SCIENCE ADVISORY BOARD FOR CONTAMINATED SITES IN BC

SCIENCE ADVISORY BOARD FOR CONTAMINATED SITES WORKSHOP & CONFERENCE

13TH ANNUAL WORKSHOP & CONFERENCE (HYBRID)
IN PERSON AT THE SFU HARBOUR CENTRE, VANCOUVER, BC

DAY 1: WORKSHOP:
NATURE-BASED SOLUTIONS FOR CONTAMINATED SITES MANAGEMENT

DAY 2: CONFERENCE:
CONFERENCE ON SITE INVESTIGATION, RISK ASSESSMENT AND REMEDIATION

SEPTEMBER 27-28, 2023 8:30AM - 4:30PM PT DAILY

SABCS.CA/SABCS-CONFERENCE

IN PERSON AT THE SFU HARBOUR CENTRE, VANCOUVER, BC
515 WEST HASTINGS STREET; VANCOUVER, BC

DAY 1 (SEPTEMBER 27TH) WORKSHOP

NATURE-BASED SOLUTIONS FOR CONTAMINATED SITES MANAGEMENT

LOCATION: SFU HARBOUR CENTRE;
515 WEST HASTINGS STREET;
7TH FLOOR: 7000 EARL & JENNIE LOHN POLICY ROOM

DAY 2 (SEPTEMBER 28TH) CONFERENCE

CONFERENCE ON SITE INVESTIGATION, RISK ASSESSMENT AND REMEDIATION

LOCATION: **SFU HARBOUR CENTRE;**
515 WEST HASTINGS STREET;
1400-1430 SEGAL CENTRE

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WORKSHOP

DAY 1: SEPTEMBER 27, 2023

8:30AM - 4:30PM

IN PERSON AT THE SFU HARBOUR CENTRE, VANCOUVER, BC
515 WEST HASTINGS STREET; VANCOUVER, BC

LOCATION: SFU HARBOUR CENTRE;
515 WEST HASTINGS STREET;
7TH FLOOR: 7000 EARL & JENNIE LOHN POLICY ROOM

NATURE-BASED SOLUTIONS FOR CONTAMINATED SITES MANAGEMENT

NATURE-BASED SOLUTIONS FOR CONTAMINATED SITES MANAGEMENT

WORKSHOP AGENDA - SEPTEMBER 27, 2023

8:30AM	**Introduction to Workshop** - *Ian Hers, Hers Environmental Consulting Inc.*

NATURE-BASED SOLUTIONS FOR CONTAMINATED SITES

8:35AM	**Towards Optimized Risk-based Aftercare at a Tar Site Case Study: Biodegradation Potential of Large-scale Contamination in the Subsurface in Netherlands - RESANAT Project** - *Annemieke Marsman, Deltares, NL*
9:10AM	**Sustainable Remediation: At the Intersection of Current and Future Regulations** - *Bruce Tuncliffe, Vertex Environmental Inc.*
9:45AM	**How Molecular Biological Tools can Support Natural Remedies** - *Stephanie Fiorenza, Arcadis*
10:20AM	**BREAK**
10:35AM	**Why Microbial Characterization Matters in Nature-Based Solutions for Remediation: Case Studies from across Canada** - *Elizabeth Haack, Ecometrix*
11:10AM	**Review of Natural Attenuation of Oil in Marine Environments** - *Will Gaherty, PGL Environmental Consultants*
11:45AM	**LUNCH**

12:30PM	**Occurrence, Removal, and Destruction of Per- and Poly-fluoroalkyl Substances (PFAS)** - *Madjid Mohseni, Professor, Department of Chemical and Biological Engineering, University of British Columbia*
12:45PM	**Innovative In-Situ Remediation Approach for Treating PFAS** - *Bruce Tunnicliffe, Vertex Environmental Inc.*
1:00PM	**Passive Sunlight-Driven Remediation via Solar Photocatalysis** - *Jeffrey Martin, H2nano*
1:15PM	**Flash Forest Rapid Reforestation Technology using Drones, AI, and Biological Seedpod Technology for Post Wildfire, Decommissioning Roads and Reforesting Mining Applications - Case Study** - *Marc Apduhan, Flash Forest*
1:30PM	**Q&A and Transition**

NATURE-BASED SOLUTIONS FOR CONTAMINATED SITES

1:40PM	**Striving for More Sustainable Risk Management at Petroleum Contamination Sites** - *Matt Lahvis, Shell*
2:15PM	**Methods to Enhance Natural Source Depletion Rates: Heat, Oxygen, and Emerging Concepts** - *Charles Newell, GSI Environmental Inc.*
2:50PM	**BREAK**
3:05PM	**Lessons Learned from Mature Phytoremediation Plots Drive Optimizations for New Design** - *Mark Madison, Jacobs*
3:40PM	**PANEL**
4:10PM	**WORKSHOP WRAP-UP**

SEPTEMBER 27-28, 2023 8:30AM - 4:30PM PT DAILY

SABCS.CA/SABCS-CONFERENCE

8:30AM - 8:35AM PT

WELCOME & INTRODUCTION TO WORKSHOP

SPEAKER IAN HERS

NATURE-BASED SOLUTIONS FOR CONTAMINATED SITES

8:35AM - 9:10AM PT

TOWARDS OPTIMIZED RISK-BASED AFTERCARE AT A TAR SITE CASE STUDY: BIODEGRADATION POTENTIAL OF LARGE-SCALE CONTAMINATION IN THE SUBSURFACE IN NETHERLANDS - RESANAT PROJECT

Tar-contaminated sites, such as former manufactured gas plants (MGPs) and creosote plants, were among the earliest sites where soil and groundwater contamination was addressed. During that time, excavation was the only feasible remedial option, resulting in large residual contaminations with tar/DNAPLs in more complex sites with deep contamination. The total number of former MGPs in Europe exceeds 6,500, with 1,700 in Germany, 228 in The Netherlands, and 151 in Belgium. At many of these MGP sites, contamination is being contained, and stakeholders face the prospect of potentially infinite aftercare. Now, 25-35 years later, containment systems are approaching the end of their lifespan, often necessitating a reevaluation of the containment approach. Practical experiences, scientific insights into contaminant behavior, new technologies, and evolving needs have led to the development of new risk-based strategies for these sites, including the realistic option of site closure. Within the RESANAT program (Dutch/Belgian cooperation: remediation of residual contamination based on nature-based techniques) and through case studies like Griftpark, nature-based soil remediation methods have been refined and promoted. The aim of this research was to investigate the possibility of halting active groundwater abstraction and purification using biodegradation, potentially enhanced by biostimulation. The effectiveness of this approach was evaluated based on evidence lines for biodegradation, including:

- Changes in groundwater composition.
- Alterations in contamination levels.
- The presence of microorganisms with degradation capacity.

At the Griftpark manufactured gas plant in Utrecht, a hydraulic containment system, including bentonite walls down to 55 meters below ground level (bgl), and a groundwater extraction system, were installed as early as 1995. In 2016, a scientific consortium was formed to focus on characterizing the residual contamination, monitored natural attenuation (MNA), enhanced natural attenuation (ENA), and the development of a 3D reactive transport model."

SPEAKER

ANNEMIEKE MARSMAN, DELTARES, NL

Annemieke studied geophysics at the University of Utrecht with specialty on tectonophysics. After that she did her PhD on multiphase flow at Wageningen University. The behavior of LNAPL's on a fluctuating groundwater level was studied. In 2003 she started working as geohydrologist for Deltares on soil and groundwater quality. Modeling transport of groundwater contamination, multiphase flow and energy transition are her specialties. She was project manager for the projects on megasite approach on groundwater contamination in the harbor of Rotterdam, project manager on groundwater remediation for the foundation on remediation for Dutch railways and coordinator of the PIB (Partners for International Business) program soil in China. As a coordinator she co-organized several workshops in Shanghai and Guangzhou for Dutch and Chinese authorities and companies in the field of groundwater and soil remediation to establish cooperation. She worked on a project on Safe Permanent Closure of the Medicine Hat - Alderson Commingled Gas Fields. At the moment she focusses on risk analysis on effects of mining activities on groundwater quality and the energy transition.

9:10AM - 9:45AM PT

SUSTAINABLE REMEDIATION: AT THE INTERSECTION OF CURRENT AND FUTURE REGULATIONS

For decades the environmental industry has applied a conservative approach to site-specific soil and groundwater remediation, using a framework of carefully designed risk-based standards while applying well-understood and preferably engineered-solutions to reach those standards. However, site clean-up does not exist in a vacuum, and positive effort spent in one area may cause negative affects elsewhere. This talk highlights the dilemma of balancing current stringent site-specific standards with potentially infringing on future regulations regarding sustainability.

When viewed through the lens of climate change, one might observe that our current high-energy, short-term remedial solutions may be compared to rearranging chairs on the Titanic. Are we remediating a site, while worsening the overall condition of the Earth? Is our current view of, and assumptions around, remediation too narrow? Micro vs Macro.

This complicated issue will be tackled through the use of real-world examples and by providing better understanding into the current use of nature-based remedial solutions. A case study will be presented that shows how the remediation of a natural environment resulted in destruction of that same natural environment. From the backdrop of this devastating remediation approach, questions will be asked, and alternative approaches presented. The carbon footprint of a common engineered remediation approach will be presented and contrasted to a nature-based remediation approach. Throughout the talk the speaker will challenge our focus on site-specific goals and offer thoughts of how changes to more sustainable remediation should be considered. All in all, the speaker will attempt to explain how sustainable remediation approaches can fit at the intersection of site-specific goals (current regulation) and climate change goals (future regulation).

SPEAKER BRUCE TUNNICLIFFE, M.A.SC., P.ENG, VERTEX

Mr. Tunnicliffe is President of Vertex Environmental Inc., is an Environmental Engineer, and has over 20 years of experience designing and implementing remediation programs for a wide variety of contaminants including chlorinated solvents, petroleum hydrocarbons and emerging contaminants such as PFAS/PFOA. Mr. Tunnicliffe holds a Master's degree from the University of Waterloo where he studied chemical oxidation in fractured bedrock.

9:45AM - 10:20AM PT

HOW MOLECULAR BIOLOGICAL TOOLS CAN SUPPORT NATURAL REMEDIES

Nature based remediation is being increasingly seen as a sustainable approach to remediation. Does the site where it is being proposed hold promise? How effective are some of the approaches? This presentation will describe some of the molecular tools that are available for use in improving our understanding of nature-based remediation.

Molecular biological tools (MBTs) are a powerful addition to the remediation toolkit. Especially for in situ remedies that rely on 'natural' processes, molecular biological tools can help identify what is possible, explain what is happening during remediation to monitor progress, and even diagnose what might have gone went wrong when remediation doesn't proceed as anticipated. During this presentation, the most widely used MBTs, such as quantitative polymerase chain reaction (qPCR) and the 'omics' will be described. Examples of appropriate application of the tools will be given along with some case studies of their use in natural remedies. New approaches that are on the horizon for MBTs such as proteomics and metabolomics will be shown to highlight the future potential for their use in remediation.

SPEAKER STEPHANIE FIORENZA, PH.D.
PRINCIPAL SCIENTIST, ARCADIS U.S., INC.

Stephanie Fiorenza, Ph.D., is a Principal Scientist and Technical Lead for the Oil & Gas sector at Arcadis U.S., Inc. Her primary experience as a remediation technology specialist is in site assessment, remediation, application of molecular tools and research on PFAS and other emerging contaminants, chlorinated solvents and petroleum hydrocarbons. Dr Fiorenza is Vice Chair of ASTM International's E50 Environmental Assessment, Risk Management and Corrective Action Committee. She co-leads an ASTM Task Group on Use of Molecular Biological Tools in Remediation and was a trainer at Battelle's International Symposium on Bioremediation and Sustainable Environmental Technologies in 2023.

10:35AM - 11:10AM PT

WHY MICROBIAL CHARACTERIZATION MATTERS IN NATURE-BASED SOLUTIONS FOR REMEDIATION: CASE STUDIES FROM ACROSS CANADA

Implementation of nature-based solutions (NBS) is needed to address the environmental, societal and economic challenges of widespread degraded lands; 20% of total land mass in Canada and US1 are categorized as degraded. NBS are approaches that are inspired by and work with nature. NBS have the potential to provide cost-effective regenerative solutions, reflecting a shift towards sustainable resilience remediation (SRR). Three case studies will be presented that underscore the importance of understanding microbial communities and function as a measure of ecosystem health status and efficacy of NBS.

Case Study 1 - Phytoremediation: Phytoremediation is an NBS that is relatively non-intrusive, maintains and improves soil integrity and biology and can be economical, but quantifying phytodegradation efficiency is challenging. Toluene mass removal associated with a hybrid poplar plot was evaluated as part of a long-term study (>10 years) at an urban site. The poplars were phytoextracting toluene, but the bulk of toluene mass removal occurred in the rhizosphere and within the tree tissues. In each of these, toluene mass removal can be related to meaningful shifts in bacterial and fungal community structure and biodegradative capacity.

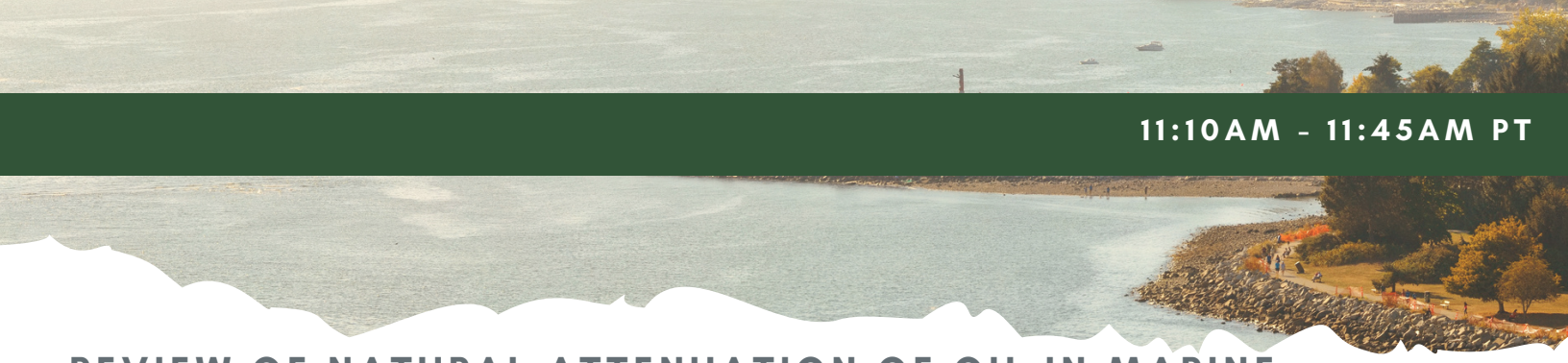
Case Study 2 - Healthy Soils are a goal of NBS. Characterization of microbial community and functional diversity is emerging as a metric of soil quality2. At a remote site impacted by salinity, comprehensive analyses of soil microbial communities and microfauna, using eDNA and next-generation sequencing tools, have been conducted to support defining healthy soil communities and identifying key indicators of future land (vegetative) reclamation success. Increases in abundance of specific species showed strong positive or negative correlations with increased salinity. However, a core bacteria/archaeal microbiome persists undisturbed in these contaminated soils. The overall maintenance of community structure across the salinity gradient is being considered as a key result for remediation actions focused on enhancing other aspects of soil structure/health and minimizing soil removal.

Case Study 3 - NBS Co-benefits: In the analysis of remediation options, the long-term potential for NBS to provide benefits beyond clean up of impacts should be included in the evaluation process. A passive treatment wetland at a site of a petroleum hydrocarbon release is undergoing evaluation to demonstrate its functional (microbial) degradation capacity. Both the environmental risks and societal benefits (ecosystem services) will be evaluated, including ecosystem function and biodiversity enhancement.

SPEAKER

ELIZABETH HAACK, ECOMETRIX INC.

Elizabeth (Liz) Haack is a Senior Environmental Consultant and Director of the Assessment Team with Ecometrix. She has 20 years of combined research and consulting experience in human and ecological risk assessment, site and water quality assessments. She is a leader in evaluating and implementing advanced technologies and innovative approaches to benefit industry and society. She has a practical and transparent approach to contaminated sites assessment and risk management, applying careful data exploration and analysis. She provides expert opinion on the adequacy of remedial activities and assessment of residual risks.



11:10AM - 11:45AM PT

REVIEW OF NATURAL ATTENUATION OF OIL IN MARINE ENVIRONMENTS

Spurred particularly by the Exxon Valdez and Deepwater Horizon disasters and by a revolution in environmental bacterial genomics, our understanding of natural attenuation of hydrocarbons has advanced significantly in the last three decades. Complex consortia of obligate hydrocarbon degraders reliably attenuate C25 minus hydrocarbon compounds in every marine environment evaluated. Heavier hydrocarbons also attenuate, though the mechanisms are less clear. The impact of various modifying environmental conditions on the rates of degradation is well understood qualitatively, and is assisting with improving spill response. This seminar will review the results of a deep literature review focused on the Canadian context.

SPEAKER

WILL GAHERTY, PGL ENVIRONMENTAL CONSULTANTS

Will has 38 years experience as an organic geochemist with a particular interest in environmental fate and behaviour, and as an environmental consultant specializing in contaminated site assessment and remediation. He has SB degrees in Chemical Engineering and in Civil Engineering from MIT, and a Master's in Civil Engineering - Environmental Engineering and Science from Stanford University. His work has been predominantly in Canada where he is currently President of PGL Environmental in Vancouver, BC. Outside work, he coaches girl's softball, and his strange hobby is flying trapeze.

INNOVATION SESSION

12:30PM - 12:45PM PT

OCCURRENCE, REMOVAL, AND DESTRUCTION OF PER- AND POLY-FLUOROALKYL SUBSTANCES (PFAS)

SPEAKER

MADJID MOHSENI, UNIVERSITY OF BRITISH COLUMBIA

Madjid Mohseni is a Professor in the Department of Chemical and Biological Engineering at the University of British Columbia. His research in the area of drinking water quality and treatment, focuses on novel and robust water treatment processes, with particular emphasis on the removal and degradation of emerging contaminants from drinking water supplies. His research involves laboratory scale development and investigation, as well as pilot scale and field evaluation of the technologies under real operating conditions at several partner community sites. Dr. Mohseni is currently the Scientific Director of RESEAU Centre for Mobilizing Innovation, a national multi-disciplinary Knowledge Mobilization program funded by partners from industry, communities, government and NGOs, focusing on achieving socioeconomically and technologically sustainable outcomes in water health and well-being for small and Indigenous communities.

12:45PM - 1:00PM PT

INNOVATIVE IN-SITU REMEDIATION APPROACH FOR TREATING PFAS

While new standards are being published in Canada for per- and polyfluoroalkyl substances (PFAS), including perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA), there unfortunately is no consensus as to the most effective remediation approach for these "forever chemicals". There will be a strong focus on PFAS remediation in 2023 as more standards (and more stringent standards) continue to be developed across Canada, North America and the world. The purpose of this talk is to summarize the current state of PFAS remediation and introduce an innovative, new method for in-situ treatment of PFAS.

Currently the most demonstrated PFAS treatment technologies rely on non-destructive means that remove PFAS from water via adsorption media. Pragmatic in-situ treatment options currently include sequestration, but the proper selection and application methods of adsorbent materials for immobilization of PFAS in groundwater plumes may be key in the near-term for full-scale, widespread, in-situ PFAS plume treatment.

This presentation will review and present data from multiple studies (bench and field) where adsorbent materials have been utilized to treat PFAS contamination in groundwater. Furthermore, this presentation will discuss the significant efforts being made to optimize and apply these existing adsorptive technologies to enhance their reliability, lifespan, and overall effectiveness in treating PFAS contaminated groundwater plumes. Various in-situ amendment materials will be reviewed, including activated carbon and clay-based materials. Throughout the presentation, recommendations and insights will be offered into the potential for future effective in-situ PFAS treatment methods.

SPEAKER BRUCE TUNNICLIFFE, M.A.SC., P.ENG, VERTEX

Mr. Tunnicliffe is President of Vertex Environmental Inc., is an Environmental Engineer, and has over 20 years of experience designing and implementing remediation programs for a wide variety of contaminants including chlorinated solvents, petroleum hydrocarbons and emerging contaminants such as PFAS/PFOA. Mr. Tunnicliffe holds a Master's degree from the University of Waterloo where he studied chemical oxidation in fractured bedrock.

1:00PM - 1:15PM PT

PASSIVE SUNLIGHT-DRIVEN REMEDIATION VIA SOLAR PHOTOCATALYSIS

Conventionally, oxidative treatment processes require significant chemical and electrical inputs and capital-intensive process equipment. To this end H2nanO has developed a passive advanced oxidation (P-AOP) treatment technology consisting of a system of buoyant photocatalyst composites that provides off-grid, high strength oxidative treatment without the need for chemical or electrical inputs. Upon exposure to naturally occurring solar or artificial ultraviolet (UV) light, the photocatalyst technology generates free radicals, including hydroxyl and superoxide. As the photocatalyst media is not consumed, it may be collected for reuse once treatment is complete (batch process) using low-energy flotation and skimming or used continuously in a flow-through system. Currently, H2nanO's SolarPass technology has been identified as a solution for the treatment of complex long-chain organics within the Canadian Oil Sands, an issue which is currently not feasible for conventional treatment technologies. This presentation will further discuss H2nanO's photocatalytic treatment technology and highlight treatment case studies, at various stages of development, including polycyclic aromatic hydrocarbons (PAHs), BTEX compounds, dissolved metals, and organoselenium compounds.

SPEAKER JEFFREY MARTIN, H2NANO

Jeffrey Martin is a Senior Water Treatment Scientist at H2nanO Inc., leading the team developing new water and emissions treatment applications for H2nanO's novel photocatalytic treatment technology. Jeff obtained his MASc in Chemical Engineering from the University of Toronto, and BASc in Chemical Engineering from the University of Waterloo. Passionate about solving complex water treatment issues with innovative and sustainable solutions, Jeff specializes in adapting H2nanO's SolarPass technology to new customers and applications.

1:15PM - 1:30PM PT

FLASH FOREST RAPID REFORESTATION TECHNOLOGY USING DRONES, AI, AND BIOLOGICAL SEEDPOD TECHNOLOGY FOR POST WILDFIRE, DECOMMISSIONING ROADS AND REFORESTING MINING APPLICATIONS - CASE STUDY

A holistic view and case study samples of innovation in reforestation, rapid disaster response, and decommissioning of ecological infrastructure using various technologies in British Columbia, Alberta, and other provinces in Canada. The presentation will discuss the Climate Emergency, and identify pain points that currently exist in reforestation, environmental consulting, policy, and ecological restoration, especially in post-wildfire devastation and in the decommissioning of various infrastructures such as log roads and other projects for scalability, safety, and accessibility that may be relevant to SABCS members. Flash Forest will highlight various solutions that are used to address these gaps, including how technologies such as artificial intelligence, machine learning, biological seedpods, robotics, automation and modular production, drone technology, collaboration with local indigenous communities, traditional knowledge, focus on biodiversity with tree and auxiliary species, and innovation bring opportunities to not only restore forests but rebuild a healthy and resilient forest at scale.

The case studies may explore the recent and severe wildfires in BC and AB and how Flash Forest is working with its partners in reforestation efforts. The team will highlight collaborative efforts with local First Nations in Canada, focusing on biodiversity-centric approaches, the challenges of collecting millions of various tree species to be converted into seedpods for deployment within a short time frame; and logistics in how Flash Forest completes drone imaging, reforestation, followed by monitoring efforts to ensure the survival of our trees. Various case studies will look at the number of hectares, seedlings per hectare, and the species breakdown accordingly based on a data-driven iterative approach.

The presentation will conclude with potential pathways forward, question and answer, and collaborative opportunities with SABCS members for Canada and outside of Canada opportunities.

SPEAKER

MARC APDUHAN, INNOVATION AND BUSINESS DEVELOPMENT MANAGER, FLASH FOREST INC.; CEO, RENOVO CREATIVE INC.

Marc is an innovation specialist and cleantech entrepreneur with over 10 years of experience in startups, and global enterprises with concept-to-commercialization initiatives. His previous work includes (1) the execution of a global innovation across 20 cities and 4 continents, (2) the innovation and business development of a drone reforestation company, (3) over $20M in private and public funding for various social and environmental initiatives, and (4) his CEO role in Renovo Creative, an environmental consulting and creative agency. For passions, he has his Rescue Diving certification, choreographs hip-hop dance, and practices yoga.

He has been a member of various government-industry collaboratives throughout BC and Canada, namely with Professional Engineers and Geoscientists BC, IRAP and National Research Council, New Ventures BC, Emissions Reduction Alberta, InnovateBC (Mentor), Alberta Innovates, entrepreneurship@UBC (Mentor), SFU VentureLabs (Mentor), Technation, ECO Canada, and SDTC. Marc is intermediate to working professional in 6 languages (in order of proficiency): Cebuano, English, French, Spanish, Tagalog, and Japanese.

1:40PM - 2:15PM PT

STRIVING FOR MORE SUSTAINABLE RISK MANAGEMENT AT PETROLEUM CONTAMINATION SITES

The scarcity and over-withdrawal of groundwater to meet societal needs has placed a premium on sustainability and preserving usable groundwater for future generations. This stewardship has served as a driver for groundwater remediation at many petroleum hydrocarbon sites. Although certain engineered remediation systems can help meet this goal though hydrocarbon mass removal, the benefits come at a sacrifice to atmospheric resources through global warming and carbon dioxide (CO_2) emissions. Fortunately, our planet's aquifer systems are equipped with a natural assimilative capacity in the form of microbes that can achieve greater hydrocarbon mass removal without corresponding detriment to global warming. Hence, understanding the role of mother nature and, in particular, rates of natural attenuation are critical in optimizing the implementation of engineered remediation to achieve a net environmental benefit. Rates of hydrocarbon mass removal in source areas where light non-aqueous phase liquid is present (i.e., natural source-zone depletion -- NSZD) can exceed rates of certain poorly performing active/engineered remediation systems. Although guidance on NSZD and different methodologies for rate quantification have been available for more than a decade, the science on NSZD has evolved, including new tools for quantification and new approaches that more strategically target site risk.

The goal of this presentation will be to present recent and developing American Society of Testing and Material (ASTM) and industry guidance on NSZD that highlight various measurement methods and ways to effectively incorporate NSZD in remedial decision making. Equipped with this knowledge, regulators, industry, and remediation practitioners can make more informed risk-management decisions that benefit both groundwater and atmospheric resources and help preserve the planet for future generations.

SPEAKER

MATTHEW LAHVIS, SHELL

Matthew Lahvis is a Principal Engineer at Shell Oil Products US and provides support on soil and groundwater issues related to the company's oil and gas operations. Matt has authored several papers on petroleum vapor intrusion and serves as an Associate Editor for the Ground Water Monitoring and Remediation journal.

METHODS TO ENHANCE NATURAL SOURCE DEPLETION RATES: HEAT, OXYGEN, AND EMERGING CONCEPTS

The past decade of research has underscored the effectiveness of natural source zone depletion (NSZD) in the remediation of light non-aqueous phase liquid (LNAPL) sites, with observed LNAPL biodegradation rates now exceeding estimates based on older LNAPL conceptual models by a factor of 10-100. However, these rates, though fast, may still fall short of the standards set by certain environmental regulators and regulatory frameworks. This necessitates a more concerted investigation into methods that could potentially increase NSZD rates.

Bioventing, an approach developed and tested across a large-scale program involving 178 sites in the 1990s, is based on slowly introducing oxygen into the LNAPL treatment zone. It has demonstrated promising results based on before-and-after total petroleum hydrocarbon (TPH) data. Initial median removal rates were approximately 11,000 gallons per acre per year, decreasing to about 3,100 gallons per acre after a year of bioventing. These rates significantly exceeded the typical natural source zone depletion (NSZD) rate of about 1000 gallons per acre per year. Factors enhancing these rates included soil moisture, soil nitrogen concentration, temperature, and gas-phase TPH. However, low soil moisture resulted in unsuccessful hydrocarbon removal in a few sites. Despite its efficacy, bioventing's application limited in the past due to the rise of risk-based and monitored natural attenuation remedies and concerns about potential vapor intrusion issues.

Several studies, both laboratory and large multiple-site studies have shown that increasing the temperature of an LNAPL source zone can increase LNAPL degradation rates. This temperature sensitivity suggests that methanogenesis, which is strongly influenced by temperature, plays a crucial role in the rate of hydrocarbon source zone attenuation. This hypothesis was supported by stronger temperature-degradation rate correlations at deeper sites and higher dissolved methane concentrations at warmer sites. Research by Colorado State University on Sustainable Thermally Enhanced LNAPL Attenuation (STELA) involves adding heat using one of several different approaches to enhance NSZD at LNAPL impacted sites. The heat addition processes include using electrical resistance heaters; solar-powered swimming pool heaters; and sheets of plastic to create mini-greenhouse effect in the shallow soils impacted by LNAPL.

Finally, there are several other methods in the conceptual stage that could be useful to enhance NSZD rates at sites. These include groundwater recirculation systems, adding reagents to increase methanogenesis rates, and methods to enhance ebullition of gases from the saturated zone to the vadose zone.

This talk will review methods to add oxygen, add heat, and employ other novel methods to enhance NSZD rates.

SPEAKER

CHARLES NEWELL, PH.D., GSI ENVIRONMENTAL INC.

Dr. Charles Newell is a Vice President of GSI Environmental Inc. He is a member of the American Academy of Environmental Engineers, a NGWA Certified Ground Water Professional, and an Adjunct Professor at Rice University. He was awarded the ITRC Environmental Excellence Award in 2016 and the 2020 Foundation Achievement Award presented by the Association for Environmental Health and Science. He has extensive experience with Natural Source Zone Depletion (NSZD) and other passive, nature-based remediation technologies.

LESSONS LEARNED FROM MATURE PHYTOREMEDIATION PLOTS DRIVE OPTIMIZATIONS FOR NEW DESIGN

Value Added. Phytoremediation provides an in situ nature-based solution for remediation of contaminated media. Site restoration and "green" initiatives occur upon installation of the plants and immediate physical transformation of contaminated sites leads to high community acceptance and healthier ecosystems. Other benefits of planting trees are carbon dioxide removal, increased human health, increased water infiltration rates, and reduced surface temperatures.

Background/Objectives. Phytoremediation is an effective technology to provide hydraulic control and treat a wide variety of environmental contaminants. Phytoremediation is the use of living plants for in situ removal, degradation, or containment of contaminants in soil, sludges, sediments, surface water, and groundwater. Many types of plants can be used for phytoremediation projects: grasses, shrubs, and trees. Plants can improve the soil structure by increasing aeration, humidity, and promote microbial growth for enhanced biodegradation in LNAPL source zones, for example. Plant roots change the soil-root interface as they release inorganic and organic compounds in the rhizosphere. This in turn increases contaminant bioavailability and degradation rates or immobilizes contaminants.

Many phytoremediation plots were established in the late 1990s and early 2000s during a period of excitement over a novel, technically practicable, cost-effective, and sustainable technology that can achieve soil and groundwater standards. These phytoremediation pioneer plots paved the way for understanding limitations and potential issues with future large-scale installations. Tapping Jacobs more than 30 years' experience with phytoremediation solutions, this presentation examines full-scale mature phytoremediation plots ranging in 10 to 20+ years of maturity at petroleum release sites.

Approach/Activities. This presentation discusses the following challenges encountered at these mature phytoremediation plots:

- Slow contaminant removal uptake rate or degradation rate
- Decreased effectiveness during winter months
- Phytotoxicity and other stressors
- Decreased remediation rates due to inadequate rooting depth
- Loss of land use long-term for client
- Long-term irrigation requirements

Results/Lessons Learned. The presentation will provide methods to overcome these challenges for designing and managing mature phytoremediation systems. The presentation will present successful optimizations implemented to increase performance and achieve remediation objectives. New methods in installation, fertilization, plant selection, maintenance, and irrigation will also be discussed to increase health, uptake rates, and resiliency with new plots.

Other considerations will be discussed such as increasing resilience to climate change (i.e., increasing water levels and drought) and the use of phyto plantations for carbon offsets. Phytoremediation design is flexible and can accommodate various operational objectives including adaptive establishment, growth, and yield with various plant types and species.

SPEAKER

MARK MADISON, JACOBS

Mr. Madison is an agricultural, environmental, and civil engineer and senior project manager with Jacobs in Portland, Oregon. He is a farm boy and specializes in managing soil, water, plants, and nutrient relationships for bioremediation, phytoremediation, wastewater reuse, wetlands treatment, and agricultural production. His experience includes site investigation, data collection, modeling, design, construction, management, operations, and monitoring and maintenance of, wetlands, and uplands bioremediation and phytoremediation systems. Mark has 42 years experience at Jacobs Engineering.

3:40PM - 4:10PM PT

PANEL

4:10PM PT

WRAP-UP

THANK YOU

FOR JOINING US FOR THE 13TH ANNUAL SABCS WORKSHOP

CONFERENCE

DAY 2: SEPTEMBER 28, 2023

8:30AM - 4:30PM

IN PERSON AT THE SFU HARBOUR CENTRE, VANCOUVER, BC
515 WEST HASTINGS STREET; VANCOUVER, BC

LOCATION: SFU HARBOUR CENTRE;
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1400-1430 SEGAL CENTRE

CONFERENCE ON SITE INVESTIGATION, RISK ASSESSMENT AND REMEDIATION

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CONFERENCE AGENDA - SEPTEMBER 28, 2023

8:30AM **Welcome & Introduction**

SESSION 1 - BC MINISTRY OF ENVIRONMENT AND CLIMATE CHANGE STRATEGY (ENV) UPDATE

8:35AM **Making Contaminated Sites Climate Ready** – *Kelli Larsen, Annette Mortensen, BC ENV*

SESSION 2 - INDIGENOUS TRADITIONAL KNOWLEDGE PANEL

9:00AM **Traditional Indigenous Knowledge and Perspective Regarding the Restoration and Remediation of Wildlands Impacted by Resource Development and Industrial Pollution** - *Gerry Oleman, St'at'imc Nation*

9:20AM **Effective Indigenous Engagement and Incorporating Traditional Indigenous Knowledge and Perspectives into Environmental Remediation Projects at Contaminated Sites** - *Michael Jacobs, Cambium Indigenous Professional Services (CIPS)*

9:40AM **Discussion on Engagement Through Knowledge** - *Gerry Oleman, St'at'imc Nation*

9:50AM **Q&A**

10:00AM **BREAK**

SESSION 3 - CLIMATE CHANGE ASSESSMENTS AND CASE STUDIES

10:15AM **Fostering Resilience: The Federal Contaminated Sites Action Plan's Efforts to Address Climate Change Impacts** – *Jonathan Pierre, Canada Federal Contaminated Sites Action Plan (FCSAP) Sec & Martine Lalande, Public Services and Procurement Canada*

10:40AM **Conducting a Climate Change Resilience Assessment in Support of Remedy Selection** – *Betsy Collins, Jacobs*

11:05AM **Evaluation of Climate Change Effects on Contamination at Multiple DFO Sites across BC** – *Adrienne Ducharme and Jari Eikenaar, WSP Canada Inc.*

11:30AM **Human Health & Ecological Risk of Contaminated Lands Under Climate Change: A Case Study of Oil Fields of Northern British Columbia** – *Gyan Chhipi Shrestha, DWB Consulting Services Ltd.*

11:55AM **LUNCH**

SESSION 4 - SUSTAINABLE REMEDIATION AND CASE STUDIES

12:45PM **Decarbonizing the Global Economy - How Can the Environmental Remediation Industry Contribute?** – *Francois Beaudoin, GHD Consultants Ltd.*

1:10PM **Significant Return on Investment Achieved by Successfully Remediating a Challenging Chlorinated Solvent Site** – *Bruce Tunnicliffe, Vertex Environmental Inc.*

1:35PM **In-situ and Ex-situ Remediation of cVOC Impacts in Conjunction with Site Construction Activities** – *Jevins Waddell, Trium Environmental Inc.*

2:00PM **Northern Abandoned Mine Reclamation Program** - *Alex Murray, Crown-Indigenous Relations and Northern Affairs Canada*

2:25PM **BREAK**

SESSION 5 - EMERGING SCIENCE AND TECHONOLOGY

2:40PM **The Ups and Downs of Passive Vapour Intrusion Mitigation System Diagnostics** - *Darius Mali, Geosyntec Consultants*

3:05PM **PFAS (Per- and Polyfluoroalkyl Substances) - Ensuring the Best Data for Canada's Forever Chemicals** – *Andrew White, Bureau Veritas*

3:30PM **Quantitative Laboratory Analysis of Inorganic, Organic and Volatile Species of Selenium** - *Louis Wagner, ALS Environmental*

3:55PM **Addressing the Need for Data Governance and Digital Transformation in our Industry as a valuable tool in Site Assessment & Remediation** - *Nick Tumney, EScIS*

4:20PM **WRAP UP**

SEPTEMBER 27-28, 2023 **8:30AM - 4:30PM PT DAILY**

SABCS.CA/SABCS-CONFERENCE

8:30AM - 8:35AM PT

WELCOME & INTRODUCTION

SESSION 1 - BC MINISTRY OF ENVIRONMENT AND CLIMATE CHANGE STRATEGY (ENV) UPDATE

8:35AM - 9:00AM PT

MAKING CONTAMINATED SITES CLIMATE READY

SPEAKERS KELLI LARSEN
ANNETTE MORTENSEN

SESSION 2 - INDIGENOUS TRADITIONAL KNOWLEDGE PANEL

9:00AM - 9:20AM PT

TRADITIONAL INDIGENOUS KNOWLEDGE AND PERSPECTIVE REGARDING THE RESTORATION AND REMEDIATION OF WILDLANDS IMPACTED BY RESOURCE DEVELOPMENT AND INDUSTRIAL POLLUTION

SPEAKER GERRY OLEMAN, ST'AT'IMC NATION

Gerry Oleman is a member of the St'at'imc Nation from British Columbia, which is located in the Coast Mountains between Whistler, the Fraser River, and the interior of BC. Gerry is an Elder, traditional knowledge keeper, mentor, storyteller, healer, and educator. He is a former Chief, Band Councillor, Tribal Director, and counsellor.

9:20AM - 9:40AM PT

EFFECTIVE INDIGENOUS ENGAGEMENT AND INCORPORATING TRADITIONAL INDIGENOUS KNOWLEDGE AND PERSPECTIVES INTO ENVIRONMENTAL REMEDIATION PROJECTS AT CONTAMINATED SITES

SPEAKER MICHAEL S. JACOBS, CAMBIUM INDIGENOUS PROFESSIONAL SERVICES (CIPS)

Michael S. Jacobs is the Chief Executive Officer for Cambium Indigenous Professional Services (CIPS) Inc. He is a proud Anishinaabe from the Curve Lake First Nation. Michael is Co-Chair for Canadian Council for Aboriginal Business (CCAB), board member of Green Communities Canada, and has been recently appointed to the Implementation Committee for the Canadian Sustainability Standards Board

9:40AM - 9:50AM PT

DISCUSSION ON ENGAGEMENT THROUGH KNOWLEDGE

SPEAKER

GERRY OLEMAN, ST'AT'IMC NATION

Gerry Oleman is a member of the St'at'imc Nation from British Columbia, which is located in the Coast Mountains between Whistler, the Fraser River, and the interior of BC. Gerry is an Elder, traditional knowledge keeper, mentor, storyteller, healer, and educator. He is a former Chief, Band Councillor, Tribal Director, and counsellor.

SESSION 3 - CLIMATE CHANGE ASSESSMENTS AND CASE STUDIES

10:15AM - 10:40AM PT

FOSTERING RESILIENCE: THE FEDERAL CONTAMINATED SITES ACTION PLAN'S EFFORTS TO ADDRESS CLIMATE CHANGE IMPACTS

The Government of Canada has made it a priority to identify and mitigate the potential impacts of climate change on the Federal Contaminated Sites in the country. Considering the risks of increased mobility of contaminants or recontamination of previously remediated sites, it is essential to consider climate adaptation measures and resiliency plans when managing contaminated sites. This will help to detect and reduce human and ecological consequences caused by climate hazards. The Federal Contaminated Sites Action Plan (FCSAP) is a government-wide program co-led by Environment and Climate Change Canada. The program has created guidance and is working on tools to ensure that all FCSAP-funded sites consider climate change in the 10-step Decision Making Framework and include climate change mitigation measures in the design of remediation and risk management strategies.
A team from the Federal Contaminated Sites Action Plan consisting of Environment and Climate Change Canada and Public Services and Procurement Canada members will present its latest progress at the 13th Science Advisory Board for Contaminated Sites in BC Workshop and Conference. This presentation will provide an overview of the program's efforts to date to ensure risk or recontamination due to climate impacts remains low. Lessons learned from FCSAP's National Coordination Offices of the Expert Support Departments will be shared with the event participants. This presentation will also showcase the resources available to Federal Custodians to evaluate if Federal Contaminated Sites are resilient to climate change.

SPEAKERS

JONATHAN PIERRE, CANADA FEDERAL CONTAMINATED SITES ACTION PLAN (FCSAP) SEC

Jonathan Pierre began working with the Federal Contaminated Sites Action Plan (FCSAP) in 2018 as a geographic information systems programmer. Currently, he works as a Physical Sciences Officer in the Science and Information Unit of the FCSAP Secretariat at Environment and Climate Change Canada. In his role, he primarily focuses on data analysis, information management and technology, scientific and technical guidance development, and integration of climate change considerations. He has produced several maps that visualize information from the Federal Contaminated Sites Inventory (FCSI) and has created tools for integrating complex data. In collaboration with the Canadian Center for Climate Services he helped developing the climate projection dataset for federal contaminated sites and worked on the climate change reporting strategy for FCSAP. As a Ph.D. candidate in Forest Sciences at Université Laval in Quebec City, Jonathan uses GIS to optimize ecosystem service values in forested lands. He completed his Bachelor of Arts (Honors) in Geomatics from Carleton University with a minor in Environmental Studies in 2019 and a joint professional Master's Degree in Applied Sciences in Sustainable Management of Forest Ecosystems from Université du Québec à Montréal in 2022. Additionally, he holds a certificate in wetland characterization from Université Laval.

MARTINE LALANDE, PUBLIC SERVICES AND PROCUREMENT CANADA

Martine Lalande, Environmental Specialist, has been with Public Services and Procurement Canada (PSPC) for over 10 years from Ottawa (ON). She is currently working with the Contaminated Sites National Centre of Expertise (NCOE) on PSPC Expert Support initiatives under the interdepartmental Federal Contaminated Sites Action Plan (FCSAP) program. Her educational background is in environmental studies from the University of Ottawa.

10:40AM - 11:05AM PT

CONDUCTING A CLIMATE CHANGE RESILIENCE ASSESSMENT IN SUPPORT OF REMEDY SELECTION

As climate change impacts become more severe around the globe, the environmental industry has increased focus on what implications this may have for remediation activities on contaminated sites. At a community in northern Canada, a climate change resilience assessment (CCRA) was conducted to identify potential risks for the proposed remedial options relative to a range of anticipated changes in climate events. The results were used to define potential adaptation measures and actions for four adjacent sites with hydrocarbon impacts. The findings of the CCRA will support the selection of remedial options that are resilient to projected effects of climate change.

The CCRA was completed using a commensurate approach to the Public Infrastructure Engineering Vulnerability Committee Protocol. It conforms to ISO 31000 Risk Management guidelines to identify and evaluate key climate risks that could affect the proposed remedial options under the current climate (past 30 years) and predicted climate change scenarios by 2050 and 2080. In total, nine climate events with quantified data for current and future climate scenarios were selected for the CCRA (e.g., summer mean temperature, days below -25˚C, high intensity and high-volume rainstorm). These climate events were selected based on their potential interaction, and potential to affect the safety, efficacy, and environment during the remedial options. Other climate related events, including flooding (open-water and ice-jams), landslide, were considered qualitatively due to a lack of available quantified (or quantifiable) data for the region that takes into consideration the 2050- and 2080-time horizons. Permafrost thaw was modelled quantitatively using site specific data for one of the four sites. It identified potential changes in permafrost conditions, potential risks based on the proposed remedial options, and provided important findings to support remedy selection.

Each of the climate events and time horizons was reviewed in relation to the proposed remedial options and their anticipated impacts. A resiliency rating (low, medium, or high) was assigned to each climate event, for each time horizon, for each remedial option. These ratings considered safety, efficacy, and the environment. Safety consequences considered risks to members of the public/community and staff (i.e., workers who implement the remedy). The efficacy consequence category considered the ability to successfully implement the remedy and the effectiveness of the remedy during the occurrence of the identified climate events. The environmental category captured ecosystem level consequences, such as impacts to air, water and land, and ecosystem function and service.

Of the six alternatives considered, one was determined to have high resiliency and five were determined to have moderate resiliency. These results will be incorporated into the final remedy selection. Additionally, whichever remedy is selected, the identified potential risks and proposed adaptation and mitigation measures for climate events and time horizons categorized as moderate to high risk, will be incorporated into the remedial design. This presentation will present a summary of the methodology used for this assessment, the findings of the assessment including potential risks and adaptation measures, and lessons learned.

SPEAKER

BETSY COLLINS, JACOBS

Betsy Collins is an Environmental Engineer with more than 10 years of experience at Jacobs. At Jacobs she is a Project Manager and a Sustainable Resilient Remediation Practice Leader. Betsy is a past president of the Sustainable Remediation Forum (SURF), a registered Professional Engineer in North Carolina, a LEED Green Associate, and an Envision Sustainability Professional.

EVALUATION OF CLIMATE CHANGE EFFECTS ON CONTAMINATION AT MULTIPLE DFO SITES ACROSS BC

According to the International Panel on Climate Change (IPCC), human activity is changing the Earth's climate in unprecedented ways, with some of the changes now inevitable and irreversible. Within the next two decades, temperatures are likely to rise by more than 1.5°C above pre-industrial levels. The effects of this increase are already being felt across the globe, with extreme weather conditions leading to some catastrophic events. In British Columbia (BC), we are currently experiencing one of the worst wildfire seasons on record, and there is a high risk of a province-wide drought in 2023. As contaminated sites practitioners and professionals, we must start considering the implications of climate change on contaminated sites.

For the 2022/2023 fiscal year, under the direction of the Secretariate, Fisheries and Oceans Canada (DFO), Regional Office of Environmental Coordination-Pacific Region, implemented a requirement to assess potential climate change related impacts on their site assessment/remediation projects. It is anticipated that such assessments will become increasingly commonplace and eventually a requirement for all contaminated sites in our industry. The evaluation presented herein focuses on the assessments recently completed by WSP for over 30 DFO sites in BC.

The approach used for WSP's assessment generally followed the steps outlined in the 2022 Federal Contaminated Sites Action Plan (FCSAP) guidance document: Integrating Climate Change Adaptation Considerations into Federal Contaminated Sites Management. The assessment included: compilation and review of climate data for a baseline case (i.e., historical climate variable data for the period 1981 to 2010) and worst-case emissions scenario (i.e., the long term high emissions scenario that represents an upper bound, or worst-case scenario of climate change trends); estimating the projected change between the baseline and the worst-case emissions scenario for an array of climate variables; and grouping climate variables into climate hazard groups as outlined in the FCSAP 2022 guidance. Following identification of the applicable climate hazard groups, and if contamination was identified, the potential impact of each climate hazard group on contamination was evaluated and a conceptual site model (CSM) developed. The CSM was developed for both the current condition and a future condition based on climate change projections.

Using the data collected from the various DFO sites, a high-level review of the overall dataset was conducted to identify patterns across geographical areas and DFO site types (e.g., small craft harbours, shorelights and lightstations, etc.). The most notable projected changes in climate variables observed were related to changes in precipitation, moisture and temperature-related indices (i.e., climate and soil moisture indices, frost days, freeze-thaw cycles etc.), relative sea level change, and fire season length. The potential impacts on contamination from these changes were considered and will be discussed. A case study will be used to demonstrate the process used and the overall implications of managing contamination through a climate change lens.

SPEAKERS

ADRIENNE DUCHARME, ENVIRONMENTAL SCIENTIST, BBA, MSC, BIT, WSP

Adrienne is an Environmental Scientist within WSP's Environmental Management team. She works on projects involving the assessment and remediation of contaminated sites with a focus on data collection, analysis, and interpretation for a variety of client sectors including mining, government (municipal, provincial, and federal) and infrastructure clients. Adrienne has co-authored several reports including Aquatics Effects Monitoring Programs (AEMP) Reports, Long-Term Monitoring Plans, Phase I, II, and III Environmental Site Assessments, and Preliminary Quantitative Risk Assessments and Problem Formulations. Over the past year and half, Adrienne has assisted with the management of WSP's portfolio of DFO sites that are undergoing site assessment, remediation, and risk assessment. As part of this work, Adrienne helped develop the approach for assessing climate change impacts on DFO sites.

JARI EIKENAAR, B.SC., P.AG., SENIOR ENVIRONMENTAL SCIENTIST, WSP

Jari is an environmental scientist and project manager with 12 years of experience specializing in contaminated sites investigation and remediation, ecological assessment, environmental monitoring, federal, provincial, and municipal permitting, and project management. His project experience includes leading Stage 1 and 2 Preliminary Site Investigations, Detailed Site Investigations, Risk Assessments, and applications to the Ministry of Environment and Climate Change Strategy for instruments under the Contaminated Sites Regulation. Jari currently manages a portfolio of contaminated sites assessment projects for DFO, which includes considerations of climate change impacts. Before starting in consulting, Jari trained and worked in Japan and England as a horticulturalist with a particular focus on bonsai tree and Japanese garden tree production and maintenance.

11:30AM - 11:55AM PT

HUMAN HEALTH & ECOLOGICAL RISK OF CONTAMINATED LANDS UNDER CLIMATE CHANGE: A CASE STUDY OF OIL FIELDS OF NORTHERN BRITISH COLUMBIA

Northern British Columbia (BC) comprises of vast area of oil fields. These oil fields are drilled for advancing wells for producing oil and gas at different sites. These sites are known as well sites. The drilling for producing oil and gas uses different types of chemicals. In addition, the drilling wastes thus generated are necessary to be properly managed. Some well sites may not have managed drilling wastes properly. Improper management of drilling waste my contaminate the soil and/or groundwater in and around the well sites resulting in contaminated land. The contaminated lands have human and ecological risks. However, these risks may further be altered by climate change. The contaminated sites are regulated by BC Contaminated Sites Regulation under BC Environmental Management Act.

The Contaminated Sites Regulation has not endorsed any legislation to deal with climate change in contaminated lands. This study investigated the impacts of climate change on human health risk and ecological risk of contaminated lands with a case study in the oil fields of northern BC. The human health risk and ecological risk of the selected contaminated sites in northern BC were estimated. The findings show that both human health risk and ecological risk are higher for several sites in northern BC. Furthermore, climate change may affect the contaminated sites such as such as increasing temperature and early thawing of frozen ground at higher rates in northern BC. These processes may increase the exposure to the contaminants of the lands in the near future, which will increase the human health risk and ecological risk of the contaminated lands. Such increased risks are necessary to be managed. Several measures are proposed to reduce human health risk and ecological risk of contaminated lands under climate change in northern BC, Canada, and beyond.

SPEAKER

GYAN CHHIPI SHRESTHA, DWB CONSULTING SERVICES LTD.

Dr. Gyan Chhipi Shrestha is an environmental engineer working as a Contaminated Site Assessment and Remediation Specialist at DWB Consulting Services Ltd. He has over 12 years of experience as an Environmental Engineer and Scientist in British Columbia, Quebec, and abroad. His expertise includes contaminated site assessment and remediation; human health and ecological risk assessment; environmental impact assessment; water quality assessment; and climate change. Also, he has extensive experience in sampling, laboratory analysis, and reporting of water, soil, soil vapor, and air quality; supervising environmental drilling; and hydrological and hydrotechnical analysis. He received PhD in Environmental Engineering from the University of British Columbia being the Applied Science Rising Star. He has co-authored over 20 technical reports, 60 peer-reviewed journal papers, and a book.

12:45PM - 1:10PM PT

DECARBONIZING THE GLOBAL ECONOMY - HOW CAN THE ENVIRONMENTAL REMEDIATION INDUSTRY CONTRIBUTE?

Background/Objectives. The remediation industry worldwide is a 100+ billion-dollar business, active in every sector of the economy. In the early 2000s, this industry began a paradigm shift towards an integration of sustainability principles. The basis of this shift was the idea that an industry whose purpose is to remove contaminants from our environment should also excel at minimizing collateral environmental and social impacts. Guidance and tools were developed to help practitioners implement this shift. But this change in practice was mostly self-driven, and often faced resistance from clients and regulators. The current global focus on sustainability and climate change promises to change this. Almost every large private company and public entity now has a decarbonation objective, and is seeking nature positive and corporate social responsibility (CSR) initiatives to demonstrate its commitment to addressing social and environmental impacts.

More specifically, in order to meet their 2030 or 2050 decarbonization targets, companies are looking at a myriad of ways they can reduce their environmental footprint: energy efficiency, shift to renewal energy, fleet decarbonization, sustainable procurement practices, waste reuse, etc. If a company is not able to identify and leverage sufficient reduction opportunities, they will need to purchase credits, the price of which is increasing every year.

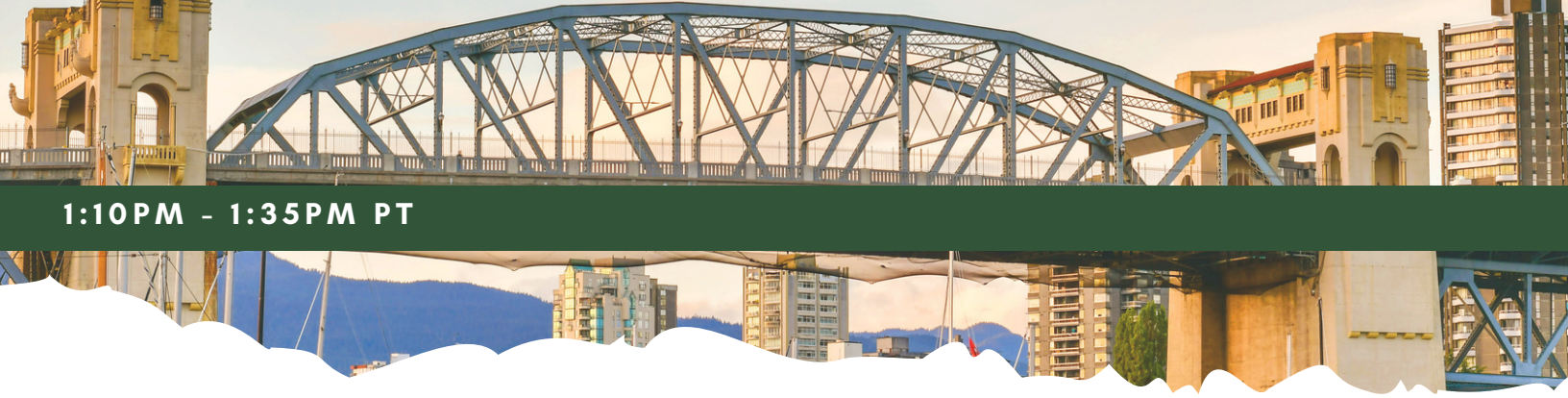
Approach/Activities. The first step in a decarbonization journey is to produce a robust baseline. In order to report on its GHG emissions, an emitter must quantity it's direct (scope 1 and 2), and indirect (scope 3) emissions using recognized standards such as the ISO14060 series and the GHG Protocole. Although only scopes 1 and 2 are typically regulated for large emitters, it is generally recognized that indirect emissions make up most of the carbon footprint. Scope 3 quantification is the more effort intensive of the three, and depends heavily on the quantity and quality of the available data. Once an accurate baseline is obtained, reduction opportunities can be identified and selected, usually based on criteria such as: cost-reduction ratio, co-benefits, associated risks and implementation schedule.

Remediation practitioners are well positioned to become key partners to support these decarbonation journeys, by leveraging their sustainable remediation expertise to bring desperately needed solutions to help meet these ambitious targets. Whether it is a mine reclamation, legacy industrial site closure, operation and maintenance of treatment systems, or excess soil management as part of construction work, remediation consultants and contractors have their role to play. Moreover, many of the tools and methods which were developed and implemented can be transferred to non-remediation activities. These include for example multi-criteria analysis as well as carbon footprint calculation tools.

This presentation will present the general methodology for GHG quantification and reduction, and the various ways by which remediation practitioners can support decarbonization efforts. The methodology, results and lessons learned from a case study of an ongoing decarbonization project for a Canadian federal entity will also be presented.

SPEAKER FRANCOIS BEAUDOIN, ING., PMP, GHD CONSULTANTS LTD.

François Beaudoin is a project director and business group leader in GHD's Montréal office. During his 21 year career, he has been involved in a wide range of projects across multiple geographies which have allowed him develop a solid expertise in the field of contaminant hydrogeology, site remediation, sustainability and climate change, air quality and waste management. He is one of the founding members of the Sustainable Remediation Forum of Canada.



1:10PM - 1:35PM PT

SIGNIFICANT RETURN ON INVESTMENT ACHIEVED BY SUCCESSFULLY REMEDIATING A CHALLENGING CHLORINATED SOLVENT SITE

Tetrachloroethylene (PCE) and related degradation products were identified in soil, groundwater and soil vapour at a shopping center in British Columbia at concentrations above the BC CSR standards both on-site and off-site beneath sensitive receptors including residential properties and a school.

Prior to remediation, PCE concentrations in groundwater greater than 10% of its solubility and therefore indicative of the potential presence of dense, non-aqueous phase liquid (DNAPL) resulting in the site being classified as “High Risk”. This made it unavailable for redevelopment and essentially unmarketable for sale by the site owners. A highly effective remedial approach was needed to realize the otherwise inherent value of the real estate asset.

A pilot-scale remediation program was completed in the worst-case area at the site in June 2019. Verification monitoring completed over the subsequent year showed that PCE concentrations in groundwater had dropped to the point that the “High Risk” designation of the site could be removed. This also enabled the owners to apply for upzoning of the site to set the stage for future redevelopment to a higher and better use.

In September 2021, after completion of the full-scale on- and off-site remediation program, a perimeter groundwater pumping and treatment system operating at the site was able to be shut down, eliminating the need for on-going operation, maintenance and monitoring activities.

There is now over an additional year of post-remediation quarterly groundwater sampling results available for the Site demonstrating that the groundwater plume has significantly decreased in size and is now considered stable. The consultant is in the process of completing a risk assessment and applying for risk-based Certificates of Compliance for the property.

Site conditions have improved to the point where it will now be possible to redevelop the site for mixed commercial and residential use. The site owners now have a marketable asset whose increase in property value is worth considerably more than the cost of the entire remediation program and are looking forward to what the site can become without the previous significant restrictions on land use.

This case study is an excellent example of how applying an effective remediation approach can turn a highly contaminated site into a fully productive property and result in a significant return on the remedial investment.

SPEAKER

BRUCE TUNNICLIFFE, M.A.SC., P.ENG, VERTEX

Mr. Tunnicliffe is President of Vertex Environmental Inc., is an Environmental Engineer, and has over 20 years of experience designing and implementing remediation programs for a wide variety of contaminants including chlorinated solvents, petroleum hydrocarbons and emerging contaminants such as PFAS/PFOA. Mr. Tunnicliffe holds a Master’s degree from the University of Waterloo where he studied chemical oxidation in fractured bedrock.

1:35PM - 2:00PM PT

IN-SITU AND EX-SITU REMEDIATION OF CVOC IMPACTS IN CONJUNCTION WITH SITE CONSTRUCTION ACTIVITIES

A commercial property had been assessed since 2010 due to chlorinated volatile organic compounds (cVOC) associated with a former dry-cleaning operation at the property. Recent Soil and groundwater tetrachloroethene (PCE) concentrations of up to 1,330 mg/kg and 223,000 µg/L, respectively, were identified to be present within the source area; beneath the former dry cleaner unit. PCE impact concentrations exceeding the referenced guidelines were identified to extend vertically up to a depth of approximately 9 metres below ground surface (BGS). A vapour intrusion mitigation system was installed at the site in 2017 and a risk management plan was also developed in 2020 for the site.
In April 2021, an overnight fire destroyed the shopping plaza building. Through this incident, there was an opportunity to remediate the subsurface cVOC impacts within the source area.

TRIUM Environmental was contracted by the client and consultant to develop a remedial approach involving In-Situ Chemical Reduction (ISCR) and source soil excavation combined with Ex-Situ Chemical Reduction (EXCR). ISCR was completed via direct injection of a chemical reducing reagent and an anaerobic bacteria consortium to treat soil and groundwater within the unexcavated areas from the surface depths and to treat groundwater below the source excavation area from the depth of the excavation floor. EXCR was done by incorporating an anaerobic bioremediation reagent into the soil at the base of the source excavation. A groundwater treatment/circulation system was also installed within the excavated area to allow for future bioremediation support and groundwater polishing. An impermeable liner was placed on the base of the excavation and the excavation was backfilled using fillcrete, as per geotechnical requirements.

This presentation will provide an overview of the remediation program that was designed and conducted at the site. A remedial contractor perspective when completing work in conjunction with construction activities will also be discussed. The preliminary results of the remediation project will be provided; however, this is an on-going remedial program.

SPEAKER

JEVINS WADDELL, P.TECH.(ENG.), TRIUM ENVIRONMENTAL INC.

Mr. Jevins Waddell, P.Tech.(Eng.), is a Principal with TRIUM Environmental Inc. Mr. Waddell has more than 20 years of contracting and consulting experience in the environmental industry, supported by an educational background in Hydrogeology. His expertise is wide-ranging and encompasses the design, management and execution of projects spanning alternative and conventional remediation, environmental site assessment, and risk analysis. With a proven track record of success, he has overseen and implemented projects not only across Canada but also in international locations such as South Korea, China, and Yemen. Mr. Waddell has also developed and supported innovative research and development projects resulting in several proprietary and patented technologies.

2:00PM - 2:25PM PT

NORTHERN ABANDONED MINE RECLAMATION PROGRAM

Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) is responsible for the management of a portfolio of contaminated sites in the Yukon, Northwest Territories, and Nunavut. Most of the northern contaminated sites managed by CIRNAC originate from private-sector mining exploration and development activities. The sites inherited from industry were largely legacy operations dating to the mid-twentieth century, when the long-term environmental effects of mining were poorly understood and the environmental regulatory system of the day did not require companies to provide full financial security to cover the costs of reclamation in the event that they became bankrupt and abandoned the property. The legacies left by these sites include toxic mine tailings, contaminant-leaching waste rock, hazardous waste, unstable and degrading infrastructure such as tailings dams, and physical dangers such as mine openings, which require continuous care to ensure regulatory compliance and the protection of human health and safety and the environment.

The closure of large abandoned mines requires extensive site assessment and remedial options development; detailed engineering design; comprehensive environmental and socio-economic assessment processes and regulatory authorizations; multi-year implementation; and post-remediation adaptive management and monitoring to ensure infrastructure such as tailings covers and water treatment systems are functioning properly.

CIRNAC funds the clean-up of its contaminated site projects through two sources, the Federal Contaminated Sites Action Plan and the Northern Abandoned Mines Reclamation Program (NAMRP). NAMRP, established in 2019, was created to advance the remediation of the eight largest and highest-risk mines in the Department's portfolio, with the objectives of reducing risks to human health and the environment; reducing federal liabilities; and maximizing socio-economic benefits to Indigenous people and Northerners, while allowing CIRNAC to manage these projects under an approach adapted to the unique complexities of the sites.

The eight projects under NAMRP are Faro, United Keno Hill, Mount Nansen, Ketza River, and Clinton Creek mines in the Yukon; and in the Northwest Territories, Giant, Cantung, and Great Bear Lake group of mines. The largest among them - the Faro and Giant Mines - are two of the most costly and complex contaminated site projects in the country, and even after remediation is complete will require care and monitoring in perpetuity. Faro Mine, located in Faro, Yukon was once the largest open-pit lead-zinc mine in the world, with risks posed by acid-generating waste rock, tailings and contaminated water. Giant mine, located in Yellowknife, North West territories contains contaminants of highly toxic arsenic trioxide and requires remove of mine buildings and remediation of surface areas including tailing ponds.

Through our presentation, learn about NAMRP and its eight projects, and how the government of Canada manages and remediates the largest contaminated sites in the North.

SPEAKER

ALEX MURRAY,
CROWN-INDIGENOUS RELATIONS AND NORTHERN AFFAIRS CANADA

Alex has a background in Environmental Studies and Earth Sciences. He's currently the Program Manager of Crown Indigenous Relations and Northern Affairs Canada's Northern Contaminated Sites Program (NCSP) headquartered in the National Capital Region. The primary purpose of this role is to manage CIRNAC's portfolio of contaminated projects in a coordinated manner to obtain benefits not available from managing them individually. Alex has been in the federal government for 14 years, with 11 years spent in contaminated site remediation. Most of this time has been within NCSP's Program Management Office, while also working a year on the Faro Mine Remediation Project. He also recently spent 3 years as a Senior Policy Advisor at Public Services and Procurement Canada's Laboratories Canada, a program established to deliver on Canada's vision to strengthen federal science by creating world class, innovative and collaborative science research centres across the nation. A career highlight of his is establishing the Northern Abandoned Mine Reclamation Program which has received $9.1 billion in federal funding to address some of Canada's most complex and costly contaminated sites. Alex is passionate about northern Canada, improving Canada's environment and working to advance reconciliation, so federal contaminated site remediation is a perfect fit for him.

SESSION 5 - EMERGING SCIENCE & TECHNOLOGY

2:40PM - 3:05PM PT

THE UPS AND DOWNS OF PASSIVE VAPOUR INTRUSION MITIGATION SYSTEM DIAGNOSTICS

Vapour intrusion mitigation systems (VIMS) are a common element addressing vapour intrusion (VI) concerns on contaminated sites. VIMS are especially relevant during redevelopment of historically contaminated sites to mitigate risk. VIMS come in two forms, active and passive. Active systems use fans or blowers to mechanically draw vapours from below a building and discharge to the ambient air. Passive systems rely on natural mechanisms such as chemical diffusion and thermal or wind induced pressure gradients, often coupled with a physical barrier such as a subslab membrane (ITRC, 2020).

Active VIMS are easier to assess system effectiveness through common diagnostics such as monitoring cross-slab vacuum, system applied vacuum and system flow rate. Passive systems often do not have these same parameters in the range that can be easily measured. Instead, passive VIMS effectiveness is commonly evaluated through subslab sampling and indoor air testing, however such data may not be representative of long-term conditions.

Following the construction of a new building, the soils and vapour pathways in the vadose zone have been altered, through excavation, footer construction and new backfill material placed below the building. Prior to the collection of subslab samples to evaluate system effectiveness, sufficient time should be allowed for migration of potential vapours to the subslab area. But how long does that take, and does it align with the developer's timeline to move occupants into the building? Indoor air sampling poses similar issues and also has the confounding factor of background sources from new construction materials, ongoing construction work or occupants in the building. Neither method measures the flow of vapours from the system, which is the intent of the VIMS.

This presentation will outline several diagnostic tools that can be used once the passive VIMS has been installed and the slab is poured. The connectivity of the VIMS should be evaluated to show that the network of piping and venting layer is well connected and enables the flow of vapours from the subsurface to the atmosphere. Tracer testing is a valuable tool which can be conducted at each riser pipe of the VIMS and will assess the direction and magnitude of flow, where other instruments are unable to measure a low flow rate associated with a passive VIMS. Finally, pressure monitoring in the vent pipe and at subslab probes can provide another line of evidence to indicate direction and magnitude of flow

SPEAKER

DARIUS MALI, M.A.SC, P.ENG (ON, BC) GEOSYNTEC

Darius has a bachelor's degree in Environmental Engineering and a Masters of Applied Science Degree in Atmospheric Pollutants and is a licensed as a Professional Engineer in British Columbia and Ontario. He has been a member of the vapour intrusion services team and phytoremediation group at Geosyntec for the past 10 years. He has worked as a vapour intrusion specialist, exceling in assessing sites using high-volume sampling and building pressure control. His current role is project manager and vapour intrusion mitigation system designer. He is also an active researcher advancing our understanding of contaminated sites, currently researching potential links between PFAS and vapour intrusion.

PFAS (PER- AND POLYFLUOROALKYL SUBSTANCES) - ENSURING THE BEST DATA FOR CANADA'S FOREVER CHEMICALS

Over the past ten years perfluorooctane sulfonic acid (PFOS), perfluorooctanoic acid (PFOA) and related per- and polyfluorinated alkyl substances (PFAS) have received global attention due to their persistence, bioaccumulation, and potential adverse health effects.

- Canada is catching up on the regulation of PFAS Substances, and there has been significant media attention and government consultation on these “forever compounds”.
- Given the rapid emergence of PFAS in the Canadian landscape, environmental practitioners have many questions.
- Do existing provincial regulatory frameworks include PFAS?
- What methods are required for PFAS compliance?
- Do analytical approaches differ for PFAS in drinking water?
- What about the (thousands of) PFAS that are not considered by current analytical approaches?
- Are there special sampling considerations for PFAS?
- What can we learn about PFAS from our neighbors south of the border?
- How are environmental programs “future proofed” to anticipate the sectors and matrices to which PFAS regulations may be applied next?
- Determining the appropriate analytical approach can be a challenge.

From an analytical standpoint, liquid chromatography coupled with tandem mass spectrometry (LC/MS/MS) has been the primary technique for PFAS analysis. This “targeted” analytical technique reports a fixed list of parameters and is included in EPA methods 537.1, 533 and Draft Method 1633. Alternative methods such as the Total Oxidizable Precursors (TOPs) assay and Total Organic Fluorine (TOF) analysis identify non-target PFAS present in a contaminated sample.

This presentation will include a survey of the current provincial and federal regulatory landscapes for PFAS. We will review the many PFAS analysis options currently available in the Canadian marketplace, along with the advantages and applications of each. We will discuss best practices for the collection and submission of samples. We will present opportunities to collaborate with analytical laboratories, consultants, and regulatory agencies to shape Canada’s future PFAS landscape.

It is critical that environmental practitioners evaluate the advantages and limitations of analytical approaches based on specific project objectives, sample matrices, target compounds, and laboratory capabilities. With the best analytical data for PFAS, stakeholders can make the best decisions to protect the environment and human health.

SPEAKER

ANDREW WHITE, BUREAU VERITAS

With 20 years’ experience in the Environmental Laboratory space, Andrew has supported customers on a variety of environmental projects. Always passionate about the success of customer projects and the team he is working with, Andrew has held a number of roles within his tenure with Bureau Veritas.
Starting out in client support, Andrew quickly moved into leadership roles and led the development of a number digital solutions that enhanced the customer experience. His relationship building and dedication to customer satisfaction was a natural fit for the Business Development team, where he has spent a number of years supporting customers from across Canada.

More recently focused specifically in Environmental DNA (eDNA) and PFAS markets, Andrew’s technical knowledge of laboratory operations, regulatory requirements and customer relationships has allowed him to become an often-relied upon and trusted resource for many of Bureau Veritas’ customers.

When not supporting environmental projects, he can usually be found either at a hockey arena for his children's teams or on stage somewhere with his band entertaining partygoers.

3:30PM - 3:55PM PT

QUANTITATIVE LABORATORY ANALYSIS OF INORGANIC, ORGANIC AND VOLATILE SPECIES OF SELENIUM

Environmental contamination of selenium is a growing global concern, since it is highly toxic to fish and marine wildlife such as aquatic birds, especially in its inorganic oxyanion forms of selenite (SeO_3^{2-}) and selenate (SeO_4^{2-}), which also have high bioaccumulation potential. Selenium is found at high levels in organic-rich marine sedimentary rocks including oil shales, coal, phosphate deposits, and in sulfide minerals. Limiting anthropogenic environmental selenium contamination has recently become a major focus for the mining and power sectors, particularly for coal fired power plants, coal mines, phosphate mines, base metals mines, and for the oil & gas industry, because stricter environmental regulations for selenium are coming into force in Canada and the USA.

In order to predict the behaviour and impact of selenium in the environment, including how bioaccumulation to toxic levels can occur, the concentrations of discrete selenium species should be measured and understood. For quantitative measurement of most non-volatile discrete selenium species to sub part per billion levels, Liquid Chromatography coupled with collision cell Inductively Coupled Plasma Mass Spectrometry (LC-ICPMS) is most commonly used. Some complex sample matrices (especially when produced by anaerobic bioreactors) may contain volatile reduced organoselenium species that can complicate routine testing for total and dissolved selenium by ICPMS, potentially causing bias such that dissolved Se test results exceed total Se results. ALS Canada has developed techniques to mitigate this bias, to facilitate generation of accurate test results for total and dissolved selenium in samples where volatile selenium species may be impacting laboratory data quality. In addition, ALS can directly analyze and quantify volatile Se species in waters down to part-per-trillion levels using Gas Chromatography with Inductively Coupled Mass Spectrometry (GC-ICPMS), to help fully characterize and explain this phenomenon.

SPEAKER

LOUIS WAGNER, ALS ENVIRONMENTAL

Louis Wagner received his B.Sc. in Biology and Chemistry from Simon Fraser University in 2003, and has worked at ALS Environmental in many different roles since that time. From 2008 until the present time, Louis took on his current role of ALS Canada National Technical Inorganics Specialist. In this role, he has led and conducted numerous analytical method development projects in the field of inorganic chemistry, including anions by IC, metals by ICPMS, automated colourimetric flow systems, and arsenic and selenium speciation by HPLC/ICPMS. Mr. Wagner is a key member of the ALS Canada National Technical Group which develops, implements, and promotes innovative best-practice techniques and national methods that are used by ten ALS laboratory locations across Canada. Mr. Wagner is widely regarded as one of the top inorganic analytical chemistry experts within the ALS Global Lab Network.

3:55PM - 4:20PM PT

ADDRESSING THE NEED FOR DATA GOVERNANCE AND DIGITAL TRANSFORMATION IN OUR INDUSTRY AS A VALUABLE TOOL IN SITE ASSESSMENT & REMEDIATION

What does "good" data governance mean?

"Good data management enables the organizational capability to ensure quality and consistent data exist, to support business objectives."

In the field of environmental management, accurate and reliable data is essential for making informed decisions. However, collecting, managing, and analyzing data can be a complex process. Inconsistencies in data can cause errors and misinterpretation, leading to incorrect conclusions. Thus, meeting accelerated schedules set by clients or regulators often depends on a sound data governance strategy made possible by integrated electronic workflows from the field to the lab.

Environmental data management systems offer full project lifecycle services for complex site remediation and monitoring programs. Everything from the initial lab quote to compiling historical data sets can be done electronically under one system to save time and resources while maintaining data accuracy.
This discussion will address data governance and integrity with cyber-security measures for compliance and sustainability objectives. We will explore the latest industry innovations and why migrating away from spreadsheets and physical paperwork is now essential to achieving sound data governance. Additional topics to be covered include the efficient processes for having visibility on quality data sets, among others. These valuable insights, along with the adaptation of a well-integrated automated database, allow environmental professionals to streamline project management tasks, have confidence in quality measures, and conduct meaningful data investigations.

For those already using data management programs, this presentation showcases industry-leading features offered by an EDMS to keep up with field data innovations and regulatory compliance monitoring. Industry-specific examples highlight the positive impacts of well-organized data systems in managing high-volume sampling events and implementing best business practices for environmental solutions. Whether using internal systems, spreadsheets, or other data management tools, environmental professionals can utilize this presentation to implement effective data management practices.

SPEAKER NICK TUMNEY, BSC, MSIS
EARTHSCIENCE INFORMATION SYSTEMS, CANADA

Nick is the Senior Implementation Manager at EScIS Canada. He oversees the implementation and client management of the ESdat Environmental Data Management System. This includes client onboarding, the development and provision of training, and other support services.

With over 15 years in the Environmental Consulting Industry, his experience includes project management, environmental sampling & fieldwork, data management and GIS tasks for various clients across the contaminated land sector. Nick has a Bachelor of Science specializing in Earthscience, and a Master of Spatial Information Science, both from the University of Melbourne, Australia.

EScIS Canada, headquartered in Vancouver, provides environmental data management software, training, and other support services to the industry, and is part of a global company providing these services all over the world.

THANK YOU FOR JOINING US FOR THE 13TH ANNUAL SABCS CONFERENCE!