMFCs for the Biodegradation of a Mixture of Low and High Molecular Weight PAHs.** *H.Z. Hamdan and D.A. Salam.*<br>Hamdan Hamdan (American University of Beirut/Lebanon) |
| 1:50 | **Synopsis of 10-Year Anniversary SURF White Paper.** *P. Favara, D. Raymond, G. Wolf, and M. Smith.*<br>Paul Favara (Jacobs/USA) | **Recent Innovative Biological Wastewater Treatment Process for Textile Dyeing Wastewater.** *S. Kanmani.*<br>Sellappa Kanmani (Anna University/India) | **U.S. EPA Superfund Optimization: Progress and Outcomes.** *K. Biggs, E. Gilbert, M. Jefferson, and C. Pachon.*<br>Carlos Pachon (U.S. Environmental Protection Agency/USA) | **Accounting for Background Sources for Risk-Based Decision Making at Vapor Intrusion Sites.** *L. Goode, N. Durant, R. Ettinger, V. Hosangadi, and M. Pound.*<br>Lisa Goode (Geosyntec Consultants/USA) | **Monitoring the Dynamics of LNAPL Distribution in Soils Using Non-Destructive Fluorescence-Based Testing.** *J.A. Zimbron.*<br>Julio Zimbron (E-Flux/USA) |
| 2:15 | SESSION BREAK | SESSION BREAK | SESSION BREAK | SESSION BREAK | SESSION BREAK |
| 2:40 | A10. Sustainable Remediation Assessment Tools<br>**The Risks and Rewards of Using Social Media.** *C.G. Deffenbaugh.*<br>Chris Deffenbaugh (Burns & McDonnell/USA) | B8. Natural Source Zone Depletion<br>**In-Field Rapid Precipitation of Carbonate Minerals for Assessing Hydrocarbon Biodegradation Rates through Radiocarbon Apportionment.** *L. Reynolds, I. Clark, and K.U. Mayer.*<br>Lindsay Reynolds (University Of Ottawa/Canada) | C10. Adaptive Management Strategies<br>**Advances in Adaptive Management for Cleanup of Complex Sites.** *T.W. Macbeth, K. Garufi, and K. Lynch.*<br>Tamzen Macbeth (CDM Smith, Inc./USA) | D9. Innovative Tools for Evaluating Vapor Intrusion Risk<br>**Cross Foundation Differential Pressure and Temperature Impacts on Vapor Intrusion at Two Buildings.** *S. LaRosa and F. Ricciardi.*<br>Steve LaRosa (Weston & Sampson, Inc./USA) | E11. Biodeg./Remed. Crude Oil/Pet. Hydrocarbons in Cold Reg.<br>**Biodegradation of Crude Oil and Corexit EC9500A in Arctic Seawater.** *T. Gofstein, M.B. Leigh, M. Perkins, and J. Field.*<br>Taylor Gofstein (University of Alaska/USA) |
| 3:05 | **Use of Media to Communicate Site Risks and Potential Future Use: The Ambler and Bo-Rit Case Study.** *E.A. Emmett, B. Dahlberg, Z. Biro, F.K. Barg, M. Anderson, and B. D'Agostino.*<br>Edward Emmett (University of Pennsylvania/USA) | **Results of Multi-Year Study on Methods for Estimation of NSZD Rates under Natural and Solarization Conditions.** *I. Hers, P. Jourabchi, A. Wozney, E. Pasha, H. Hopkins, S. Mercer, C. Gosse, and N. Nickerson.*<br>Ian Hers (Golder Associates/Canada) | **Importance of Adaptive Technical Approaches: Case Studies from a 10-Year Performance-Based Remediation Contract.** *A. Tingle, S. Smith, and K. Page.*<br>Tarek Ladaa (APTIM/USA) | **VaporSafe™ Continuous Air Monitoring for a Sustainable Solution to the Vapor Intrusion Pathway at a Non-Residential Facility.** *D. Litz and S. Metz.*<br>Darby Litz (TRC/USA) | **Low-Rate Biodegradation Demonstration for Natural Attenuation of Benzene in Cold Saline Groundwater.** *C. Sharpe, R. Hinchee, T. Conklin, R. Mutch, C. Andrews, and P. Hare.*<br>Charles Sharpe (Ramboll/USA) |

# Thursday Platform Sessions—3:30pm–3:55pm

| | A SESSIONS (Holiday Ballroom 1&2) | B SESSIONS (Holiday Ballroom 3) | C SESSIONS (Holiday Ballroom 5) | D SESSIONS (Holiday Ballroom 4) | E SESSIONS (Peale, 1st Floor) |
|---|---|---|---|---|---|
| 3:30 | A10. Sustainable Remediation Assessment Tools<br>**Social, Environmental, and Economic Impact and Benefit Sustainability Analysis.** *S.E. Apitz, A. Fitzpatrick, D. Harrison, and A. McNally.*<br>Amanda McNally (Geosyntec Consultants/USA) | B8. Natural Source Zone Depletion<br>**What to Do with Natural Source Zone Depletion: Fitting New NSZD Developments into Regulatory Frameworks and Site Management Practices.** *S. Garg, D.C. King, P.R. Kulkarni, and C.J. Newell.*<br>Sanjay Garg (Shell Global Solutions [US] Inc./USA) | C10. Adaptive Management Strategies<br>**Three Decades of Remediation at the CDOT Materials Testing Laboratory Remediation Project: A Model for Adaptive Management.** *C.D. Divine, K.L. Heinze, J.L. Manley, K. Preston, S.D. Andrews, and T. Santangelo-Dreiling.*<br>Craig Divine (Arcadis/USA) | D9. Innovative Tools for Evaluating Vapor Intrusion Risk<br>**Building-Specific Attenuation Factors from Flow and Vacuum Data.** *T. McAlary, W. Wertz, and D. Mali.*<br>Darius Mali (Geosyntec Consultants/Canada) | E11. Biodeg./Remed. Crude Oil/Pet. Hydrocarbons in Cold Reg.<br>**Microbial Community Structure in Eroding Crude Oil Asphalt and Emulsion in Shallow Marsh Embayments.** *W. Coronel, V. Elango, and J. Pardue.*<br>William Coronel (Louisiana State University/USA) |
| 3:55 | A10. Sustainable Remediation Assessment Tools<br>**Parameterization of Project Footprints: Estimating Your Impact.** *B. Collins, P. Favara, and F. Messina.*<br>Betsy Collins (Jacobs/USA) | B8. Natural Source Zone Depletion<br>**Estimates of Engineered and Natural Source Zone Depletion by Wireline Temperature Measurement.** *P.E. Stumpf, R. Kannappan, L. Klinchuch, and N. Sihota.*<br>Peter Stumpf (AECOM/USA) | C10. Adaptive Management Strategies<br>**An Adaptive Approach to Integrating RCRA Corrective Action with Facility Demolition.** *D.Y. Marquez, M. Hildebrandt, C. Grant, and D. Barker.*<br>Diana Marquez (Burns & McDonnell/USA) | D9. Innovative Tools for Evaluating Vapor Intrusion Risk<br>**Risk Factors and Sampling Approaches for VI Preferential Pathway Investigations.** *L. Beckley and T. McHugh.*<br>Thomas McHugh (GSI Environmental, Inc./USA) | E11. Biodeg./Remed. Crude Oil/Pet. Hydrocarbons in Cold Reg.<br>**Bioremediation of Heavily-Contaminated Marine Sediments by Petroleum Hydrocarbons Using Sediment Microbial Fuel Cells (SMFCs).** *H.Z. Hamdan and D.A. Salam.*<br>Hamdan Hamdan (American University of Beirut/Lebanon) |

## 4:30-5:00 CLOSING COCKTAIL RECEPTION—Key Ballroom South Foyer

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**AECOM** is a world leader in developing innovative bioremediation and sustainable remediation solutions. We have a long history of solving complex site challenges using an effective endpoint strategy, addressing a broad range of contaminants, and working with diverse stakeholders. Bringing together the best resources, AECOM remediation teams critically assess the nature and extent of contamination, risks to receptors, and safe exposure levels. We are known for developing leading-edge biological, chemical, and physical technologies to enhance effectiveness and reduce project costs. **aecom.com**

**CDM Smith** provides lasting and integrated solutions in water, environment, transportation, energy and facilities to public and private clients worldwide. As a full-service consulting, engineering, construction and operations firm, we deliver exceptional client service, quality results and enduring value across the entire project life-cycle. **cdmsmith.com**

**EN Rx** was founded in 2001 and has established itself as a member of the engineering vendor community that offers innovative environmental remediation solutions. EN Rx is a Service-Disabled Veteran Owned Company with offices in Texas, Florida, Colorado and California. The flagship product is the Vertebrae™ Segmented Horizontal Well System with several unique operational features. The nested, segmented design offers great flexibility in assessment and treatment of sites and can overcome access issues, whether it be in the overhead or built environment, or as a function of business criteria (secure locations or property encroachment). EN Rx can deploy its systems wherever an independent driller can create the proper borehole. Applications in development include a lower cost and easy to deploy sub-slab depressurization system (SSDS) or for preventative measure such as in leak detection in active storage and distribution operations. On a cost basis, a major advantage of the Vertebrae™ System is that one horizontal well can be the equivalent of up to eleven vertical wells, depending on variable site conditions. Vertebrae™ Systems are smaller and more compact in design offering other advantages in cost and deployment; one example is there is a shorter setback requirement for drilling access.

EN Rx also has a support platform, called EN Rx (SP)™, for use with the Vertebrae System or other subsurface infrastructure. It is a self-contained, solar-powered, remotely operating and communications-ready injection device that can either assess the aquifer or inject reagents into it. In the assessment phase there is a vacuum module that can draw in gas or water. In the remediation phase, the unit can mix/dilute and deliver reagents in a programmed fashion or, the assessment vacuum function can also be applied to air sparging, soil vapor extraction or be a part of SSDS applications. **enrxinc.com**

For over 15 years, **EOS Remediation** has been the leading provider of in situ remediation products that re-engineer the groundwater environment transforming contaminants into non-toxic end products. We offer a complete suite of remediation products including: Emulsified Vegetable Oil Substrate, Colloidal Buffers, Electron Acceptor Products and Bioaugmentation Cultures. **eosremediation.com**

For over 39 years, **GEOKLOCK** has been providing environmental engineering and consulting services, developing innovative techniques and setting quality standards for the industry. Our many years of experience have made GEOKLOCK a leader in the Brazilian market and a benchmark for clients, competitors and environmental agencies. Our team members adhere to strict ethical principles and take the confidentiality of our clients very seriously. Our structure meets the most stringent safety and quality standards, so that we can provide our clients and teams with the support required to successfully complete highly complex projects. **geoklock.com**

**Innovative Environmental Technologies (IET)** is a turn-key remedial contractor and geotechnical/environmental drilling company providing in-situ chemical and biological injection services for over 20 years. IET personnel are comprised of microbiologists, chemists, engineers, geologists and experienced drillers that are able to design and implement remediation and drilling projects in a timely and cost-effective manner. **iet-inc.net**

**Langan** provides an integrated mix of engineering and environmental consulting services in support of land development projects, corporate real estate portfolios, and the energy industry. Our clients include developers, property owners, public agencies, corporations, institutions, and energy companies around the world. Langan employs over 1,000 employees in its Parsippany, NJ headquarters and among 28 regional offices. **langan.com**

**Provectus Environmental Products, Inc.**, is a performance technology/chemistry provider to the soil and groundwater remediation industry. We specialize in the development and global commercialization of next-generation, synergistic in situ chemical reduction (ISCR), in situ chemical oxidation (ISCO), and bioremediation technologies. Our proprietary technology portfolio represents the safest, most effective, and most cost-efficient solutions available to our industry. We are not consultants. Our business model is to support responsible parties, environmental engineers, technical consultants, governmental regulators, and the wider academic community by providing design and selection of cost-effective remediation strategies. Our team has over 75 years of combined in situ remediation experience addressing common and emerging constituents of interest. For more information about our technologies, visit our website or call (815) 650-2230. **provectusenvironmental.com**

A leading engineering, design and consultancy company, **Ramboll** employs 15,000 experts worldwide with especially strong representation in the Nordics, UK, North America, Continental Europe, Middle East and Asia Pacific. We partner with clients to create sustainable societies where people and nature flourish. Our globally recognized Environment & Health practice has earned a reputation for technical and scientific excellence and innovation. We are trusted by clients to manage their most challenging environmental, health and social issues, and continually strive to achieve inspiring and exacting solutions that make a genuine difference to our clients, the environment and society as a whole. **ramboll.com**

**REGENESIS** is a global leader in proven, cost-effective environmental technologies for the remediation of contaminated sites. Gasoline, diesel fuel, jet fuels, heat oil, and industrial solvents impact the subsurface as a result of spills, leaks, and/or poor disposal practices. With over 26,000 product applications in 26 countries worldwide, REGENESIS leads the industry in developing, manufacturing and supporting a wide range of integrated solutions that can be applied directly into soil and groundwater to speed the remediation process for the removal of environmental contaminants. REGENESIS technologies take a scientific approach to solving a broad range of environmental concerns. **regenesis.com**

**Terra Systems** was founded in 1992 and holds the first U.S. Patent for the use of emulsified vegetable oil substrate, lactate and nutrients for the in-situ bioremediation of chlorinated solvents in groundwater (US Patent 6,398,960). Since then, using our core competencies in research and development, in-house manufacturing and unsurpassed pre and post sales technical support our family of patented SRS® slow release emulsified substrates has expanded and offers our clients the broadest solutions for today's challenging aquifer conditions. Research & Development is focused on the advancement of bioremediation technology and implementation cost reduction. **terrasystems.net**

**Wood** is a global leader in the delivery of project, engineering and technical services to energy and industrial markets. We provide performance-driven solutions throughout the asset life cycle, from concept to decommissioning across a broad range of industrial markets, including the upstream, midstream and downstream oil & gas, power & process, environment and infrastructure, clean energy, mining, nuclear, and general industrial sectors. We strive to be the best technical services company to work with, work for and invest in. **woodplc.com**

## Learning Lab Sponsor

**Burns & McDonnell** is a full-service engineering, architecture, construction, environmental and consulting solutions firm, based in Kansas City, Missouri. Our staff of 5,700 includes engineers, architects, construction professionals, planners, estimators, economists, technicians and scientists, representing virtually all design disciplines. We plan, design, permit, construct and manage facilities all over the world, with one mission in mind: Make our clients successful. **burnsmcd.com**

## Student Events Sponsors

**ERM's** remediation management services help clients resolve their soil and groundwater liabilities by meeting regulatory obligations and optimizing remedial strategies. We seek to control life-cycle costs, protect our clients' bottom lines, and help them capture value from their asset portfolios. ERM is a world leader in helping global companies address their most challenging contaminated sites throughout the remediation life cycle. For over 40 years, ERM has supported Fortune 500 Global companies to develop innovative, cost-effective, risk-based and sustainable complex Site liability management strategies. Strategies include: innovative investigation tools, active and sustainable remediation, project life-cycle assessment and management, liability closure and managing change conditions. From single sites to global portfolios, our site investigation and remediation management services minimize clients' financial exposure to remediation liabilities. Working with ERM, organizations can transform EHSS liabilities into assets to increase competitive advantage and drive stronger financial and reputational outcomes. **erm.com**

**Jacobs** leads the global professional services sector delivering solutions for a more connected, sustainable world. With $15 billion in proforma revenue and a talent force more than 74,000 strong, Jacobs provides a full spectrum of services including scientific, technical, professional and construction- and program-management for business, industrial, commercial, government and infrastructure sectors. For more information, visit **jacobs.com**, and connect with Jacobs on LinkedIn, Twitter, Facebook and Instagram.

A leading engineering, design and consultancy company, **Ramboll** employs 15,000 experts worldwide with especially strong representation in the Nordics, UK, North America, Continental Europe, Middle East and Asia Pacific. We partner with clients to create sustainable societies where people and nature flourish. Our globally recognized Environment & Health practice has earned a reputation for technical and scientific excellence and innovation. We are trusted by clients to manage their most challenging environmental, health and social issues, and continually strive to achieve inspiring and exacting solutions that make a genuine difference to our clients, the environment and society as a whole. **ramboll.com**

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| MONDAY, April 15 | TUESDAY, April 16 | WEDNESDAY, April 17 | THURSDAY, April 18 |
|---|---|---|---|
| **7:00-8:00 a.m. Morning Course Check-In**<br>**12:00-1:00 p.m. Afternoon Course Check-In**<br>**2:00-9:00 p.m. Symposium Registration** | **7:00 a.m.-7:00 p.m. Registration, Exhibits, Poster Group 1 Display**<br>**7:00-8:00 a.m. Continental Breakfast**<br>**9:00-9:30 a.m. AM Beverage Break**<br>**11:30 a.m.-1:00 p.m. Lunch**<br>**2:30-3:00 p.m. PM Beverage Break** | **7:00 a.m.-7:00 p.m. Registration, Exhibits, Poster Group 2 Display**<br>**7:00-8:00 a.m. Continental Breakfast**<br>**9:00-9:30 a.m. AM Beverage Break**<br>**11:30 a.m.-1:00 p.m. Lunch**<br>**2:30-3:00 p.m. PM Beverage Break** | **7:00 a.m.-1:00 p.m. Registration, Exhibits, Poster Group 2 Display**<br>**7:00-8:00 a.m. Continental Breakfast**<br>**9:00-9:30 a.m. AM Beverage Break**<br>**11:30 a.m.-1:00 p.m. Lunch**<br>**2:30-3:00 p.m. PM Beverage Break** |
| **8:00 a.m.-5:00 p.m. Short Courses** | **8:00 a.m.-5:35 p.m. Platform Sessions** | **8:00 a.m.-5:35 p.m. Platform Sessions** | **8:00 a.m.-4:20 p.m. Platform Sessions** |
| **8:00 a.m.-5:00 p.m.**<br>• ITRC Managing PFAS Contamination at Your Site: Site Characterization, Remediation Alternatives, Risk Assessment and Risk Communications<br><br>**8:00 a.m.-Noon**<br>• Utilizing CSIA in the Assesment and Remediation of Contaminated Site<br><br>**1:00-5:00 p.m.**<br>• ITRC Characterization and Remediation in Fractured Rock | **A1.** GAC-Based PFAS Treatment Technologies<br>**A2.** Fate and Transport of PFAS<br>**PANEL:** How are We Going to Effectively Manage PFAS Risks and Liability?<br>**A3.** PFAS Program Management in a Rapidly Changing Regulatory Environment | **A4.** Innovative Treatment Technologies for PFAS<br>**A5.** PFAS Risk Assessment<br>**A6.** PFAS Source and Forensic Considerations | **A7.** Best Practices and Approaches for Analyzing PFAS<br>**A8.** Best Practices in GSR<br>**A9.** Incorporating Sustainability Considerations into Remediation Projects<br>**A10.** Sustainable Remediation Assessment Tools |
| | **B1.** Combined Remedies<br>**B2.** Successes and Continuing Challenges for Bioaugmentation and Biostimulation | **B3.** Innovative and Efficient Amendment Delivery Strategies<br>**B4.** Strategies for Bioremediation Performance Assessment<br>**B5.** Bioremediation of Heavy Metals | **B6.** Biobarrier Installation and Management<br>**B7.** Advances in Biological Wastewater Treatment Processes<br>**B8.** Natural Source Zone Depletion |
| | **C1.** Munitions Response Site Management Strategies<br>**C2.** Impacts of Mixed Contaminants on Biodegradation<br>**C3.** Amendment Delivery in Bedrock and Complex Geologic Environments<br>**C4.** Biodegradation in Complex Geological Settings | **PANEL:** Green and Sustainable Remediation: The Why and How of Establishing a Corporate Program<br>**C5.** 1,4-Dioxane Treatment Technologies<br>**C6.** Combined Treatment of Emerging Contaminants with CVOCs<br>**C7.** Addressing Emerging Contaminants | **C8.** Impacts of Climate Change and Extreme Weather Events on Remedial Design<br>**PANEL:** What Does a Successful Risk Communication Strategy for PFAS Sites Look Like?<br>**C9.** Optimizing Existing Systems<br>**C10.** Adaptive Management Strategies |
| | **D1.** Enhanced Methods for Biodegradation of Organic and Inorganic Contaminants<br>**D2.** Advances in Amendment Formulation<br>**D3.** Phytoremediation/Mycoremediation | **D4.** Aerobic and Anaerobic Biodegradation of Contaminants<br>**D5.** Advances in Heat-Enhanced Bioremediation<br>**D6.** Abiotic Transformation Processes | **PANEL:** Remediation Geology: The Increasing Role of Geology in Successful Remediation<br>**D7.** Vapor Intrusion Design and Mitigation Methods<br>**D8.** VOC Vapor Intrusion<br>**D9.** Innovative Tools for Evaluating Vapor Intrusion Risk |
| | **E1.** Advances in Monitoring and Optimization Techniques<br>**E2.** Compound-Specific Isotope Analysis<br>**E3.** High-Resolution Site Characterization | **E4.** Modeling and Monitoring Approaches to Improve Remedy Design and Implementation<br>**E5.** Conventional Molecular Biological Tools in Site Assessment and Monitoring<br>**E6.** Big Data and Integration of Molecular Tools in Site Assessment: Advanced Omics<br>**E7.** Advances in Tools and Techniques for Assessing MNA | **E8.** Aerobic Processes for the Remediation of Petroleum Hydrocarbon Sites<br>**E9.** Combined Approaches for the Remediation of Petroleum Hydrocarbons<br>**E10.** Remediation and Management of Petroleum Hydrocarbon-Contaminated Sites<br>**E11.** Biodegradation and Remediation of Crude Oil and Petroleum Hydrocarbons in Cold Regions |
| **5:30-7:00 p.m. Plenary Session**<br>**7:00-9:00 p.m. Welcome Reception, Exhibits, Poster Group 1 Display** | **5:45-7:00 p.m. Poster Group 1 Presentations and Reception**<br>**See page 18 for sessions in Poster Group 1.**<br>**7:30-8:30 p.m. Student/Young Professional Reception** | **5:45-7:00 p.m. Poster Group 2 Presentations and Reception**<br>**See page 28 for sessions in Poster Group 2.** | **4:20 p.m. Symposium adjourns**<br>**4:30-5:00 p.m. Closing Cocktail Reception** |


Complimentary wireless Internet access is available in the Exhibit Hall and session rooms.
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