2024

SCIENCE ADVISORY BOARD FOR CONTAMINATED SITES IN BC

14TH ANNUAL

SCIENCE ADVISORY BOARD FOR CONTAMINATED SITES WORKSHOP & CONFERENCE (HYBRID)

IN PERSON AT THE SFU DOWNTOWN CAMPUS, VANCOUVER, BC

DAY 1: WORKSHOP:
NEW ADVANCES FOR RISK ASSESSMENT AND SITE RESTORATION

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

SEPTEMBER 25 & 26, 2024
8:25AM – 4:30PM DAILY

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SCIENCE ADVISORY BOARD FOR CONTAMINATED SITES IN BC

NEW ADVANCES FOR RISK ASSESSMENT AND SITE RESTORATION

WORKSHOP

DAY 1: SEPTEMBER 25, 2024

8:25AM - 4:30PM

IN PERSON AT THE SFU DOWNTOWN CAMPUS
515 WEST HASTINGS STREET; VANCOUVER, BC

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

SCIENCE ADVISORY BOARD FOR CONTAMINATED SITES IN BC

WORKSHOP AGENDA

8:25AM **Introduction to Workshop** - *Ian Hers, PhD – Hers Environmental Consulting Inc.*

8:30AM **Land Acknowledgement Ceremony**

NEW ADVANCES FOR RISK ASSESSMENT AND SITE RESTORATION

8:40AM **Pollution in our Coastal Environment: How can we best identify and address contaminants of concern?** - *Dr. Peter S. Ross, PhD – Raincoast Conservation Foundation*

9:20AM **Setting a New Standard: Merging Western and Indigenous Science to Apply the Burrard Inlet Water Quality Objectives to Contaminated Sites – an Interactive Session** - *Anuradha Rao, M.Sc., R.P.Bio., Cert.RNS – Tsleil-Waututh Nation*

10:00AM **BREAK**

10:15AM **The Healthy Waters Plan** - *Jamie Huang, P.Eng, MAS, Dave Young, M.Env.Sc., P.Ag. – City of Vancouver*

10:45AM **A Novel Approach to Developing Water Quality Guidelines for Polycyclic Aromatic Hydrocarbons (PAHs)** - *Allison Dunn – Environment and Climate Change Canada*

11:15AM **Development of a Light Absorption Model for Phototoxic PAHs** - *Parisa Jourabchi, Ph.D., P.Eng. – ARIS Environmental Ltd.*

11:45AM **LUNCH**

SPECIAL INNOVATION SESSION - ARTIFICIAL INTELLIGENCE

12:30PM **Evaluating Application of AI in Environmental Remediation Industry** - *Andrew Kirkman, PE – bp Remediation Management, Chicago, IL*

12:55PM **AI vs. Environmental Experts: Are Humans Becoming Obsolete in Remediation Design** - *Eric Cowan, B.A.S., C.Tech. – VEI Contracting Inc.*

1:20PM **Putting the FLOW in workflow: Using Hydrocarbon Plume Prediction AI to Quantify Groundwater Risk and Liability** - *Nicholas Higgs, Environmental Material Science, Inc. Saskatoon, SK, Canada & Steven Mamet, PhD –Director of Science and Product Environmental Material Science Inc. (EMS)*

1:45PM **Q&A**

NEW ADVANCES FOR RISK ASSESSMENT AND SITE RESTORATION

1:55PM **Using Successional Patterns to Track Remediation/Restoration, Relative to Ecological Benchmarks, as an Approach to Address Wide-Area Contaminated Sites in Wildlands** - *Deb MacKillop, BC Public Service*

2:25PM **PFAS Risk Assessment and Risk Management: Is the Risk Paradigm Failing Us?** - *Usha Vedagiri, PhD. – WSP*

2:55PM **BREAK**

3:10PM **Incorporating In Vitro Bioaccessibility for Arsenic and Lead in Soil in Human Health Risk Assessment** - *Matt Dodd, PhD – School of Environment and Sustainability, Royal Roads University*

3:40PM **An Overview of 6PPD-Quinone: Where we Started, Where we are Now, and Where we are Headed** - *Caitlin Lawrence, Washington State University*

4:10PM **WORKSHOP WRAP-UP**

SEPTEMBER 25, 2024 **8:25AM - 4:30PM PT DAILY**

NEW ADVANCES FOR RISK ASSESSMENT AND SITE RESTORATION

8:25AM - 8:30AM PT

WELCOME & INTRODUCTION TO WORKSHOP

SPEAKER Ian Hers, PhD - Hers Environmental Consulting, Inc.

8:30AM - 8:40AM PT

LAND ACKNOWLEDGEMENT CEREMONY

NEW ADVANCES FOR RISK ASSESSMENT & SITE RESTORATION

8:40AM - 9:20AM PT

POLLUTION IN OUR COASTAL ENVIRONMENT: HOW CAN WE BEST IDENTIFY AND ADDRESS CONTAMINANTS OF CONCERN?

British Columbia faces profound questions about the state of its aquatic environment. Its coastal waters are home to the most PCB-contaminated marine mammals in the world; microplastics have been discovered throughout the marine environment and in zooplankton and shellfish; and the tired-related chemical 6PPD-Quinone is killing coho salmon in urban streams. Why have these pollutants seemingly escaped regulatory scrutiny? Where are they coming from? How can we better protect salmon, whales and people from the adverse consequences of industrial and consumer pollution? With an estimated 500,000 chemicals on the market, this is a daunting challenge for scientists, regulators and resource managers. Considering that 80% of ocean pollutants originate from the land, the generation of data that helps us track contaminants back to their source will underpin solution initiatives. Raincoast is now launching a new community-oriented water pollution program - Healthy Waters - that will track priority pollutants from land to sea. This will help bridge regulatory and jurisdictional boundaries, and enable a more ecosystemic approach to documenting and tackling pollutants of past, current and emerging concern.

SPEAKER

Dr. Peter S. Ross, PhD - Raincoast Conservation Foundation

Dr. Peter S. Ross is an internationally recognized ocean pollution expert, having published over 160 scientific articles and book chapters on pollutants of concern in water, air, sediments, fish and marine mammals. He is Senior Scientist at Raincoast Conservation Foundation, where he oversees its new *Healthy Waters* program - a community-oriented water pollution monitoring program. In his previous role as a Research Scientist at DFO, he discovered the region's killer whales to be the most contaminated marine mammals in the world in a groundbreaking 2000 study. While at Ocean Wise, he and his team launched *PollutionTracker (http://pollutiontracker.org)* the first comprehensive monitoring program for pollutants of concern in coastal British Columbia; and the *Plastics Lab*, a dedicated high-resolution facility that documented microplastic pollution in the Pacific and Arctic oceans. Dr. Ross is an Adjunct Professor at the University of Victoria School for Environmental Studies. Dr. Ross's work has been profiled in international media, including CBC's the Fifth Estate, the National, Radio Canada, NBC Nightly News, the Washington Post, New York Times and the Guardian.

9:20AM - 10:00AM PT

SETTING A NEW STANDARD: MERGING WESTERN AND INDIGENOUS SCIENCE TO APPLY THE BURRARD INLET WATER QUALITY OBJECTIVES TO CONTAMINATED SITES – AN INTERACTIVE SESSION

səlilwət (Burrard Inlet) is at the core of Tsleil-Waututh Nation (TWN) unceded traditional territory, within the metropolitan Vancouver region. Tsleil-Waututh have used, occupied, and governed səlilwət according to Coast Salish protocol since time immemorial. Adverse effects of colonial settlement, urban, industrial, and port development, including pollution, and resource exploitation have eroded the ecological health, integrity, and diversity of səlilwət and are preventing Tsleil-Waututh from practicing their ways of life. Examples are a ban on shellfish harvesting since 1972 due to contamination, losses of key species such as herring due to overexploitation, and closures of waterfront areas. Collectively, these reduce or eliminate access and availability of important sites and foods, among other impacts. Tsleil-Waututh Nation has a goal to restore the health of the Inlet so the community can once again utilize the waters and beaches of səlilwət for traditional food harvesting and other cultural practices.

TWN's Burrard Inlet Action Plan, published in 2017, is a founding guidance document for a new science-based, First Nations-led initiative to improve the health of səlilwət. Of the six proposed actions in the Action Plan, updating the Burrard Inlet Water Quality Objectives (WQOs) is the first priority, and is being completed. The updated Burrard Inlet WQOs are co-signed by the Province of BC and Tsleil-Waututh Nation, representing a first of its kind Government-to-Government initiative that weaves together Indigenous and western science.

WQOs are numbers or statements that represent safe levels of substances in waterbodies. They inform resource management decisions and promote the stewardship of water resources in BC.

TWN is the first to undertake data analysis and visualization at a basin-wide scale, including maps of point- and non-point sources, and contaminant heat maps using data from 1971 to 2016. Some 700 contaminants have been detected in Burrard Inlet. Contaminants enter the Inlet from hundreds of point and non-point sources, and potentially also from the approximately 4600 federally-, provincially- and port-managed contaminated sites in its catchment area.

We are now entering the implementation phase of the work. Because the Inlet is affected by a wide range of contributors, the work to implement and attain the WQOs also requires a wide range of contributors.

This session will include a presentation summarizing the work and analyses undertaken by TWN and the Province of BC, with the guidance of a multi-sector Roundtable. The session will also include a hybrid interactive portion where we will work together to identify opportunities to better understand and manage contaminated sites and other pollution sources with an aim towards attaining the Burrard Inlet WQOs.

SPEAKER Anuradha Rao, M.Sc, R.P.Bio., Cert.RNS - Tsleil-Waututh Nation

Anuradha Rao, M.Sc., R.P.Bio., Cert.RNS, is the Senior Environmental Specialist - Marine Ecosystems on staff with Tsleil-Waututh Nation. Her work currently focuses on marine policy development and implementation, and coastal/marine ecosystem research and restoration. She is a Registered Professional Biologist, writer and facilitator. She has worked on research, conservation, mapping, planning, policy, restoration and stewardship projects across Canada and in 12 other countries. She is the author of the book One Earth: People of Color Protecting Our Planet (Orca Books, 2020) and has authored or co-authored more than 60 other technical and popular works. Anu finds her happy place when she walks off a beach and snorkels among the creatures of the sea.

10:00AM - 10:15AM PT

BREAK

10:15AM - 10:45AM PT

THE HEALTHY WATERS PLAN

Based on the principles of "One Water," the City of Vancouver began the development of a comprehensive long-range plan for sewage and rainwater management in 2020. This initiative, now referred to as the "Healthy Waters Plan", is an integrated planning effort to address pollution from sewer overflows and urban runoff, adapt to the impacts of aging infrastructure, population growth and climate change, including extreme weather events, sea level rise and urban heat and drought. Guiding principles for this work include reconciliation, considering the City of Vancouver's UNDRIP Strategy, as well as equity, collaboration, stewardship, and resilience.

The plan will define the strategic roadmap for billions of dollars of infrastructure investments, as well as operating programs, policies, and regulations required to protect people and the environment. It will also define the optimal approach for integrating traditional grey infrastructure with green infrastructure and nature-based solutions. Affordability is a critical challenge, largely driven by aging infrastructure, regional sewage treatment costs and the need to adapt to an uncertain climate future. Development of this plan involves significant investments in new analytical tools, as well as silo-cutting collaboration across regional government, First Nations, senior government, and community groups.

This presentation will cover the collaborative process for plan development and two key innovative tools developed for the plan: the City's Mass Balance Model and the Human Health and Ecological Comparative Risk Evaluation Framework that support decision-making and prioritization of infrastructure implementation. These tools allow for the conceptualization of the impacts of management decisions on the water quality in Burrard Inlet and the Fraser River.

SPEAKERS

Jamie Huang, P.Eng, MAS - Technical Lead Healthy Waters Plan City of Vancouver

Jamie is the Technical Lead for the Healthy Waters Plan at the City of Vancouver. He has over 10 years of experience in the water resources sector and worked on drainage projects across Canada (Nova Scotia, Quebec, Ontario, Manitoba, British Columbia) ranging from single lot redevelopment applications to extreme rainfall analysis on metropolitan regions. Jamie is experienced in conceptual design, detailed design, and contract administration of various green and grey infrastructure solutions for addressing multiple objectives (erosion and sediment control, water quality treatment, flood management, ecosystem preservation). He holds a Bachelor's degree in Civil Engineering from the University of Waterloo and a Master of Advanced Studies in Sustainable Water Resources from ETH Zurich.

Dave Young, M.Env.Sc., P.Ag. - Senior Lead Environmental Programs and Projects, City of Vancouver

Dave is leading the development of the Human Health and Ecological Comparative Risk Evaluation Framework (CREF) tool for the City of Vancouver's Healthy Waters Plan. The CREF tool models the City's stormwater and sanitary sewage discharges in Burrard Inlet and the Fraser River and assesses the relative human health and ecological risks to help prioritize future investments. Dave has a contaminated sites management background and leads a variety of water quality projects, source control programs, and initiatives with senior levels of government and First Nations.

10:45AM - 11:15AM PT

A NOVEL APPROACH TO DEVELOPING WATER QUALITY GUIDELINES FOR POLYCYCLIC AROMATIC HYDROCARBONS (PAHS)

Polycyclic aromatic hydrocarbons (PAHs) are a complex group of organic substances that are ubiquitous in the environment, including in surface waters, with thousands of individual non-substituted (parent) and alkylated PAHs possible. Due to their sources, PAHs do not occur as individual substances but rather as a mixture of PAHs in the environment. In addition, many PAHs demonstrate increased toxicity in the presence of ultraviolet light, a process called phototoxicity. Current Canadian Council of Ministers of the Environment (CCME) water quality guidelines are outdated, limited to eleven non-substituted PAHs, do not provide a means to consider the overall toxicity of PAHs as a mixture and have limited consideration of their phototoxicity. Therefore, CCME has initiated a project to update or derive new water quality guidelines for PAHs for a large number of parent and alkylated PAHs which will include consideration of phototoxicity and a means to derive guidelines for a mixture of PAHs. A novel approach using two models, the narcotic target lipid model (NTLM) and the phototoxic target lipid model (PTLM), will be trialed as a method to address current challenges to PAH guideline development, including overcoming data limitations and consideration of phototoxicity. This presentation describes the proposed approach for deriving water quality guidelines for both low and high ultraviolet light conditions as well as how to apply them to mixtures.

SPEAKER Allison Dunn - Environment and Climate Change Canada

Allison Dunn is an environmental toxicologist with 25 years of experience working in the chemical hazard and risk assessment fields, primarily within Canada's federal public service. Since joining the public service in 2001, her work has varied from evaluating the toxicity of pesticides as an evaluator for Health Canada's Pest Management Regulatory Agency, serving as a program officer for Environment and Climate Change Canada's (ECCC) National Pollutant Release Inventory, conducting research and monitoring of pesticides used in agricultural and urban settings in Atlantic Canada, conducting environmental assessments and water license reviews in Canada's North, coordinating the review of Nunavut-based research proposals under the Northern Contaminants Program and delivering the long-term monitoring program for remediated sites in Nunavut. Currently, Allison is a senior environmental quality guidelines specialist with ECCC where she leads the Canadian Council of Ministers of the Environment (CCME) PAH project team.

Additional Authors: Janet Cermak, National Guidelines and Standards Office, Environment and Climate Change Canada

11:15AM - 11:45AM PT

DEVELOPMENT OF A LIGHT ABSORPTION MODEL FOR PHOTOTOXIC PAHS

The derivation of water quality guidelines for phototoxic substances requires a unique understanding of site-specific conditions, in addition to the chemical-specific properties typically used in the derivation of threshold values for the protection of aquatic life. More specifically, phototoxicity arises from exposure to solar radiation, particularly ultraviolet radiation in the aquatic environment. A subset of PAHs known to exhibit phototoxicity (i.e., enhanced toxicity with light exposure) have lower values of median lethal concentrations (LC50s) as compared with their narcotic LC50s (i.e., in the absence of light exposure). Therefore, recent models that relate the narcotic LC50 (NLC50) to phototoxic LC50 (PLC50) rely on an estimate of in-situ light absorption as a function of the specific chemical and site- specific light exposure. This presentation will walk through the development of a model for practical estimates of light absorption values based on site location and routinely measured water quality parameters. This is because the water quality parameters, such as dissolved organic carbon, turbidity or chlorophyll concentrations, impact the optical properties of the water and thereby the attenuation of light through the water column. The model thus provides a practical alternative to direct measurement of underwater irradiance and supports the development of water quality guidelines. The model was developed under contract with the BC Ministry of Water, Land and Resource Stewardship (BC WLRS) and the Canadian Council of the Ministers of the Environment (CCME) and has been guided by feedback from both.

SPEAKER Parisa Jourabchi, Ph.D., P.Eng. - ARIS Environmental Ltd.

Parisa is an environmental engineer and leader on bringing multidisciplinary and collaborative approaches to site investigation and remediation projects. She has developed models in rock physics, early diagenesis in aquatic sediments, contaminants in groundwater and soil gas, and vapour intrusion into buildings, and more recently on light attenuation for the derivation of WQGs for phototoxic PAHs. She specializes in applying science and digital tools for practical solutions to risk management at contaminated sites. Parisa spearheaded the development and publication of the ASTM Standard Guide for Estimating Natural Attenuation Rates for NAPL in the Subsurface. At ARIS, she supports the consulting, industry and regulatory professionals who bring innovation into sustainable remediation.

11:45AM - 12:30PM PT

LUNCH

SPECIAL INNOVATION SESSION - ARTIFICIAL INTELLIGENCE

12:30PM - 12:55PM PT

EVALUATING APPLICATION OF AI IN ENVIRONMENTAL REMEDIATION INDUSTRY

Background/Objectives: This discussion is intended for project managers, project scientists or engineers who may be interested in leveraging Artificial Intelligence (AI) (including Machine Learning, Deep Learning and Generative AI) but may not have direct experience with AI implementation. Artificial intelligence and machine learning projects often promise to automate tasks and find new insights. However, depending on the solution, there can remain some doubt about how robustly these AI solutions can deliver on these promises. Concerns about the cost, efficiency and near-term achievability of these promises persist, particularly regarding the time and costs associated with data preparation and cleaning. This in turn raises questions about which AI applications can add sufficient value to Environmental Remediation efforts. The bp Remediation Management team has been evaluating the benefits and risks associated with AI solutions to support environmental remediation, to better prepare for future project proposals claiming to leverage AI technologies.

Approach/Activities: bp has employed AI models recently to predict natural streamflow, to enhance daily desktop work such as revising text, and to extract information from maintenance data which supports improved risk ranking of operational equipment. Through sharing experiences and knowledge, a few key themes have emerged. To support decision-making and refine specific applications, it is crucial to ask:

1. If the AI approach failed did we ask too much of it? Going back to a common theme that AI aides the human rather than replaces is not only ethical but also technical. Problems are often solved with multiple steps, is the AI solving too many steps?
2. Is the AI model pre-calibrated, or does it require calibration using our dataset?
3. Do we possess, or can we acquire the appropriate data without incurring excessive cost or the risk of violating others intellectual property?

Addressing these questions can clarify the effort involved and the likelihood of success for a given project. The value derived from a project depends on its use case. This presentation will offer case studies related to these questions.

By focusing on these considerations, bp aims to harness AI's potential more effectively within Environmental Remediation projects, ensuring that technological advancements translate into tangible benefits and a safe and ethical adoption of the tools.

SPEAKER

Andrew Kirkman, PE - bp Remediation Management Chicago, IL

Andrew Kirkman is a hydrocarbon and hydrogeology subject matter expert for BP. His experience includes LNAPL at hydrocarbon sites and DNAPL related to coal tar and creosote. Andrew's career started doing field work including groundwater sampling, well installation, and hydrocarbon field investigations at railroad, pipeline, manufactured gas plant, and tie treatment plant sites. Continual technical development resulted in Andrew leading the AECOM's LNAPL technical practice, leading the development of the ASTM LNAPL Transmissivity standard prior to joining BP. Andrew has publications in peer reviewed journals and technical guidance documents including a one on NAPL drawdown in fractured settings published in Groundwater Monitoring and Remediation in 2020. Andrew has provided review for journal articles and doctoral dissertations.

Andrew's skills include field testing to python coding, database, general modelling expertise and training. Andrew has provided workshops, conference presentations and webinar trainings related to hydrocarbon remediation for the Association for Environmental Health and Safety Foundation conferences, ASTSWMO, NEIPCC tanks conference, ASTM International, Interstate technical and Regulatory Council and multiple states over the past decade.

Additional Authors: Keith Modesitt, bp Technology; Irene Montero, bp Remediation Management

AI VS. ENVIRONMENTAL EXPERTS: ARE HUMANS BECOMING OBSOLETE IN REMEDIATION DESIGN

Will you one day soon lose your job to ChatGPT?

As the environmental remediation landscape evolves, the integration of Artificial Intelligence (AI) has emerged as a transformative force in designing effective solutions. This abstract challenges the traditional role of human environmental professionals by exploring the potential of AI, such as ChatGPT, in shaping and executing remediation programs.

While AI-driven technologies demonstrate remarkable capabilities in data analysis, pattern recognition, and complex decision-making, a crucial question arises: Are human professionals becoming redundant in the face of this technological revolution? This presentation dives deep into the advantages and limitations of AI, highlighting its potential to autonomously design remediation strategies based on vast datasets, scientific principles, and optimization algorithms.

Through thought-provoking examples and case studies, the roles of human professionals in the AI-enabled remedial design process will be examined. Are they merely responsible for posing the problem and providing data inputs, or do they still hold the vital role of providing a reality check on AI-generated designs? By addressing this critical question, this presentation aims to spark a discussion on the future of environmental expertise and collaboration between human professionals and AI systems.

This talk aims to present an engaging exploration of the evolving landscape, where hyper-efficient AI algorithms intersect with human intellect and experience. Attendees will gain insights into the implications of AI on environmental remediation design and the evolving roles of human professionals in an era of accelerating technological advancement.

SPEAKER

Eric Cowan, B.A.S., C.E.T. - VEI Contracting Inc.

Eric Cowan is a Project Manager at VEI Contracting Inc. and has over 9 years of experience and expertise in the field of environmental science and in-situ remediation. Since joining VEI in 2015, Eric has been involved in the design and implementation of remediation programs for a variety of environmental contaminants including petroleum hydrocarbons (PHCs), chlorinated solvents, heavy metals, pesticides, etc. Eric is also experienced in designing and implementing High Resolution Site Characterization (HRSC) projects utilizing semi-quantitative screening technologies such as Membrane Interface Probe (MIP), Hydraulic Profiling Tool (HPT), and Ultraviolet Optical Screening Tool (UVOST). Additionally, Eric has designed and conducted multiple bench treatability studies and pilot-scale experiments to develop innovative remedial technologies to use at full-scale. Eric holds a Bachelor's degree in Biology and Sociology from the University of Guelph and a Graduate Certificate – With Distinction – in Environmental Engineering Applications from Conestoga College.

Additional Authors:
Kevin French, VEI Contracting Inc.

PUTTING THE FLOW IN WORKFLOW: USING HYDROCARBON PLUME PREDICTION AI TO QUANTIFY GROUNDWATER RISK AND LIABILITY

Site owners and environmental regulators struggle to obtain a clear picture of how their contaminated sites change through time or treatment. This limits stakeholders' ability to adequately assess risk underlying decision critical predictions. Routine water sampling and sporadic soil sampling are typically used to estimate pollutant fate and transport. Owners incorporate these data into their conceptual site models, which they use to plan and evaluate remedial action plans. Groundwater and soil fate models are rarely used because models are challenging to calibrate with few data points, and often fail to capture changing site conditions even when calibrated.

Here, we describe a new generation of contaminated site models that overcome these limitations by leveraging increased data density from cost-effective IoT sensors. This increased data density facilitates models that continuously calibrate, update, and improve predictability and enable adaptive management of contaminated sites.

Environmental Material Science Inc. (EMS) manufactures and deploys subsurface sensors in soil and groundwater that measure temperature, pressure, humidity, as well as CO2, CH4, N2O, and petroleum hydrocarbon concentrations every 30 minutes. These sensors transmit data wirelessly via Long Range (LoRa) to gateway to cloud wireless communication technology, which is designed for long-range, low-power communication among IoT (Internet of Things) devices. This allows models to be continually updated through highly parameterized inversion using the Parameter Estimation (PEST++) software suite.

We present a family of artificially intelligent models that leverage the latest in modern data assimilation to quantify and reduce the uncertainty in contaminant fate and transport modeling. We show how these models can be continuously updated with cost-effective IoT sensors to overcome traditional limitations with numerical modeling. We conclude with case studies showing real-world examples of these models and sensors, and their use in continuous monitoring and adaptive management.

SPEAKERS:

Nicholas Higgs - Environmental Material Science, Inc.

Nicholas is a software developer working for Environmental Material Science Inc., a small start-up based out of Saskatoon Saskatchewan Canada, where they develop sensors and software that enable data assimilation for environmental modelling. While he does not have an environmental science background, he enjoys the challenging applied problems this space presents for him to put his statistical and programming skills to work on. After all, Nicholas' favourite part about being a stats-geek is that he gets to play in everyone else's backyard.

Steven Mamet, PhD - Director of Science and Product Environmental Material Science Inc. (EMS)

Steven Mamet is a Senior Environmental Scientist in EMS's Data, Science, and Engineering Unit. Environmental Material Science Inc. (EMS) specializes in technologies to detect, monitor, and remediate contaminated soil and groundwater.

His responsibilities at EMS are spearheading our knowledge management efforts, transforming complex scientific data into comprehensible information accessible to diverse audiences. This work makes real-time data from hydrocarbon detection, monitoring, and prediction easily accessible and relevant to users.

He currently leads a multi-disciplinary team of computer scientists, chemists, and a mechanical engineer to conduct high-level research and development projects. Dr. Mamet's expertise is in data analytics, product and project management and numerical ecology. Steve combines the principles of design and aesthetics with scientific accuracy to effectively communicate "big data" science with meaningful insights.

He graduated from the University of Alberta with a PhD in Earth and Atmospheric Sciences. Steve's current work builds on 8 years of experience studying hydrocarbon depletion in contaminated sites and 20 years studying climate and ecological change in the Subarctic.

Additional Authors: *Alejandro Alvarez, Environmental Material Science, Inc. Saskatoon, SK, Canada; Kevin Stanley University of Victoria, Computer Science, Victoria BC, Canada; Steven Siciliano, Environmental Material Science, Inc. Saskatoon, SK, Canada*

1:45PM - 1:55PM PT

Q&A

NEW ADVANCES FOR RISK ASSESSMENT AND SITE RESTORATION

1:55PM - 2:25PM PT

USING SUCCESSIONAL PATTERNS TO TRACK REMEDIATION/RESTORATION, RELATIVE TO ECOLOGICAL BENCHMARKS, AS AN APPROACH TO ADDRESS WIDE-AREA CONTAMINATED SITES IN WILDLANDS

Remediation of contaminated sites in Wildland areas poses unique challenges. Some natural systems are sufficiently resilient to recover on their own, but it can be a slow process, and sometimes the systems need help. Restoration approaches can speed up or make the recovery process possible. Restoration generally seeks to return the structures, functions and composition of the ecosystem back to a natural state, which may be possible when contamination is present. There are many ways to evaluate the potential feasibility and chance of success for restoration, but the focus of this presentation is on conditions that do allow for restoration.

Restoration of Wildland contaminated sites can be extremely complex. It requires consideration of ecosystem variability and successional patterns and can require long timeframes for interventions and monitoring. Remediation of wide area contamination adds an additional challenge in avoiding unnecessary destruction of ecosystems and their components that may be associated with physical contamination removal. Thus, an approach is needed that uses as a set of community metrics to evaluate if an ecosystem's conditions are on- or off-track relative to natural successional process that contribute to a healthy ecosystem, by comparison with reference site conditions and/or ecological benchmarks.

British Columbia has developed the Biogeoclimatic Ecosystem Classification (BEC) system to describe ecosystem variability and complexity. It is a hierarchical classification system, that groups ecosystems at higher levels into 16 zones that can be subdivided into subzones and variants at regional and subregional scales. At finer scales, site-level classification units, called site series, differentiate wetter, drier, richer, and poorer sites within subzones/variants. It is based on natural ecosystems, and emphasizes relationships between site, soil, climate, and vegetation. Historically, most vegetation classification has focused on plant communities in mature and old successional stages. Seral classification, which looks at the range of natural vegetation communities across earlier successional stages, can be a way to build ecological benchmarks that include ecosystem development trajectories.

Application of ecosystem benchmarks that include structure, function, and composition over successional trajectories may be appropriate to support habitat recovery and preservation, but this approach may have limitations when conditions are beyond recovery without physical removal of contamination and/or consideration of factors (e.g., pH, nutrients, organic content, invasive species). Other lines of evidence, such as toxicity and bioavailability testing, should be used alongside these community metrics to support a weight of evidence risk assessment framework.

SPEAKER

Deb MacKillop, BC Public Service

Deb MacKillop is an ecologist and a Registered Professional Forester. After spending 17 years working in the Ministry of Forests' Kootenay Boundary Region in southeast BC, she now works as the Ministry's Provincial Forest Ecologist. She has written three books on describing ecosystems in southeastern British Columbia using the Biogeoclimatic Ecosystem Classification (BEC) system and is in the midst of writing the fourth. Her work focuses on old growth forest ecology, partial harvesting, and forest carbon. She has also worked on cumulative effects assessments, environmental assessment projects, and ecosystem benchmarks.

2:25PM - 2:55PM PT

PFAS RISK ASSESSMENT AND RISK MANAGEMENT: IS THE RISK PARADIGM FAILING US?

The conventional paradigm of dose-response-based human health risk assessment has been in use for more than 30 years. It allows us to assess risk based on standardized assumptions and methodology regarding exposure and toxicity and also provides some flexibility in remediation and risk management options by allowing consideration of background or ambient levels of chemicals and establishes varying risk thresholds. However, this risk paradigm appears to be less useful when applied to PFAS due to the extremely high numbers of PFAS compounds, occurrence of PFAS mixtures, widespread ambient occurrence in multiple media and very limited toxicology data and rapidly changing analytical methods. Decision-making becomes a very challenging process when even ambient levels of PFAS may be associated with health risks that exceed EPA's acceptable range. This presentation identifies a range of conceptual and management options for application of the risk paradigm to PFAS that may be of interest to regulators and responsible parties. Strategies and PFAS-specific approaches that can be applied at every stage of the risk management process including development and implementation of remedial goals and remedial actions are presented and discussed. Active discussion of these options, with engagement by all stakeholders, can assist with more timely and practical risk-based decision-making and site management for PFAS-contaminated sites.

SPEAKER Usha Vedagiri, Ph.D., - WSP, Oakland, CA, USA.

Usha Vedagiri is Vice-President for Risk Assessment and Toxicology at WSP. She is based in California and has more than 25 years of experience in human health and ecological risk assessment. She has worked on PFAS issues since 2013 and is currently involved with supporting government and commercial clients on PFAS risk assessment and risk management. She is an active member and contributor to the ITRC PFAS Team. She has published on and is currently working on R&D projects related to interpreting the significance of PFAS occurrence in multiple environmental and biological media.

2:55PM - 3:10PM PT

BREAK

3:10PM - 3:40PM PT

INCORPORATING IN VITRO BIOACCESSIBILITY FOR ARSENIC AND LEAD IN SOIL IN HUMAN HEALTH RISK ASSESSMENT

The United States Environmental Protection Agency (USEPA) defines bioavailability as the fraction of an ingested dose that crosses the gastrointestinal epithelium and becomes available for distribution to internal target tissues and organs. Bioavailability data can be used to provide realistic information on potential health effects of contamination and modify site-specific soil clean-up levels. Metal bioavailability is best measured using in vivo animal models. However, due to cost and ethical issues associated with animal studies, in vitro models have been developed. The in vitro models determine bioaccessibility, which is the fraction of the contaminant that dissolves in gastrointestinal tract fluids and is available for absorption. Comparisons of in vitro and in vivo results show that the bioaccessibility data generated from in vitro models can provide good prediction of selected metal bioavailability including arsenic and lead. Various in vitro bioaccessibility (IVBA) methods are available including the USEPA Method 1340, the Barge Unified Bioaccessibility (UBM), Physiological Based Extraction Test (PBET) and the Ohio State University In Vitro Gastrointestinal Method.

Due to the variability in bioaccessibility results associated with using different methods various jurisdictions resort to recommending preferred methods. For example, the USEPA recommends Method 1340 whereas in Europe, the UBM is preferred. In 2007, Health Canada published a guidance document for incorporating oral bioavailability of chemicals in soils and soil-like media in human health risk assessment (HHRA) at federal contaminated sites. Recommendations included the use of validated IVBA methods accepted by a regulatory agency such as the USEPA Method 1340.

The BC Ministry of Environment and Climate Change Strategy selected USEPA Method 1340 for potential inclusion in the BC Environmental Laboratory Manual (BC Lab Manual). Method 1340 requires the use of NIST 2711a or 2710a standard reference materials (SRMs) for quality assurance/quality control. These standards are difficult to obtain due to cost and availability in Canada. Furthermore, the concentrations of arsenic and lead in these SRMs are elevated compared to the typical ranges encountered in contaminated sites in Canada. A round robin was organized to evaluate the capabilities of BC-based laboratories to conduct USEPA Method 1340 including the use of alternate SRMs.

Following this a method for arsenic and lead IVBA was drafted for inclusion in the BC Lab Manual. A second round robin was organized using the draft method to determine arsenic and lead IVBA in 10 field-collected soil samples. Based on the findings of the two round robin studies, laboratories in BC can use the published BC Lab Manual method for "In Vitro Bioaccessibility (IVBA) for Arsenic and Lead in Soil - Prescriptive" to provide reproducible and comparable arsenic and lad IVBA. After a brief overview of various in vitro bioaccessibility methods, the rationale for the selection of USEPA Method 1340 for inclusion in the BC Environmental Laboratory Manual, the results of the round robin studies along with case examples that incorporate IVBA data for HHRA will be presented.

SPEAKER:

Matt Dodd, PhD - School of Environment and Sustainability, Royal Roads University

Matt Dodd is a faculty member in the School of Environment and Sustainability at Royal Roads University. He is an environmental analytical chemist with research interests in metal speciation, bioaccessibility and bioavailability, contaminants in the urban environment, e-waste, air quality monitoring, soil toxicity testing, and microplastics. He has conducted research and served as project scientist for environmental projects in Canada, China, and Ghana some of which have included in vitro bioaccessibility assays. He has also supervised or provided scientific advice on the remediation of contaminated sites including mines in the Yukon, Northern BC, and the Canadian Arctic. His laboratory has participated in various in vitro bioaccessibility studies including round robins conducted by the USEPA and other agencies.

SCIENCE ADVISORY BOARD FOR CONTAMINATED SITES IN BC

3:40PM - 4:10PM PT

AN OVERVIEW OF 6PPD-QUINONE: WHERE WE STARTED, WHERE WE ARE NOW, AND WHERE WE ARE HEADED

In 2020, researchers at the University of Washington and Washington State University identified 6PPD-quinone (6PPDQ), a novel chemical leaching from vehicle tires, as the primary causal toxicant of pre-spawn mortality in coho salmon (Oncorhynchus kisutch) in the Pacific Northwest. 6PPDQ is an ozonated transformation product of 6PPD, an essential antiozonant used in tires to prevent rubber from cracking. Since its discovery, 6PPDQ has been shown to be toxic to several species of fish at environmentally relevant concentrations. The ubiquitous presence of tires all over the world presents a unique problem as this contaminant is present in nearly all locations that have been sampled. The urgency of this issue has led to rapid developments in the research surrounding 6PPDQ and other tire-related contaminants. This presentation will cover how researchers linked stormwater and tire chemicals to coho mortality, what we have learned about 6PPDQ since its discovery, and provide an overview of current research being performed in the aquatic ecotoxicology lab at Washington State University. This talk will also encompass the search for alternatives to 6PPD and the regulatory actions that are being taken at the state and federal levels in the United States.

SPEAKER:

Caitlin Lawrence - Washington State University

Caitlin Lawrence is a second year master's student at the Washington State University's School of the Environment working under Dr. Jenifer McIntyre. Her current research is centered around identifying alternatives to 6PPD, a chemical used in tires that poses a threat to aquatic life, particularly coho salmon. Before attending WSU, Caitlin worked as an analytical chemist at Alpha Analytical, an environmental testing laboratory in Massachusetts, and as lab technician at AquaTox Research, Inc. in New York performing toxicity tests to fulfil state and federal effluent discharge permit requirements.

In addition to her academic work, Caitlin has been actively involved in public outreach and policy initiatives related to salmon conservation and stormwater toxicity. As the Salmonids and Stormwater Policy Intern at Puget Soundkeepers, she organized community meetings and collaborated with local governments to standardize salmon survey methods. She has also contributed to public awareness through podcast interviews, presentations, educational lessons, and workshops and about 6PPD-quinone. Caitlin is passionate about leveraging research to protect people and the environment by bridging the gap between scientific research and environmental policy implementation.

4:10PM PT

WRAP-UP

THANK YOU

FOR JOINING US FOR THE 14TH ANNUAL SABCS WORKSHOP

WE LOOK FORWARD TO SEEING YOU TOMORROW!

CONFERENCE ON SITE INVESTIGATION RISK ASSESSMENT AND REMEDIATION

CONFERENCE

DAY 2: SEPTEMBER 26, 2024

8:25AM - 4:30PM

IN PERSON AT THE MORRIS J. WOSK CENTRE FOR DIALOGUE, VANCOUVER, BC

580 WEST HASTINGS STREET; VANCOUVER, BC

LOCATION: MORRIS J. WOSK CENTRE FOR DIALOGUE
580 WEST HASTINGS STREET;
ROOM 320

SCIENCE ADVISORY BOARD FOR CONTAMINATED SITES IN BC

CONFERENCE AGENDA

8:25AM **Welcome & Introduction** - *Ian Hers, PhD – Hers Environmental Consulting Inc.*

8:30AM **Land Acknowledgement**

SESSION 1 - WILDFIRE RECOVERY AND CONTAMINATION ASSESSMENT

8:35AM **Indigenous Perspectives on Community Restoration** - *Patrick Michell, Former Chief of T'eqt"aqtn'mux (Kanaka Bar Band) and LFN Rebuild Director*

9:05AM **Lytton Wildfire Recovery - Contaminant Assessment and Remediation** - *Lance Hunt, B.Sc., P.Chem, – Arcadis*

9:30AM **Evaluating PCOCs From Wildfires Using Case Studies** - *Tadd Berger, M.Sc., P.Ag., EP, CSAP – Pinchin Ltd.*

9:55AM **BREAK**

SESSION 2 - RISK ASSESSMENT APPROACHES AND CASE STUDIES

10:15AM **Ecological Risk Assessment for Contaminated Sites: New and Updated FCSAP Guidance** - *Michelle Latimer, B.Sc., Lindsey Wilson, M.Sc. – Environment & Climate Change Canada, Jennifer Young, B.Sc., – Fisheries and Oceans Canada*

10:40AM **A Site-specific Approach for Assessing Risks to Ecological Receptors from DDT at an Agricultural Site** - *Debby Reeves, MSc – WSP*

11:05AM **A Future First Nations Garden on Current Contamination** - *Jennifer Trowell, M.ET., R.P.Bio. – Ausenco*

11:30AM **Long-Term Baseline Monitoring of Creosote-Treated Pile Infrastructure: A 25-Year Update of the Sooke Basin Study** - *Paddy McManus – Fisheries and Oceans Canada*

11:55AM **LUNCH**

SESSION 3 - EMERGING CONTAMINANTS ISSUES, ANALYTICAL AND ASSESSMENT METHODS

12:45PM **Analysis of Tire Anti-Oxidant 6PPD-quinone by LC-MSMS.** - *Louis Wagner, BSc – ALS*

1:10PM **Rethinking Field Sampling Practices in PFAS Testing: Challenging Conventional Cross-Contamination Assumptions** - *Andrew White – Bureau Veritas*

1:35PM **The Power and Benefits of Using Hydrogeological Conceptual Site Models at Contaminated Sites** - *Stephan Munzar, MSc – Core6*

2:00PM **Using Multiple HRSC Technologies to Develop a Detailed CSM for a Complex Fractured Bedrock Site** - *Kevin French, B.A.Sc., P. Eng. – VEI Contracting Inc.*

2:25PM **BREAK**

SESSION 4 - REMEDIATION APPROACHES, TECHNOLOGIES AND CASE STUDIES

2:40PM **Remediating Bedrock: What Once Was Impossible Is Now Routine. Three Case Studies** - *Eric Cowan, B.A.S., C.Tech – VEI Contracting Inc.*

3:05PM **Protection of Potable Aquifer Affected by PFAS via in situ Point of Entry Treatment Technologies** - *Jean Paré, P.Eng. – Chemco Inc.*

3:30PM **Using Electrical Hydrogeology for Reduced Risk in Final Remedial Design** - *John Sankey, P.Eng. – True Blue Technologies*

3:55PM **Residential Redevelopment of a Former Multi-well Pad and Battery Site within an Urban Environment** - *John Forbes, B.Sc., P.Biol. – Trace Associates Ltd.*

4:10PM **WRAP-UP**

SEPTEMBER 26, 2024 **8:25AM - 4:30PM PT DAILY**

8:25AM - 8:30AM PT

WELCOME & INTRODUCTION

8:30AM - 8:35AM PT

LAND ACKNOWLEDGEMENT

SESSION 1 - WILDFIRE RECOVERY AND CONTAMINATION ASSESSMENT

8:35AM - 9:05AM PT

INDIGENOUS PERSPECTIVES ON COMMUNITY RESTORATION

Located 14 km south of Lytton, BC (Canada's hotspot), Patrick Michell of the Kanaka Bar Indian Band (one of 15 indigenous communities that make up the Nlaka'pamux Nation) has chosen to live in the Fraser Canyon all his life.

In 2021, my family lost our intergenerational home in the June 30, 2021, Lytton fire and were evacuated, like so many others. Living in response mode, knowing our homes and hometown, was lost, was not easy for any Lytton evacuee and everyone also had to manage the additional impacts of the Atmospheric River in November that "wiped out" all but one regional road and in late December, our region also experienced - 32-degree temperature along with a snowfall event more than 4 feet in places.

Regardless of these compounding events and logical delays to return, recovery and actual rebuild, the people who chose to live in the Fraser Canyon are working together to not just replace homes and economy, we are designing a rebuild around land and resources based on knowing's thousands of years in the making combined with the incredible science and technology of today. The goal - to create for our children and grandchildren, a region free from contamination and resilient to weather extremes and the air, land and water catastrophes that follow.

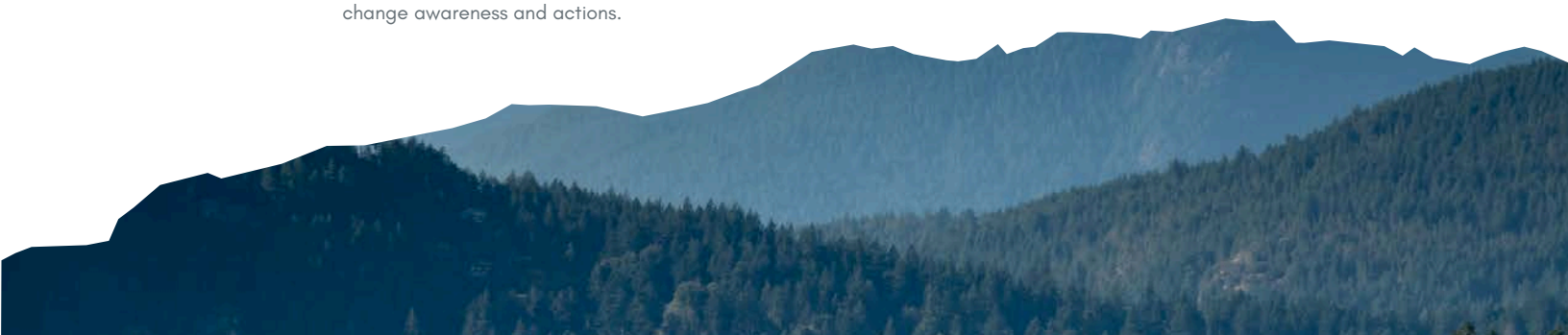
With my family safe and stable, in November of 2023, I started work as the Lytton First Nations Rebuild Director and contaminated site identification, assessment and remediation is a priority for the community. Rebuild has a chance to fix over 150 years of "land and resources" uses done wrong. My presentation for SACBS I'm calling "Death by a Thousand Cuts?" which is a look back and more importantly, a look forward, for all of us.

SPEAKER

Patrick Michell - Former Chief of T'eqt"aqtn'mux (Kanaka Bar Band) & LFN Rebuild Director

I have a Diploma in Administrative Management from New Westminster's Douglas College and spent an additional 5 years at UBC where I graduated from Law School in 1993. In 2005, I left my Fraser Canyon law practice to work solely on the Kwoiek Hydro project, first initiated by Kanaka back in 1990, and after not one, but two, EAO reviews, a formal Commercial Operations date was awarded by BC Hydro "as at" January 1, 2014. With the retirement of Chief James Frank in December 2014, I became the Chief of Kanaka in May of 2015 until my own retirement in July of 2022.

In 2018, I was honored with a Clean Energy BC lifetime achievement award for works in renewable energy project design, permitting, development and operations, and in 2021 was further honored with a Clean50 Lifetime Achievement Award for works on climate change awareness and actions.



9:05AM - 9:30AM PT

LYTTON WILDFIRE RECOVERY - CONTAMINANT ASSESSMENT AND REMEDIATION

On June 29, 2021, the temperature in the Village of Lytton reached a Canadian record-breaking high of 49.6°C. One day later, on June 30th, a wildfire started, causing catastrophic damage that destroyed over 90% of the Village and impacted over 50 properties on Lytton First Nation reserve lands. The nearly 300 residents were forced to evacuate and find new temporary shelter.

The Lytton First Nation (LFN) retained Arcadis to assess the impact of the June 30, 2021, wildfire on numerous residential and community buildings that were destroyed on Halhalaeden IR 14, Klahkamich IR 17, Klickkumcheen IR 18, Kleetlekut IR22 and 22A. The site assessment findings were used to develop a Remedial Action Plan (RAP) to address the contamination. To minimize potential delays to the recovery program and facilitate an expedited remedial timeline, the primary objective of the RAP was focused solely on the removal of burned debris and elimination of potential risks to human health from contaminated soils.

A total of 54 properties were assessed and elevated concentrations of metals (particularly antimony, arsenic, barium, cadmium, chromium, cobalt, copper, lead, tin, sodium, and zinc), combustion by-products such as benzene, toluene, ethylbenzene and xylenes and polycyclic aromatic hydrocarbons were identified in waste burned debris and contaminated soils. Asbestos was also identified in a select number of burned building wastes. Concentrations of other potential contaminants including petroleum hydrocarbons, polychlorinated biphenyls and polychlorinated dibenzodioxins and furans were typically less than provincial standards. Leachate testing of select samples with very high metals concentrations (particularly lead from former lead-based paint or destroyed vehicle batteries) confirmed the presence of hazardous waste debris and soils, that required treatment to neutralize the amount of lead that leached from the soil, prior to disposal. Subsequent confirmatory testing indicated that all potential human health risks associated with contamination caused by the wildfire were removed, while minor risks to ecological receptors remained at some sites for future management.

Overlapping with the LFN wildfire recovery project, the Village of Lytton (VOL) retained Arcadis to complete a similar scope of work within the village. The findings of the LFN site assessment helped inform and streamline the VOL contaminant assessment and expedite preparation of the RAP. The scope of work involved in the VOL recovery project was substantial, involving over 140 individual properties that included single family homes, school, church, hospital, RCMP office, hotels and miscellaneous municipal and commercial buildings. Over 25,000 tonnes of burned waste debris and contaminated soils were remediated by excavation and appropriate offsite disposal.

The diverse number of stakeholders involved in the project (private individual, with or without insurance, multiple insurance companies, municipal, federal and provincial interests) represented a significant challenge with respect to negotiation of timely and efficient access to properties to carry out site assessment and remediation work. In addition, due to long history of indigenous habitation at the confluence of the Thompson and Fraser Rivers, archaeological assessment and protection was a critical component of the recovery program that resulted in significantly longer project timelines than anticipated.

SPEAKER Lance Hunt, B.Sc., P.Chem, - Arcadis

Mr. Hunt is a Professional Chemist with the Association of the Chemical Profession of BC and a Contaminated Sites Qualified Professional with over 20 years of experience conducting environmental site assessments and remediation work within the province. Mr. Hunt is an Associate Principal and Practice Lead of the Vancouver Environmental Solutions team at Arcadis and is responsible for developing, coordinating, and managing large scale environmental site investigation and remediation programs. Over his 20 years of practice, Lance has been working in partnership with Indigenous Peoples from over 40 Nations within British Columbia. These long-term partnerships are built on mutual respect, understanding, trust and delivery by Arcadis of high-quality professional services and solutions to complex environmental issues.

Mr. Hunt has recently been involved with managing large scale recovery programs (Lytton and Shuswap) related to impacts from natural disasters in British Columbia including wildfires and flooding events (Merritt, atmospheric rivers). These projects required development and implementation of a hybrid site assessment and debris management and contaminated soil remediation programs, designed to expedite cleanup and recovery works.

9:30AM - 9:55AM PT

EVALUATING PCOCS FROM WILDFIRES USING CASE STUDIES

The frequency and magnitude for wildfire and other structure fire events has been increasing as a direct result of climate change. The cleanup required to rebuild following a fire event often necessitates the evaluation of affected soils, ash, and other debris in order to evaluate the residual risks to human health and the environment, as well as to characterize materials that are to be taken off-Site for disposal.

As fire is known to generate several toxic chemicals from incomplete combustion, to properly characterize these potentially impacted materials, it is first necessary to determine which potential contaminants of concern (PCOCs) may be associated with a fire event. This evaluation process is critical, as the exclusion of PCOCs could result in the misclassification of soils, while the inclusion of too many PCOCs may be cost prohibitive, especially for expensive analysis such as Dioxins and Furans.

This presentation will examine the soil and surface ash analytical results from several post-fire investigations conducted following various wildfire and large fire events in order to provide insight into the likely presence of individual compounds as a direct result of a fire event.

SPEAKER

Tadd Berger, M.Sc., P.Ag., EP, CSAP - Pinchin Ltd.

Mr. Berger is a Director and Practice Leader with Pinchin Ltd. He has approximately 25 years of environmental experience with site investigation and remediation projects. He has managed numerous subsurface investigations and remediations in multiple geologic environments throughout North America. Mr. Berger's experience ranges from small commercial outlets to major chemical and refinery complexes to mine sites. These include numerous chlorinated and mixed contaminant sites, several of which have received regulatory closure under Mr. Berger's guidance. He has been responsible for a variety of projects in which soil, groundwater, surface water, soil vapour and sediment quality in relation to regulatory standards and risk-based evaluations were investigated and remediated. This includes conducting baseline risk assessments, corrective measures studies, remedial feasibility studies, and corrective measures implementation planning.

9:55AM - 10:15AM PT

BREAK

SESSION 2 - RISK ASSESSMENT APPROACHES AND CASE STUDIES

10:15AM - 10:40AM PT

ECOLOGICAL RISK ASSESSMENT FOR CONTAMINATED SITES: NEW AND UPDATED FCSAP GUIDANCE

The Federal Contaminated Site Action Plan (FCSAP) is continuously creating and updating guidance for the assessment, remediation and risk management of federal contaminated sites. Most recently Environment and Climate Change Canada (ECCC) has finalized the update to the guidance document: *Ecological Risk Assessment for Contaminated Sites*, which was originally published by the Federal Contaminated Sites Action Plan (FCSAP) in 2012. The Department of Fisheries and Oceans (DFO) in collaboration with ECCC has recently completed: *Module 8, Fish-specific Toxicity Reference Values for use in Ecological Risk Assessment V.2, December 2022*. ECCC is currently developing guidance for inclusion of reptiles in ecological risk assessment: *Module 9: Reptiles in Ecological Risk Assessment on Federal Contaminated Sites*.

These technical guidance documents are intended to provide support to site managers and Ecological Risk Assessment (ERA) practitioners when conducting ERAs for federal contaminated sites. The updated ERA guidance document clarifies and updates the federal ERA process and framework to more accurately represent best practices identified by site managers, federal Expert Support Departments, and consultants. Both Modules 8 and 9 are new and provide additional guidance, considerations and data specific to the inclusion of fish and reptiles in risk assessment. This presentation will provide an overview of existing ERA guidance for federal contaminated sites, highlight key updates to the *Ecological Risk Assessment for Contaminated Sites* guidance document relative to the previous version, provide a brief summary of *Module 8, Fish-specific Toxicity Reference Values for use in Ecological Risk Assessment V.2, December 2022*, and provide an update on the development of *Module 9: Reptiles in Ecological Risk Assessment on Federal Contaminated Sites*.

SPEAKERS

Michelle Latimer, B.Sc. - Environment and Climate Change Canada

Michelle Latimer has worked at Environment and Climate Change Canada (ECCC) for the past 4 years as Contaminated Sites Expert Support within the Federal Contaminated Sites Action Plan (FCSAP) program. In this role she provides technical advice and guidance to custodians of federal contaminated sites on ecological matters. Previous to working with ECCC, Michelle worked for Indigenous Services Canada (ISC) for 10 years as a contaminated sites custodian, managing the assessment and remediation of contaminated sites on First Nation reserve land. Although her academic background is in freshwater ecology, she has spent the last 10+ years developing expertise in many aspects of contaminated sites. Most recently, she has focused more on ecological risk assessment and assisted with the updating of the FCSAP Ecological Risk Assessment Guidance. Michelle is also currently leading the development of FCSAP guidance for the inclusion of reptiles in ecological risk assessment.

Jennifer Young, B.Sc. - Fisheries and Oceans Canada

Jennifer is a Biologist at Fisheries and Oceans Canada (DFO) working as Expert Support for the Federal Contaminated Sites Action Plan (FCSAP) program in the Pacific Region, based in Vancouver. She previously worked with an environmental engineering consulting company as a contaminated sites project coordinator and project manager as well as a toxicology bioassay team lead in the laboratory. Jennifer holds a Bachelor of Science from the University of British Columbia.

Lindsey Wilson, M.Sc. - Environment and Climate Change Canada

Lindsey Wilson has worked at Environment and Climate Change Canada (ECCC) for over 10 years in programs related to environmental protection. As Expert Support within the Federal Contaminated Sites Action Plan (FCSAP) she provides guidance and technical information on ecological matters related to the management of federal contaminated sites. Her academic background is in freshwater ecology and aquatic ecotoxicology. She was one of the ECCC technical leads that updated the FCSAP Ecological Risk Assessment Guidance with WSP.

Additional Authors: *Gary Lawrence, WSP*

10:40AM - 11:05AM PT

A SITE-SPECIFIC APPROACH FOR ASSESSING RISKS TO ECOLOGICAL RECEPTORS FROM DDT AT AN AGRICULTURAL SITE

A detailed quantitative risk assessment (DQRA) was completed at an agricultural research station in the Okanagan to assess the potential ecological risks associated with dichloro-diphenyl-trichloroethane (DDT) and its metabolites. DDT was extensively used locally and globally as an insecticide from the 1940 through to the 1970s, before being discontinued by 1990. DDT is a concern because it is a biomagnifying persistent organic pollutant that has been linked to adverse effects on higher trophic levels. This was a concern because the site was home to many species of birds, mammals, and herptiles, including approximately 20 species at risk (SAR).

An earlier preliminary risk assessment identified the site as high-risk based on several conservative assumptions. Therefore, the focus of the DQRA was on collecting site-specific exposure data, deriving site-specific toxicity reference values (TRVs), and evaluating risks to common and SAR wildlife. Although we evaluated other wildlife groups, including herptiles, the focus herein is on terrestrial birds and mammals.

Site-specific inputs used to refine the food chain model (FCM) included: plant and earthworm tissue data, which were used to develop bioaccumulation models in conjunction with region-specific models; grasshopper and fruit tissues collected for site-specific tissue concentrations; and derivation of a region-specific uptake equation for robin eggs and nestlings.

Given the technical limitations of default no-observed-adverse-effect-level (NOAEL) and lowest-observed-adverse-effect-level (LOAEL) literature based TRVs, de-novo effect dose-based (EDx-based) TRVs for common and SAR birds and mammals were derived following methods in the Federal Contaminated Sites Action Plan guidance. The United States Environmental Protection Agency (US EPA) Ecological Soil Screening Level (Eco-SSL) compendium was used as the source of toxicity data, focusing on studies that indicated effects (i.e., bounded and unbounded LOAELs). For each study, we reviewed the original paper to confirm Eco-SSL's summary of NOAELs and LOAELs. The raw data were extracted to determine the level of effects for each test concentration (i.e., change relative to the negative control). The consolidated dose-response relationship was explored graphically to evaluate the strength of the different regression relationships available within the broad categories of endpoints. An ED20-based on growth and reproduction was considered to represent a low-to-moderate effect, reasonable for common species. An ED10-based on growth, reproduction, and behaviour was considered to represent a negligible level of effect, reasonable for SAR. The recommended site-specific common and SAR TRVs ended up being around 1.5 times to an order of magnitude higher than the default Eco-SSL TRVs.

Based on the results of the FCM that incorporated the site-specific data and TRVs, potential risks were considered potentially unacceptable for three out of four carnivorous receptors evaluated and were considered potentially unacceptable to multiple SAR, including the western screech owl and multiple herptile species known or having a high potential to occur at the site. Refinement of the FCM would unlikely change our high-level conclusions and targeted remediation is a reasonable compromise between reducing the mathematical risks versus risks associated with the destruction of critical habitat.

SPEAKER

Debby Reeves, MSc - WSP

Debby Reeves is an environmental scientist within WSP's risk assessment group in Vancouver, BC. She has four years of consulting experience conducting human health and ecological risk assessments for provincial (BC, Alberta, Ontario) and federal sites. She works on projects involving the assessment and remediation of contaminated sites with a focus on data interpretation and analysis, food chain modelling for human and ecological receptors, literature reviews and toxicity reviews and reporting. She has worked for a variety of client sectors including mining, government (municipal, provincial, and federal) and infrastructure clients. Debby has a MSc from Simon Fraser University where she used molecular and biochemical endpoints to assess the effects of neonicotinoid pesticides on salmon. Her career goals include using her expertise to help find solutions to environmental problems through risk assessment.

Additional Authors: *Jennifer Cook, WSP; Alexis Fast, WSP; Blair McDonald, ERM*

11:05AM - 11:30AM PT

A FUTURE FIRST NATIONS GARDEN ON CURRENT CONTAMINATION

As part of reconciliation efforts with Tsleil-Waututh (TWN) and other Coast Salish Nations, stakeholders in the Maplewood Flats Conservation Area proposed to plant a demonstration garden containing Indigenous plants and shrubs. In collaboration with TWN and integrating a two-eyed seeing approach, this demonstration garden will provide an opportunity for outreach and education and shift to opportunities to showcase TWN and Coast Salish histories and futures. Prior to garden installation, stakeholders, including Environment Canada and Climate Change, Wild Bird Trust, Port of Vancouver, and others wished to investigate the potential for risks to humans who may interact with this garden. Since this garden was proposed to include plants used by the TWN for medicinal purposes and Indigenous art as well as for consumption, a Human Health Risk Assessment was conducted to evaluate the potential for unacceptable risks. Prior to risk assessment, the area of the proposed garden was sampled extensively, including surface soil and plant samples. Risks were assessed to future gardeners and consumers of garden produce from the food and tea gardens. Based on the results of the surface soil sampling, boron was the only contaminant identified as potentially accumulating into plant material. When intake of boron through berries, roots and tea was considered for both Adults and Toddlers, unacceptable risks were not predicted. With the completion of this risk assessment, this is a garden is one step closer to becoming a reality.

SPEAKER

Jennifer Trowell, M.ET., R.P.Bio - Ausenco

Jennifer is an environmental toxicologist and a human health and ecological risk assessor with thirteen years of experience. Over this period, Jennifer has been involved in a variety of human health and environmental risk assessments, with sites varied in nature ranging from industrial to rural, from marine/freshwater intertidal and subtidal to terrestrial. She has conducted risk assessments in British Columbia, Alberta, Yukon Territory, and as far away as Brazil, Argentina and Sweden.

11:30AM - 11:55AM PT

LONG-TERM BASELINE MONITORING OF CREOSOTE-TREATED PILE INFRASTRUCTURE: A 25-YEAR UPDATE OF THE SOOKE BASIN STUDY

Creosote-treated piles, despite long-term adverse impacts on the environment, are widely used as a component of infrastructure in marine settings. Creosote-treated wood is durable and cost efficient but introduce a source of polycyclic aromatic hydrocarbons (PAHs) into the environment when used as a building material.

Differentiating the contribution of creosote-treated beneficial use structures (ie/ wharfs or docks) as a source of PAHs at small craft harbours from other possible sources is essential in addressing uncertainty during site assessments.

In 1995, Fisheries and Oceans Canada began a pilot study off the coast of Sooke, British Columbia, Canada to provide a scientific basis for establishing guidelines on the use and placement of creosote treated wood in sensitive marine aquatic habitats. Creosote-treated sets of piles (dolphins) were installed in an undisturbed location, sediment chemistry, toxicity and benthic infaunal community structure were then monitored periodically until 2005 whereupon the piles remained but sampling events ceased. The results of this study were the basis for assessment policy and site management decisions for all small craft harbors in Canada under federal government custody. In 2020 the site was revisited, inspected and the sediment surrounding the piles were resampled for chemical and benthic infaunal impacts. Detected PAHs and benthic community structure form a spatial gradient that has stabilized over time. These results will be used to inform future research and guidance related to creosote-treated timber usage in infrastructure in marine environments.

SPEAKER

Paddy McManus - Fisheries and Oceans Canada

11:55AM - 12:45PM PT

LUNCH

SESSION 3 - EMERGING CONTAMINANTS ISSUES, ANALYTICAL AND ASSESSMENT METHODS

12:45PM - 1:10PM PT

ANALYSIS OF TIRE ANTI-OXIDANT 6PPD-QUINONE BY LC-MSMS

For years, scientists struggled to understand the mysterious deaths of coho salmon in urban streams of the US Pacific Northwest, particularly after heavy rainfall. These deaths, known as "Urban Runoff Mortality Syndrome" (URMS), caused up to 90% of coho salmon to die before spawning.

Finally, in December 2020, researchers at the University of Washington identified the culprit: 6PPD-Quinone (6PPD-Q), a chemical degradant of anti-oxidants used in tires. This discovery sparked further investigation into the toxicity of 6PPD-Q on aquatic life, particularly on coho salmon populations in the Pacific Northwest, which is a key issue impacting our region. Previously abundant in BC, coho salmon stocks suffered huge declines in the 1990's, and were listed as endangered in 2002. Their status in BC has begun to improve (threatened since 2016), and they remain essential to many coastal communities and First Nations, providing irreplaceable cultural, commercial, and ecological value.

Recognizing the urgency of this issue in 2021, ALS immediately began to develop a test method to detect 6PPD-Q at extremely low concentrations (0.001 µg/L), utilizing advanced LC/MS/MS technology for definitive identification and measurement. This method utilizes the same technology and method principles as the recently released 6PPD-Q US EPA Method 1634. The release of this method in such a short timeframe by the US EPA is unprecedented and suggests upcoming regulations on 6PPD-Q levels in the United States. Locally, BC ENV has confirmed they are also working on water quality objectives for 6PPD-Q. This method is intended to support water quality evaluations in support of important pending US and BC guidelines for 6PPD-quinone.

SPEAKER

Louis Wagner, BSc - 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 2004. In 2008 Louis took on his current role of ALS Canada National Technical Specialist. In this role, he has led and conducted numerous analytical method development projects in the field of inorganic chemistry. Most recently Louis has led several projects to develop trace metal and organometallic speciation test methods, as well as expanding into the exciting world of LC-MSMS analysis and method development.

RETHINKING FIELD SAMPLING PRACTICES IN PFAS TESTING: CHALLENGING CONVENTIONAL CROSS-CONTAMINATION ASSUMPTIONS

As the environmental landscape of contaminants of concern continues to evolve, so do our approaches to PFAS (Per- and polyfluoroalkyl substances) testing. Analytical laboratory efforts continuously probe the boundaries of methodology, precision, and accuracy, all while accommodating the continual demand for rapid answers. However, amidst the quest for ultimate quality, are we inadvertently constraining productivity by imposing overly stringent procedures for field sampling?

The widespread and ubiquitous presence of PFAS in industrial and consumer products poses significant challenges for Environmental practitioners when designing field sampling programs. When the source of cross-contamination is potentially everything, how does one mitigate the chances of misrepresentative results?

This discussion challenges the current conventional guidance surrounding PFAS field sampling protocols, particularly in relation to cross-contamination prevention.

Recent laboratory findings have intriguingly demonstrated that exposure to common PFAS sources such as food packaging, sunscreen and Teflon tubing does not necessarily compromise the overall integrity of a sampling program; however various publications and guidance documents suggest otherwise.

Supported with an in-depth investigative laboratory study of potential contamination sources, we aim to spark discussion around commonly accepted field protocols that may be overly cautious and cumbersome and suggestion there may be an opportunity to redefine PFAS sampling protocols.

SPEAKER

Andrew White - Bureau Veritas

With over 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.

1:35PM - 2:00PM PT

THE POWER AND BENEFITS OF USING HYDROGEOLOGICAL CONCEPTUAL SITE MODELS AT CONTAMINATED SITES

Hydrogeological conceptual site models (CSMs) adapted to the environmental field are often not used or are underutilized when completing contaminated site investigation and remediation work. CSMs can be an effective tool even in the earliest stages of a contaminated sites investigation when no intrusive geologic, hydrogeologic, or chemistry data has been collected. If used at this stage, the CSM can be a powerful tool to help guide and plan subsequent investigation work and ultimately remediation / risk assessment of contaminated sites. In British Columbia, Canada, CSMs have recently become a regulatory requirement when preparing detailed site investigation reports, and should discuss in detail the site geology, physical and contaminant hydrogeology; as well as, sources and pathways of vapour contamination. However, despite this requirement, CSMs are either not used, poorly constructed, or under utilized when carrying out site investigation and remediation work.

Several case studies will be presented where CSMs helped guide the site investigation and remediation process at contaminated sites to more effectively understand the physical and contaminant processes occurring while meeting and perhaps exceeding regulatory requirements. Ultimately, we demonstrate through the case studies why it is important to construct CSMs and how they can assist site investigators and remediation experts in conducting effective, cost efficient site investigations and reduce the potential for misinterpretation of data that could otherwise lead to not identifying risks from contamination.

SPEAKER

Stephan Munzar, MSc., P.Geo - Core6

Stephen has a Bachelors of Science in Geology and Masters of Science in Hydrogeology from the University of British Columbia. Stephen has over 23 years of combined geology and hydrogeology experience, specializing in hydrogeologic site characterization and remediation with particular expertise in evaluating the fate and transport of petroleum hydrocarbons, non-aqueous phase liquids (NAPLs), and inorganic substances. Stephen has presented on numerous technical hydrogeology topics at conferences within Canada and the US. He has also been involved in regulatory working groups tasked with developing guidance for conducting hydrogeologic investigations within BC.

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2:00PM - 2:25PM PT

USING MULTIPLE HRSC TECHNOLOGIES TO DEVELOP A DETAILED CSM FOR A COMPLEX FRACTURED BEDROCK SITE

Background/Objectives:
Utilizing modern and innovative High Resolution Site Characterization (HRSC) technologies to develop an accurate conceptual site model (CSM) is increasingly pertinent for remediation of fractured bedrock sites. Inherent complexities and variability of flow and contaminant transport in fractured bedrock can result in erroneous representations of site conditions and can stymie site clean-up efforts. As such, in-situ remediation of fractured bedrock aquifers used to be considered near impossible. As recently as 2013, the US Department of Defense's (DoD's) environmental research arm (SERDP) wrote "One of DoD's most challenging environmental restoration issues is determining how to deal with contaminants that have seeped into the fractures in bedrock and are a continuing source of groundwater contamination" (SERDP, 2013). The U.S. Geological Survey (USGS) noted that "remedial action is delayed or stymied by the complexity of contaminated fractured-rock aquifers". This presentation will summarize multiple HRSC technologies and methodologies utilized at a complex bedrock site with chlorinated volatile organic compound (cVOC) contamination. The HRSC suite of technologies applied at the site included injectable tracer testing, downhole geophysical surveys, and remedial design characterization (RDC) via discrete soil, bedrock, and groundwater sampling. HRSC tools aided in developing an accurate CSM and was used to design a pilot-scale in-situ remedial injection into the fractured bedrock.

Approach/Activities:
Multiple technologies were employed to assist in developing an accurate and representative CSM at a complex bedrock aquifer site impacted with chlorinated solvents. An initial tracer injection test was completed using rhodamine dye and potassium bromide in 1,900 L of solution to understand real-world groundwater flow and transport conditions. A total of 40 discrete soil samples and six bedrock core samples were collected for inspection and baseline analyzed of CVOCs. Subsequent downhole borehole geophysical surveys were completed in the bedrock over a depth interval from 6.1 to 13.44 m below grade develop a greater understanding of bedrock fracture conditions and flow patterns at the site. A review and interpretation of all upfront HRSC data collected was utilized to aid in the design of an 8,300 L pilot-scale remedial amendment injection of an activated carbon-based injectable (CBI) remedial amendment into four injection boreholes using pressure packer techniques to assess injection flow rates and pressures, injection radius of influence and treatment effectiveness.

Lessons Learned:
Reducing data gaps in a CSM for a complex bedrock aquifer site is essential for effective and timely remediation. Multiple lines of evidence were used to create a detailed CSM for the site and help develop a targeted remedial approach. The presentation will review the suite of HRSC technologies applied at the site, the data collected that assisted in constructing an accurate CSM, and the eventual pilot-scale in-situ remedial approach that was designed in accordance with the detailed CSM. An extensive follow-up sampling and laboratory analytical program was completed at the site, results of which will be presented to highlight the importance of HRSC tools in understanding complex sites.

SPEAKER

Kevin French, B.A.Sc., P. Eng. - VEI Contracting Inc.

Kevin French is Vice President of Vertex Environmental and has over 35 years of experience and expertise in environmental engineering, specializing in site characterization and remediation. He has been involved in the design and implementation of remediation programs across Canada involving permeable reactive barriers, adsorptive and stabilization technologies, in-situ chemical oxidation and reduction, aerobic and anaerobic biodegradation, etc. in soil, groundwater and fractured bedrock for a variety of contaminants, including PFAS, petroleum hydrocarbons, chlorinated solvents, heavy metals, soil sterilants and other compounds. Kevin holds a Bachelors' degree in Engineering from the University of Waterloo and is a Professional Engineer and a Qualified Person in Ontario.

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2:25PM - 2:40PM PT

BREAK

SESSION 4 - REMEDIATION APPROACHES, TECHNOLOGIES AND CASE STUDIES

2:40PM - 3:05PM PT

REMEDIATING BEDROCK: WHAT ONCE WAS IMPOSSIBLE IS NOW ROUTINE. THREE CASE STUDIES

In-situ remediation of fractured bedrock aquifers used to be considered near impossible. As recently as 2013, the US Department of Defense's (DoD's) environmental research arm (SERDP) wrote "One of DoD's most challenging environmental restoration issues is determining how to deal with contaminants that have seeped into the fractures in bedrock and are a continuing source of groundwater contamination". The U.S. Geological Survey (USGS) noted that "remedial action is delayed or stymied by the complexity of contaminated fractured-rock aquifers".

However, environmental practitioners are curious and creative, and as our industry evolves, what was once close to impossible is now routinely possible. The ITRC (Interstate Technology Regularly Council) stated that while contaminated fractured bedrock sites have often been considered too complex to be remediated, "with new strategies and technologies…fractured bedrock challenges that may have prevented site remediation in the past are now surmountable".

In the past, bedrock remediation failed for a variety of reasons, including variable and indeterminant groundwater flow pathways and velocities, significant contaminant back diffusion from the porous rock matrix into groundwater, and a lack of economical remedial amendments and delivery techniques. By addressing these key restrictions, the environmental industry has been able to successfully remediate contaminated bedrock sites.

This talk will present an overview of bedrock remediation challenges, before demonstrating the evolution of bedrock site remediation technologies through three recent and varied bedrock remediation sites. One site was contaminated with heavily impacted groundwater and separate phase petroleum hydrocarbons (PHCs), a second site contained the dissolved chlorinated solvent (i.e., tetrachloroethene or PCE) contamination, while a third site was impacted with heavy metals, specifically hexavalent chromium.

For each bedrock site the remediation approach will be presented along with pre-remediation and post-remediation groundwater quality analytical results. Throughout the presentation recommendations and insights will be offered into state-of-the-art bedrock remediation amendments and approaches that can be employed for successful in-situ fractured bedrock remediation.

SPEAKER

Eric Cowan, B.A.S., C.E.T. - VEI Contracting Inc.

Eric Cowan is a Project Manager at VEI Contracting Inc. and has over 9 years of experience and expertise in the field of environmental science and in-situ remediation. Since joining VEI in 2015, Eric has been involved in the design and implementation of remediation programs for a variety of environmental contaminants including petroleum hydrocarbons (PHCs), chlorinated solvents, heavy metals, pesticides, etc. Eric is also experienced in designing and implementing High Resolution Site Characterization (HRSC) projects utilizing semi-quantitative screening technologies such as Membrane Interface Probe (MIP), Hydraulic Profiling Tool (HPT), and Ultraviolet Optical Screening Tool (UVOST). Additionally, Eric has designed and conducted multiple bench treatability studies and pilot-scale experiments to develop innovative remedial technologies to use at full-scale. Eric holds a Bachelor's degree in Biology and Sociology from the University of Guelph and a Graduate Certificate – With Distinction – in Environmental Engineering Applications from Conestoga College.

3:05PM - 3:30PM PT

PROTECTION OF POTABLE AQUIFER AFFECTED BY PFAS VIA IN SITU POINT OF ENTRY TREATMENT TECHNOLOGIES

The intensive use of PFAS, described as eternal and considered carcinogenic, are a source of contamination in various environments and can be transported over very long distances, particularly in air and water thus leading to contamination of drinking water sources that must be addressed.

PFAS contaminants are not found naturally and are not easily chemically or microbiologically degraded thus the use of new materials for in situ control of PFAS movement utilizing sorption processes. In situ permeable adsorption barriers (PAB) based on injectable colloidal modified clays and/or activated carbon can effectively and sustainably halt the rapid advance of PFAS plumes that could affect downgradient sensitive receptors.

For surface water body contaminated (lake, river) these amendments can be adapted using a bank filtration design to reduce above ground system cost or deployed in situ to protect underground potable water wells.

Mass flux contaminant modelization shows that in situ permeable sorption barriers based on colloidal activated carbon ensure long-term retention, on the order of several decades to hundred of years.
This presentation will include a real-life case study where the city of La Baie, Qc is installing surface filtration equipment at the potable network point of entry for these contaminants. We'll be comparing this approach both technically and economically versus the use of the soption materials based on in situ colloidal injectable surface-modified medias.

SPEAKER

Jean Paré, P.Eng. - Chemco Inc.

3:30PM - 3:55PM PT

USING ELECTRICAL HYDROGEOLOGY FOR REDUCED RISK IN FINAL REMEDIAL DESIGN

Background/Objectives: Environmental site characterization field efforts have demonstrated that Conceptual Site Models (CSMs) typically require high subsurface data density to accurately predict contaminant distribution and groundwater transport. Electrical hydrogeology via specialty electrical resistivity imaging (ERI) has been applied to site characterization for multiple decades with great success and increasing use. This technology can be used to build a robust conceptual site model (CSM) of the site for better remedial design characterization.

Approach/Activities: Electrical hydrogeology principles were added to the workflow at a Brownfields site contaminated with PCE and PAHs in Washington State. Targeted drilling locations were selected from the resulting images, and the CSM was updated. This scan-first-then-drill approach located additional areas of concern and helped identify bioremediation and zero valent iron injection as a potential remedial technology to compliment electrical resistance heating.

Results/Lessons Learned: The use of electrical hydrogeology revealed three primary areas of concern that were the focus of the subsequent targeted drilling. The CSM was expanded by including an assessment of the structural geologic controls influencing groundwater and contaminant migration. The results also indicated the presence of high biological activity in the dissolved phase contaminant plume. These results were supported by monitoring well data with PCE degradation products downgradient from the primary source area. Stakeholders were able to incorporate these results into their remedial design plans, providing discrete target zones for more cost-effective remediation and reducing the risk of trailing liabilities. The electrical resistance heating has reduced PCE/TCE (+/- 40 ppb or less) in GW and the bioremediation amendment/ISCR the injection area has reduced VC below 0.48 ppb. The estimated savings on remediation by using the characterizations tools was $3.7 Million.

SPEAKER

John Sankey, P.Eng. - True Blue Technologies

John is a solutions engineer with a degree in Mechanical Engineering from Queen's University in Kingston, Ontario. He has been in the groundwater industry for 24 years and in 2003 started True Blue Technologies, a business dedicated to providing engineering, technical support and business development for technologies in groundwater remediation and characterization.

Additional Authors: *Samantha Frandsen (Aestus, LLC, Reno, NV, USA), Stuart McDonald (Aestus, LLC, Loveland, CO, USA), Kyle Spears (Aestus, LLC, Oklahoma City, OK, USA)*

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3:55PM - 4:20PM PT

RESIDENTIAL REDEVELOPMENT OF A FORMER MULTI-WELL PAD AND BATTERY SITE WITHIN AN URBAN ENVIRONMENT

This presentation is a case study of environmental site assessments (ESAs), risk assessment, remediation, and facilitation of a timely Reclamation Certificate on a former multi-well pad and battery site within an urban environment. The objective was to remediate the site and redevelop it to residential/parkland land use. A land development application was in progress, and the stakeholders (developer, operator, and municipality) required the work to be completed in a timely manner to progress the development application as current development was encroaching on the lease.

Multiple ESAs and groundwater monitoring programs were conducted at the Site between 2011 and 2015 to evaluate potential soil and groundwater impacts related to former well site activities. Four areas of potential environmental concern were identified including three wellheads, several process buildings, a flare pit, a drilling waste disposal area, and aboveground storage tanks. A supplemental Phase 2 ESA was conducted in 2021 with the objective of delineating exceedances of petroleum hydrocarbons (PHCs), metals, and salinity parameters in soil. The volume of impacted soil at the site was estimated to be 18,700 m3.

Following the ESA activities, risk assessment was conducted using a screening level risk assessment (SLRA) approach. Site-specific remediation objectives (SSRO's) were developed for PHCs (Tier 2 pathway exclusion and modification) and salinity parameters in subsoil (Tier 2B Subsoil Salinity Tool [SST]). The SLRA and Tier 2 PHC guidelines development focused on soil quality guidelines for the vapour inhalation and drinking water pathways. To refine the results of the SLRA before remediation activities were initiated, a soil vapour assessment was conducted in 2021. The objective was to determine if the volatile PHC concentrations in soil vapour presented a risk through the indoor vapour inhalation pathway as related to future residential development with basements.

The remediation activities were conducted in Fall 2021 through excavation to Tier 2 PHC and Tier 2B SST guidelines. Model input assumptions initially made did not coincide with actual conditions encountered during the remedial efforts. Additional data collected during the remedial activities and backfill sampling were utilized to update the Tier 2B SST guidelines. In total, approximately 6,500 m3 of soil was excavated and transported off site, and a Reclamation Certificate application was submitted in February 2022.

Through the use of risk assessment and development of SSR O's the impacted volume of soils was greatly reduced (roughly 1/3 of the original estimated volume of impacted soils), resulting in avoiding unnecessary excavation of soils, unnecessary impacts to the environmental, and substantial cost savings.

SPEAKER

John Forbes, B.Sc., P.Biol. - Trace Associates Ltd.

John Forbes is an Environmental Scientist and Project Manager with Trace. John has over 10 years of experience in the industry and manages a wide variety of projects for clients in the upstream and midstream oil and gas industry, real estate and development, government, and other industrial sectors. John manages projects from initiation through to completion. He completes proposals and cost estimates for clients, conducts complex ESAs, soil and groundwater remediation, hazardous building materials assessments, data evaluation, technical report writing, and is responsible for mentoring and training junior staff. John is also a certified SST practitioner and completes complex salinity assessments for clients in all sectors.

4:20PM - 4:25PM PT

WRAP-UP

THANK YOU FOR JOINING US FOR THE 14TH ANNUAL SABCS CONFERENCE!