AGENDA

February 11, 2016
Vancouver – Hilton Vancouver Airport
www.smartremediation.com

Start	Name	Title	Company
7:30-8:15	Registration and Breakfast		
8:15-8:30	Intro and Announcements & Platinum sponsor address – **CCC/REGENESIS**		
8:30-8:50	George (Bud) Ivey	**Surfactant Enhanced Push-Pull Method for In-Situ Remediation of Petroleum Hydrocarbons**	Ivey International Inc.
8:50-9:10	Jean Paré	**Chemical Oxidation Update: New Method for Activating Persulfate**	Chemco Inc.
9:10-9:30	Phil Dennis	**Optimizing In-Situ Bioremediation of Chlorinated Ethenes in British Columbia's Groundwater**	SiREM
9:30-9:50	Pete Craig	**In Situ Stabilization and the Emerging World of In-Situ 3-D Environmental Construction**	ALLTERRA Construction Ltd
9:50-10:10	Martinus (Barry) Brouwers	**Modelling Uncertainty Analysis for Contaminant Risk Assessment**	Matrix Solutions Inc.
10:10-10:50	Networking & Demonstration Corner & Gold Sponsor Address - **Chemco**		
10:50-11:15	Joe A. Ricker	**Groundwater Plume Analytics for Assessing Remediation Effectiveness**	EarthCon Consultants, Inc.
11:15-11:40	Mike Mazzarese	**Overburden and Bedrock Remediation Using Activated Carbon Based Injectates**	AST Environmental, Inc.
11:40-12:05	Marc McAree	**Experts in Environmental Litigation**	Willms & Shier Environmental Lawyers LLP
12:05-12:15	Closing Remarks and Door Prizes		
12:15-1:30	Light Lunch and Networking		

George (Bud) Ivey, Ivey International Inc.

Surfactant Enhanced Push-Pull Method for In-Situ Remediation of Petroleum Hydrocarbons

This study evaluates a novel in-situ 'Push-Pull' method for surfactant enhanced remediation of petroleum hydrocarbon contaminated soil and groundwater at the Chester River Hospital Center (CRHC), Chestertown, Maryland. This site has been contaminated for over 20 years as a result of an on-site diesel spill from an underground storage tank.

The historical application of a conventional pump and treatment remediation approach at the site recovered greater than 80% of the original spill mass over 19 years. However, the residual contamination presented a significant risk of impacting the nearby municipal groundwater aquifer.

A pilot-scale application was completed in 2014 at four (4) impacted wells near the source zone using the 'push-pull' surfactant enhanced remediation process to target the contaminant smear zone within a silty medium to fine sand layer. A total of three (3) 'push-pull' events were completed over a two week period, with on-going groundwater quality monitoring, and real-time field test measurements associated with each event, to evaluate the efficacy of this novel method for full-scale remediation.

The pilot-scale test results indicated that the remediation method was very effective with the calculated increase in contaminant mass recovery rates ranging between one thousand percent (1,000%) to eighteen thousand percent (18,000%) compared to baseline levels at the subject wells associated with the existing pump and treatment remediation system. The success of this pilot-scale 'push-pull' method received Maryland Department of the Environment (MDE) regulatory approval for full scale application in 2015.

George (Bud) Ivey is the President and Senior Remediation Specialist with Ivey International Inc. of Vancouver, Canada. He has over twenty-eight years of environmental remediation experience, and has worked on more than 1500 environmental projects internationally. His multi-disciplinary education background includes: Organic Chemistry, Geological Engineering and a Master's Certification in Project Management. Some of his more noticeable accomplishments include: He holds several International Patents; Has received many International Environmental Awards (Globe, Frost & Sullivan, MISTIC, Environmental Business Journal, and Roy F. Weston Awards); Has developed several innovative remediation technologies for air, soil, water, and groundwater remediation, with more coming; Is currently working on several high-profile remediation projects globally; and Sits as a the 2nd VP on BCEIA Board When he's not busy solving complicated contaminated site remediation problems, he very much enjoys long distance running, multi-day hiking, great red wine, and the company of very good friends!

Jean Paré, Chemco

Chemical Oxidation Update: New Method for Activating Persulfate

Activated Klozur® persulfate has been implemented for over 10 years to successfully remediate sites with a wide assortment of contaminants; and to activate persulfate. The ability to treat different contaminants has been attributed to the activation method and the formation of the sulfate, hydroxyl, and superoxide radicals. Conventional methods of activating persulfate include iron chelates, alkalinity, heat, and hydrogen peroxide.

A new area of research is the use of organic substrates to activate pesulfate. This has the potential of being a low cost alternative with the benefits of ease of implementation, greater degree of control over the rate of activation, and the ability to produce both oxidative and reductive radicals. This presentation will discuss the existing methods of activating persulfate and introduce data collected on the science behind and key characteristics of the organic activation of persulfate. This presentation will also showcase a series of bench and pilot scale tests that have been conducted to assess this novel activation method.

These tests were conducted in a series of batch reactors evaluating the rate of reaction with different contaminants of concern, persistence of persulfate, effect on geochemical parameters, and potential degradation pathways. Finally, the field implementation of this new organic activator will be discussed.

Mr. Paré P. Eng., has a degree in Chemical Engineering from Laval University. For 18 years he has been involved in the evaluation, development, design and promotion of both conventional and innovative environmental technologies for Industry, Engineering Firms, Specialized Environmental Consultants and various levels of Governments. As Vice-President with Chemco Inc., Mr. Paré responsibilities includes the development of remediation strategies, assistance in drafting certificates of authorization, technical-economic analysis, design and the supply of storage equipment, pumps and the logistics of supply for the projects. Last year, Mr. Paré has worked with over 250 sites applying his expertise to various type of contaminants ranging from chlorinated compound, pesticides and petroleum hydrocarbons. He is also involved with many Environmental organisations like the Canadian Brownfield Network, ESAA, OCETA and Reseau-Environnement where he is an active technical committee member and occasional speaker.

Phil Dennis, SiREM

Optimizing In-Situ Bioremediation of Chlorinated Ethenes in BC's Groundwater

Cleanup of perchloroethene (PCE) and trichloroethene (TCE) in groundwater through enhanced in situ bioremediation (EISB) includes the addition of electron donors (biostimulation) and the addition of beneficial dechlorinating microorganisms (bioaugmentation). EISB is a proven and cost effective remedial approach which is now being widely implemented at Canadian chlorinated solvent sites due to:

- The availability of bioaugmentation cultures and related testing;
- Federal and provincial regulatory approvals for bioaugmentation culture;
- Demonstrated success of bioremediation at Canadian sites; and,
- Novel approaches for amendment distribution in low permeability matrices.

A Canadian bioaugmentation culture (KB-1®) containing Dehalococcoides (Dhc) can be used to enhance bioremediation at sites where these dechlorinating microorganisms are absent or poorly distributed. The KB-1® culture has been available for use in Canada since 2008 upon receiving regulatory approvals obtained through Environment Canada's New Substances Notification program. As a result, bioaugmentation culture is being applied in Canada including sites in British Columbia. A case study highlighting a successful KB-1® application in the Lower Mainland will be presented. Geologies where EISB is being implemented include fractured rock as well as low permeability clay and glacial till. Low permeability strata are common in some of the most highly industrialized areas in Canada. Originally conceived as an oil and gas extraction technology, hydraulic fracturing can be used to improve distribution of bioremediation amendments, thereby improving bioremediation outcomes. Electrokinetic (EK) bioremediation is a novel approach that uses an electrical current to move amendments in the subsurface.

Examples of successful implementation of hydraulic fracturing and EK-enhanced bioremediation to improve amendment distribution in clay strata will also be presented.

Phil Dennis has over 25 years of research and management experience in molecular biology, environmental microbiology and environmental remediation. He holds a Masters of Applied Science in Civil Engineering from the University of Toronto and a B.Sc. in Molecular Biology and Genetics from the University of Guelph. Phil is a Senior Manager at SiREM where he focuses on research and development and technical marketing and sales. SiREM is an industry leader in bioaugmentation and testing related to bioremediation located in Guelph, Ontario. Phil oversaw the implementation of one of the first commercial Dehalococcoides testing services and participated in the production scale-up and commercialization of a leading Dehalococcoides bioaugmentation culture (KB-1®). Phil is an Adjunct Lecturer at the University of Toronto, where he teaches environmental microbiology and a 2016 Clean50 Honouree, the award recognizes individuals who have advanced the cause of sustainability and clean capitalism in Canada.

Pete Craig, ALLTERRA Construction Ltd.

In Situ Stabilization and the Emerging World of In-Situ 3-D Environmental Construction

Stabilisation/solidification (S/S) comprises the amendment of a natural material with reagents, typically cementitious agents, to create higher strength result. It has been used for thousands of years in civil works such as road construction. In the twentieth century, it was extended to applications on contaminated sites, where the mobility and/or bioavailability of contaminants can controlled by, e.g., formation of insoluble compounds, reduction of permeability, control of pore space pH, sorption and micro-encapsulation. S/S has seen extensive application, from the Sydney Tar Ponds, to hundreds of U.S. Superfund sites.

Recent B.C. experience stabilizing tidally-influenced, saturated mixed fill containing rubble, cables and debris demonstrates that new mixing equipment and techniques are effective, even under adverse conditions. The experience also illustrates the potential of 3-D GPS-based machine control with mixing system data acquisition.

The case study includes design, pilot study and full scale in situ S/S data for a shallow (< 3 m) large-scale application in Esquimalt, British Columbia.

Redevelopment of the site entailed management of a relatively large area of metals and hydrocarbon contaminated fill. Excavation, transport, and disposal of the 12,000 metric tons of contaminated fill at a licensed waste facility was initially considered; however, the cost was estimated at over $11 million, with significant uncertainty around the management of tidally-influenced seepage into the 4 to 5 metre deep excavation. In situ stabilization solved the problem at less than half the cost. The system reclaimed recyclable/reusable materials and homogenized the residue. Novel depth-specific sample collection equipment was also developed and deployed to provide depth-specific quality assurance sample collection capacity.

Based on the success of the method, a new mixing head was developed which is effective to 8 metres below grade. It is expected machine control advances in the next two to five years will allow the in-situ "printing" of honeycomb containment walls capped with mass-stabilization rafts while maintaining excellent control of both position and mix properties. Such "wall-and-cap" structures can cost-effectively contain contaminated materials while supporting large infrastructure

Pete Craig is an environmental remediation specialist and professional chemist (BC PChem), with over 15 years of professional experience with some of North America's leading environmental consultants. Since May of 2015, Pete has directed environmental remediation and waste disposal for Allterra Construction and Environmental Ltd. (Allterra), and its wholly owned subsidiary, South Island Resource Management Ltd. (SIRM). Pete earned his B.Sc. in Chemistry from the University of California Berkeley in 1996 and his M.Sc. in Environmental Engineering from Stanford in 1998. He has worked on a diverse array of environmental remediation projects, ranging from the injection of microscale zero valent iron to dredging, dredge material processing, chemical oxidation, fractured rock excavation, in situ solidification/stabilization and waste encapsulation.

Martinus (Barry) Brouwers, Matrix Solutions Inc.

Modelling Uncertainty Analysis for Contaminant Risk Assessment

Models are often relied upon to extrapolate from our existing site knowledge and make predictions regarding potential future impacts associated with contaminant plumes, or the effectiveness of proposed remediation systems. Predictions made with models are always subject to uncertainty. That uncertainty stems from having incomplete conceptual understanding of the hydrogeology and groundwater flow system, incomplete characterization of the contaminant source and distribution in the subsurface, sparse observation data to calibrate the model, and incomplete measurements of hydrogeologic parameters.

Recent developments in cloud computing and numerical analysis tools (e.g., FEFLOW + PEST) have made meaningful assessment of model prediction uncertainty more cost-effective and informative. With such advancements, detailed models that accurately depict our understanding of the hydrogeologic setting can be applied, as opposed to simplified analytical models.

This presentation will illustrate how modelling tools are being applied to evaluate contaminant prediction uncertainty, data gap implications, and remediation alternatives for a contaminated site in Western Canada. The uncertainty analysis provides insights regarding the range of potential exposure levels, the most likely levels, and the timing of expected exposures. This process also highlights data gaps that control the predictions and the value of filling such data gaps with respect to reducing exposure level uncertainty.

Mr. Martinus (Barry) Brouwers is a practicing groundwater modeling specialist with nine years of experience in the industry. He has a wide range of modeling experience from simple spreadsheet models to complex, three-dimensional groundwater flow and fully-integrated groundwater/surface water models. Currently his interests include: model optimization approaches for developing alternative conceptual understanding, prediction uncertainty analysis for remediation approaches, as well as watershed scale modeling with a focuses on groundwater resource management and source water protection.

Joe A. Ricker, EarthCon Consultants

Groundwater Plume Analytics for Assessing Remediation Effectiveness

Remediation effectiveness may be evaluated using a variety of techniques that oftentimes focuses on the performance of engineered remedial systems (e.g., flow ate, energy use, mass recovered, etc.). Rather than focusing on engineered systems, this session will focus on the evaluation of remediation effectiveness by evaluating the groundwater plume dynamics resulting from either anthropogenic or intrinsic remediation systems.

Groundwater plume analytics refers to the use of innovative evaluation techniques and methods to reliably and effectively communication meaningful patterns in environmental data. Analytics relies primarily on graphical displays to communicate insight. Outputs from the Ricker Method® plume stability analysis can be used to further dissect and evaluate dissolved plumes allowing the Ricker Method® to be a powerful tool in plume analytics. Various case studies demonstrating the use of plume analytics tools to evaluate remediation effectiveness will be presented.

Multiple plume analytics tools derived from the Ricker Method® will be presented, with a focus on chlorinated volatile organic compounds (cVOCs) and evaluation of data on a molar basis. This can be important for evaluating and detecting potential new, separate, and/or episodic release sources within a plume.

The Ricker Method® has been successfully used as part of long-term risk management strategies to help stakeholders analyze unique groundwater plume characteristics including area, average concentration, and mass indicator, and describe the behavior of that plume as decreasing, increasing, or stable. Further, the evaluation on a molar basis for chlorinated plumes has been successfully used for the cessation of remediation systems, identification of commingled plumes, identification of potential unrealized source areas, defining specific molar based signatures (biological or abiotic degradation), and providing additional lines of evidence for natural attenuation; examples of which will be presented. During 2012 a transport truck containing 35,000 L of heated waste formaldehyde crashed releasing its contents and diesel fuel to a steep embankment. The steaming waste cascaded to and along a secondary roadway before being released through a culvert and downwards to cottages and ultimately a lake which supplied drinking water to more than 75,000 people. The formaldehyde and/or petroleum hydrocarbon compounds (PHCs) impacted surface soils, surface water, sand and bedrock aquifers, and the local community, elected officials, and Ministry of the Environment all became actively involved.

The purpose of this case study is to present how the spill response was completed with a focus on the careful efforts undertaken once the easily accessible soils were excavated and removed. With formaldehyde concentrations in the sand and bedrock aquifers at greater than 3,000,000 ug/L and 600,000 ug/L, respectively, and with a high degree of public interest, an evaluation of in-situ remedial methods was completed. Due to the unknown behaviour of high dissolved and adsorbed formaldehyde and PHC concentrations in the subsurface, a bench-scale study was completed to assess oxidation treatment effectiveness. Pilot-scale testing was also undertaken using various tracers to assess oxidant delivery, and full-scale in-situ work was completed to remediate the spill and downgradient locations. This talk will present all aspects of the in-situ spill response, including the bench, pilot, and the successful full-scale clean-up.

Mr. Ricker is a Principal Engineer for EarthCon Consultants, Inc. and is responsible for managing various environmental investigation, remediation, and property evaluation and redevelopment projects. Mr. Ricker has over 21 years of industrial and environmental consulting experience involving the development, implementation and management of complex, interdisciplinary environmental investigation and remediation projects. Additionally, Mr. Ricker has developed and/or collaborated on the development of various innovative approaches to interpreting environmental assessment and remediation site data. Mr. Ricker received his M.S. degree from the University of Memphis and his B.S. degree from Rose-Hulman Institute of Technology.

Mike Mazzarese, AST Environmental, Inc.

Overburden and Bedrock Remediation Using Activated Carbon Based Injectates

Activated carbon based injectates were utilized to remediate petroleum hydrocarbon and chlorinated solvent contamination at two subject sites. Each site underwent a thorough data gap analysis and subsequent Remedial Design Characterization (RDC) in order to develop a complete conceptual site model. The RDC programs included vertically dense soil and groundwater sampling and/or bedrock fracture characterization using custom inflatable straddle packers. Once the RDC data was incorporated into the final designs, the reagents were surgically applied to the impacted areas and vertical zones identified during the RDC taking into account the project objectives, total mass present (aqueous and sorbed), lithology, hydraulics, and reagent distribution. A brief overview of each site, the remedial strategy, and results will be discussed.

Site #1. Former Manufacturing Facility - A large manufacturing facility used vapor degreasing in the 1970s and 1980s that resulted in chlorinated volatile organic compound contamination of limited soil and widespread groundwater areas. In the primary source areas, Trichloroethene (TCE) concentrations in groundwater exceeded 50 mg/L. BOS 100® (activated carbon impregnated with reactive iron) was applied over two injection rounds to achieve average contaminant reductions of 90% (vinyl chloride) to 98% (TCE).

Site #2. Former Retail Petroleum Station - AST was contracted to remediate petroleum hydrocarbon impacted groundwater within shallow fractured bedrock and overburden soil at a former retail petroleum site. After a RDC was performed in both the unconsolidated and consolidated strata, BOS 200® (activated carbon blended with terminal electron acceptors, nutrients, and a bacterial blend) was injected over two field events to successfully achieve the site cleanup goals.

Mike has been involved with in-situ remediation for fifteen years having worked within the remediation compound and environmental consulting community his entire professional career. His role as Senior Engineer at AST involves project assessment and design, field implementation oversight, and post project data analysis. Mike is a graduate of Penn State University holding BS and MS degrees in Environmental Engineering. He has previously worked for Vironex, Regenesis, and URS.

Marc McAree,
Willms & Shier Environmental Lawyers LLP

Managing Environmental Liabilities: Case Law Update and Case Studies

Environmental litigators find themselves embroiled in a world of disputes where science, engineering and environmental law intersect. These disputes lead to environmental claims. Environmental litigators retain experts to help decipher, untangle and inform at the intersection of environmental technical and legal issues.

The speaker will set out an overview of what environmental litigators should consider when counting on environmental experts in litigation. The speaker will review what environmental litigators need to know about finding and retaining experts, and experts' professional and legal duties. The speaker will also examine what opinions Canadian courts offer about the expected relationship between counsel and experts and alternative approaches to tendering expert evidence.

Finally, the speaker will canvass the law of admissibility of expert evidence including how far legal privilege extends over communications with experts and experts' reports, and how best to establish and maintain an expert's credibility before and at trial. This speech will explore many of the issues set out in the speaker's article titled "Experts in Environmental Litigation" published in Canadian Journal of Administrative Law & Practice, 28 C.J.A.L.P. 111-258, June 2015.

Marc provides advice and solutions to a wide range of clients to overcome their environmental law and litigation issues. Marc has significant environmental law expertise in contaminated land/brownfields clean ups, transactions and litigation, and environmental compliance and approvals. Marc also helps clients reduce and manage environmental risks and liabilities. Marc is recognized for his excellence representing clients in environmental civil litigation at all levels of Ontario Courts, defence of clients against environmental regulatory prosecutions, and appearances before Ontario's Environmental Review Tribunal and other administrative law decision-makers on appeals and other hearings. Marc has particular experience litigating soil and groundwater contaminant impacts, nuisance and odour issues.

Marc is named in the 2015 Lexpert™®/American Lawyer Guide To The Leading 500 Lawyers in Canada. He is peer selected annually for inclusion in The Best Lawyers in Canada© for environmental law. Marc is also ranked "Consistently Recommended" by The Canadian Legal Lexpert directory, ranked "AV® Preeminent™" by peers in Martindale-Hubbell. He is also named annually in both the international Who's Who Legal—Environment and Who's Who Legal—Canada. Marc is called to the bar in Ontario and British Columbia and obtained a joint Bachelor of Laws/Masters in Environmental Studies at York University.

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