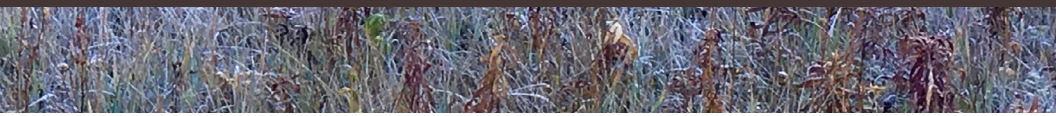

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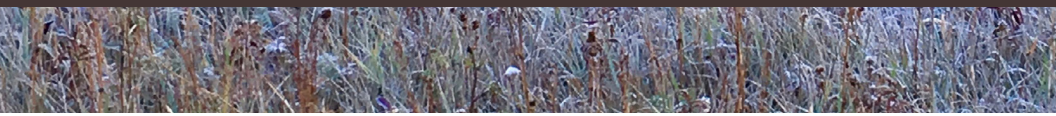

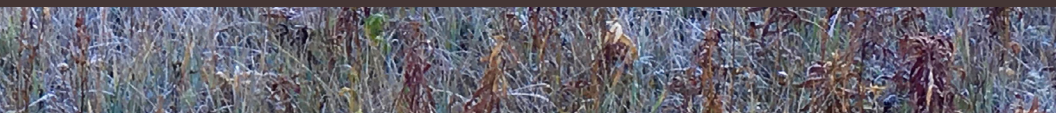

Appropriate Use of Dust Suppressants to Achieve Effective Dust Control for Unpaved Roads, Construction Sites and Industrial Sites

Xin Qiu and Amanda Allen, SLR Consulting

Dust from unpaved roads, construction sites, pipelines and facilities can cause safety and health concerns, increase operating costs, and cause nuisance issues for workers, landowners and stakeholders. Dust control on these sites can take considerable resources and time to manage.

The impacts of dust reach far beyond nuisance concerns, dust can have adverse environmental and health effects for both onsite staff and in neighboring communities. The airborne particles and contaminants can also have an impact on the surrounding environment as it deposits in fish bearing waterways and reduces air quality. Dust can also cause immediate safety concerns as it impacts visibility on unpaved roads and construction sites, dramatically increasing the potential for collisions. Dust can also reduce surface longevity of equipment, increasing maintenance costs.

Tailing ponds are designed to permanently hold mining waste material which is produced during the process of grinding up and separating minerals from ore. When mine waste material is pumped onto the tailings pond and the waste material left on top has dried out, it is of an extremely fine consistency. If left exposed, the material will inevitably be picked up by the wind and turned into dust. Until a mine site is fully rehabilitated with vegetation, which may take years, dust must be effectively managed.

There are many dust control techniques and options available to suit various purposes. One of the most common controls is the use of dust suppressants; however, the ideal suppressant for unpaved roads is unlikely to be suitable for a tailing pond application. There are several important factors to be considered when selecting a suppressant: effectiveness, applicability, environmental impact, and cost. This presentation will review different dust suppressant technologies and application scenarios, including watering, vegetation covering, moisture control with deliquescent salts, coagulants, organic nonpetroleum, electrochemical stabilizers, and synthetic polymers. The focus of the talk will be on the concept and consideration of appropriate dust suppressants selections for various common uses with minimized environmental impact, higher efficiency, and lower cost.

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Xin Qiu

Dr. Qiu has over 20 years of experience in meteorology, climatology and air quality studies. He has led and been involved in projects focusing on local and regional air quality, meteorology, severe weather, climate change, and GHG emission inventories, local/regional health impacts assessment in Canada and abroad. He has specialized in dust suppression, including modelling and mitigation for various situations including unpaved road, tailing ponds, mining surfaces, etc, Dr. Qiu is an Adjunct Professor of York University leading a climate change and advanced downscaling research project for Government of Ontario and Environment Canada. He is the Expert Panel Member of Standards Council of Canada (SCC) for climate change.

Dr. Qiu is an expert on climate change modelling, GHG emissions inventory, regional air quality and haze modelling, weather forecasting, analysis and consultation for mitigation and management large mining and oil and gas projects, including analysis of dust sources and emissions for regulatory modelling and monitoring, dust Management and dust mitigation consultation.

Amanda Allen

Ms. Amanda Allen is a Senior Environment Engineer and Regulatory Specialist with 18 years of experience in environmental management, permitting, regulatory compliance and risk management. She has managed environmental compliance on large scale pipeline projects, facility construction, and operating sites throughout western Canada. Ms. Allen has also led teams on major projects completing stakeholder engagement with internal, 3rd party, public and government stakeholders. Ms. Allen's pragmatic and versatile understanding of the regulations and needs of projects and clients have resulted in outstanding environmental performance with significant cost savings for her clients.

Reducing Methane Emissions One Alt-Femp at a Time

Terence Trefiak, Montrose Environmental

New regulations introduced by the Canadian provincial and federal governments in 2020 provide fugitive emissions management guidelines to the oil and gas industry, with the goal of reducing the industry's overall impact on climate change.

In Western Canada, the regulations that outline the requirements for fugitive emissions programs (FEMPs) include Directive 60 in Alberta, The Fugitive Emissions Management Guideline in British Columbia and The Oil & Gas Conservation Act in Saskatchewan all which require Leak Detection and Repair (LDAR) at every oil and gas site and facility.

When you consider how many facilities, sites and individual components there are to monitor, does it make sense to approach each site with the same brush? Considering multiple technologies depending on your site may be a better opportunity to develop a comparable dataset to the traditional survey method and could provide longer term benefits in reducing your greenhouse gas emissions. The allowance in the current regulations for this approach is an Alternative Fugitive Emissions Program or alt-FEMP.

In this presentation, Montrose will explore several technologies that assess a site from a micro view up to a macro level to gain a full picture of the fugitive emissions at a given site. These technologies include OGI cameras, mobile vehicle-based systems, drone detection and continuous monitoring sensors.

Terence Trefiak

Terence Trefiak brings over 20 years of industry experience to the Montrose team where he currently serves as Senior Vice President of LDAR, North America. He is an expert in fugitive emission management and specializes in providing clients with advanced emission reduction technologies for GHG/Methane and LDAR compliance. Terence is a Registered Professional Engineer in Alberta, Canada and is a member of the Association of Professional Engineers and Geoscientists of Alberta. In 2016, he received recognition from Ernst and Young as Entrepreneur of the Year in Canada. Terence holds a Bachelor of Science Degree in Chemical Engineering from the University of Calgary.

Using Intelligent Emissions Monitoring to Effectively Manage Emissions

Dennis Prince, Airdar Inc.

Emissions present challenges in many industries, ranging in severity from nuisance odors and losses in productivity to climate change and increased risks to public health. Effective management of emissions requires an understanding of the nature of emission sources affecting the site. Many emissions monitoring technologies are available that locate and quantify emissions with varying levels of success.

We present a novel solution that locates and accurately quantifies emission sources at a facility using continuous monitoring and intelligent analytics. The system uses concentrations of the target compound(s) measured at multiple locations either by stand-alone sensors or air samples drawn from several remote sampling inlets to one high-end instrument. Using intelligent data analytics, concentration measurements are combined with wind speed and direction data to identify emission plumes, track them back to their sources, and determine their emission rates. This solution can be used for any detectable compound and to date, has been used to track emissions of 26 different compounds including methane, hydrogen sulfide, benzene, 1,3-butadiene, and mercaptans.

Two case studies will be presented to demonstrate how concentration and wind data can be transformed into actionable information by the system. The first case study presents an application of the system at a steam-assisted gravity drainage (SAGD) facility. Here, continuous monitoring with data analytics informed facility operators on the location and relative importance of major emission sources. This provided information that allowed the right interventions to be made and effectively reduce overall site emissions. The second case study presents monitoring results at a composting facility in Edmonton, Alberta, Canada. During the initial monitoring period from October 2019 to March 2020, two focal points of hydrogen sulfide (H_2S) emissions were identified on the site. A plume of H_2S coming from the direction of several potential off-site emission sources was also identified, which could further explain the odors experienced in the community that were primarily attributed to the composting facility. Additional monitoring was performed from October 2020 to January 2021 and showed that interventions made at the facility reduced on-site H_2S emissions by 80%.

These case studies illustrate the potential of emissions monitoring technologies to help effectively manage a site's emissions by locating and quantifying emission sources, demonstrating improvement in facility operations, and resolving uncertainty regarding who is responsible for emission-related problems. This solution has been successfully applied in the oil and gas, chemical, wastewater treatment, and waste management industries, resulting in significant cost savings, improved safety at client facilities, and reductions in greenhouse gas (GHG) emissions and nuisance odors.

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Dennis Prince

With 25 years of experience in emissions monitoring, Dennis Prince is the inventor of the Airdar technology, and the CEO of Airdar Inc. Prince has led numerous projects in the oil & gas, chemical, wastewater treatment and waste management industries to remove uncertainty around odors and greenhouse gas emissions.

Dennis obtained a Master of Science in Environmental Engineering in 1993 from the University of Alberta. His experience includes eight years working as an environmental consultant, during which time he led the development of a personal monitor capable of measuring hydrogen sulfide in the low parts per billion (ppb) range. He is also the inventor of a slow sand filter that addresses the difficulties faced by rural communities in obtaining clean drinking water. In 2003, he realized he could use ambient air quality data to visualize plumes of airborne compounds and track them to their sources. His focus has been on developing Airdar ever since.

Geothermal Energy Sources, Applications and Benefits

Vladimir Agatonovic, Ecoterra Solutions Inc.

Geothermal energy, obtained by hot groundwater and/or steam extraction is a clean renewable source of energy. Today, geothermal energy applications in Europe, Asia, Australia and Americas present a significant alternative power (energy) source. Numerous applications have been developed and implemented to transfer heat from the hot groundwater or hot-dry rock systems to thermal or electrical power.

Geothermal power is considered to be sustainable because the heat extraction is small compared to the Earth's heat content. The emission inventory of existing geothermal electric plants is on average 122 kg of CO_2 per megawatt-hour (MW·h) of electricity, a small fraction of that of conventional fossil fuel plants.

Geothermal potential of an area could be estimated using various exploratory or analytical methods such as; drilling logs, down-hole geophysical logs, hot spring occurrences and other methods to identify geothermal gradient anomalies. In addition, water quality data from hot springs and wells can be used to predict water temperature deeper in a formation by analyzing indicator geothermometers (Na, Ca, Li ratios) and silica content.

Global estimates of the electricity generating potential of geothermal energy vary from 35 to 2000 GW. In 2005 worldwide installed capacity was 9,064 MWe, with the largest capacity in the United States (2,544 MW), Philippines (1931) and Indonesia (797). Direct uses at the same time contributed to approximately 15,000 MWt.

Primarily, there are three technological categories for geothermal use: geothermal heat pumps, direct-use applications, and power plants. Currently, the most efficient technologies require minimum water temperatures of 75ºC for 20MW electric power generation (Ormat). 1MW – 5MW power plants are commercially available, though they also require adequate hot water flow rates. A 1MW power plant is sufficient to supply 3,000 homes.

Open-loop geothermal systems are not generating any waste or byproducts, they do not cause any adverse effects on environment since hot water is extracted and injected back into the primary aquifer and therefore they could be considered clean energy. Same applies to closed-loop geo-exchange systems.

Oil and gas wells (active, non-active or abandoned) are producing formation water (produced water) as a by-product. An application of beneficial produced water use would be a geothermal application, with installation of a heat exchanger at the water-flood plant to provide a heat source. Heat exchangers could be used to heat or chill process facilities and buildings prior to injection into the desired formation. Following the heat extraction, produced water would be used to flood an oil reservoir through an existing injection well network.

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Vladimir Agatonovic

Mr. Agatonovic is a Senior Hydrogeologist with over forty years of experience undertaking water resources and environmental studies in North America, Europe, Thailand, Suriname and Venezuela. He also provides senior level technical review and oversight of groundwater quantity and quality exploration studies, environmental site assessment and remediation projects.

Vladimir planned, designed and supervised construction and testing of geothermal production wells and assisted in developing geothermal applications. During the 1980s oil crises, Mr. Agatonovic led a team of 7 specialists (mechanical, thermal, geological and chemical/process engineers) in selecting and developing areas of elevated geothermal anomalies (gradients) for the construction and installation of the geothermal energy applications in ex Yugoslavia, Greece, Hungary and Slovakia. Over the period of 5 years 24 geothermal systems with hot groundwater in a range from 340C to 860C were designed and constructed. The extracted geothermal energy was used for district residential and commercial facilities heating, industrial process enhancements, recreational and balneology applications. In addition, Vladimir conducted 3D hydrogeological numerical model to determine the groundwater cold front advancement generated by injecting used geothermal into the primary aquifer. Subsequently, few research studies and projects were developed to help determine the most suitable methods and techniques in controlling mechanical, biological and chemical well scaling issues and well performance optimization.

Planned, controlled and supervised production and geothermal energy, by exploitation of hot groundwater. Geothermal hot groundwater pre-treatment and methane gas separation. Planned and supervised a program to dispose of wastewater from geothermal projects by injecting it into primary aquifer. Technical and economic evaluation of 20 geothermal systems including determination of optimal production flow rate and energy use. Assisted in a project where dissolved methane from geothermal water had been separated and than contact-burned to increase hot water temperature by 20% - 25%.

Following enrolment on several international alternative energy conferences and workshops, in 1988, Vladimir competed Application in Geothermal Energy Diploma Course organised by International Geothermal Association (IGA), International Summer School, Pisa, Italy, with field trip applications in Macedonia and Greece. In 1989, Vladimir attended Geothermal Applications conference in Lagio di Como, Italy, organised by ENEL (Ente Nazionale per l'energia Elettrica) and visited the oldest geothermal power plant in Lardarello, Italy.

Subsequently, an array of geothermal applications was promoted, developed and implemented focusing on multi-user cascading energy (temperature) utilization based on industry needs, from large-scale district heating, recreational and balneology facilities to low enthalpy algae, fish and plant growing farms.

In the last decade Vladimir provided hydrogeological input a couple of geothermal projects in BC: Winfield Retirement Lodge heating, St. Leon Hot Spring Geothermal Potential and Ecotex geothermal potential.

Net Zero 2050: Energy Transition Opportunities for Alberta

Dani Urton, Vertex Professional Services Ltd.

Canada has recently made a number of domestic and international commitments to achieving ambitious goals related to climate change and energy system transformation. Canada's commitment to cut greenhouse gas emissions by 45% from 2005 levels by 2030 and target to reach net zero by 2050 will have substantial implications on Alberta's oil and gas industry, presenting significant challenges and opportunities to industry players.

In January 2022, the International Energy Agency (IEA) published an in-depth review of Canada's energy policies as part of a process to support policy development internationally. The findings of this report outline several opportunities through a forward look at anticipated changes to our energy system, including accelerated energy technology innovation; financial support for carbon capture, utilization and storage (CCUS), hydrogen, and cost prohibitive solutions such as geothermal energy and direct air capture; as well as policy measures to support the country's targets, including an ambitious carbon pricing scheme and a strong regulatory framework.

This presentation will provide an overview of the findings of the IEA report with a particular focus on Alberta's oil and gas industry, anticipated transition activities, and the implications on existing oil and gas producers, regulators, and service providers. We will discuss opportunities presented by the energy transition, highlighting the unique position of Alberta's energy industry to leverage existing, top-tier resources to achieve ambitious targets on the pathway to net zero by 2050.

These targets are achievable through collaborative efforts, effective utilization of existing and developing technologies, and by leveraging the cross-disciplinary creativity and ambition that our energy industry was built on. By pivoting from legacy systems and capitalizing on existing knowledge, we have an opportunity to manage the energy transition in a practical and meaningful way that provides a continued source of economic prosperity.

Dani Urton

Dani Urton is a senior leader with Vertex Professional Services, a leading provider of environmental services for the North American energy industry. Dani works to implement growth strategies related to energy transition and climate change initiatives across the organization to support the energy industry in meeting ambitious targets for sustainability. She has a decade of experience in the environmental sector of the energy industry including experience in environmental regulatory compliance, liability management, greenhouse gas emissions management, and strategic development of emerging growth opportunities. Dani holds a master's degree in Environment and Business from the University of Waterloo, an Environmental Management Certificate from the University of Calgary, and a bachelor's degree in Commerce from the University of Victoria.

Sustainability for Small- and Medium-Sized Enterprises – A Western Canada Case Study

Jacqueline Gorman, Trace Associates Inc.

Sustainability programs are commonly developed within large, publicly traded corporations. Recently, there has been increasing pressure from these organizations on their suppliers, along with their customers, to demonstrate sustainable practices. Small- and medium-sized enterprises (SMEs) are less likely to have sustainability programs in place due to the required investment and lack of internal expertise for program development.

Interactive Tracking Systems Inc. (itracks), a Saskatoon software company that develops online market research software, is presented as a case study for how SMEs can successfully participate in the sustainable economy. In 2021, itracks effectively overcame challenges and obtained external expertise to establish their first Sustainability Management Program in response to global customer demands.

itracks' baseline sustainability state was documented, and areas of weakness were identified via a gap assessment. A materiality study was undertaken to identify sustainability topics important to itracks' staff, clients, competitors, and leadership. Topics identified as material by the Stainability Accounting Standard Board (SASB) were referenced to confirm relevance and completeness.

itracks is planning a vision setting process in the near future to guide sustainability actions and metrics. In the meantime, a sustainability road map was created to document the material topics, targets, metrics, and schedules to guide the change management process through the early stages.

Jacqueline Gorman

Jacqueline Gorman is a Partner and Practice Area Lead for Remediation and Risk at Trace Associates Inc. (Trace). She is a registered Sustainability Excellence Associate with the International Society of Sustainability Professionals and has training through the Greenhouse Gas Management Institute. At Trace, Jacqueline is responsible for establishing internal technical standards, developing strategy, and managing quality assurance within her practice area. She provides senior technical guidance for complex projects, and staff mentorship.

Ms. Gorman is a technical expert in environmental assessment and remediation, liability assessment, regulatory management, and large facility decommissioning, with a focus on contaminant hydrogeology and sustainable remediation. Additionally, Jacqueline has led multidisciplined teams conducting risk assessment, reclamation, and natural science projects throughout Western Canada. Ms. Gorman is a registered Professional Geoscientist in the provinces of British Columbia, Alberta, and Saskatchewan, and acts as an environmental subject matter expert for the ASET/ APEGA Joint Board of Examiners.

Pushing the Boundaries on Quantitative PFAS Analysis

Darlene Hoogenes-Stastny, ALS Canada

There are hundreds of chemicals that can be classed as PFAS (Per and poly-fluorinated Alkyl Substances). Accredited laboratories typically determine approximately 30 of these specific chemicals. ALS continues to be a global leader in support of the on-going investigation into PFAS impacts on the environment and the many compounds that are currently not actively measured in routine analysis. Traditional PFAS analysis only targets the key analytes and therefore may or may not greatly underestimate the presence of PFAS in the environment. US EPA continues to discuss the ongoing PFAS Action Plan to address these long-lasting 'forever chemicals'. Under the CWA Analytical Methods it was announced that in collaboration with the US Department of Defense a more extensive list of 40 compounds would be analytically developed in support of wastewater as well as surface water, groundwater, leachate, soil, sediment, biosolids, and fish tissue matrices. This includes the following compounds not routinely tested at accredited laboratories:

Abbreviation	Name – Acid/Neutral Form	CAS#
3:3 FTCA	2H, 2H, 3H, 3H-perfluorohexanoic acid	356-02-5
5:3 FTCA	2H, 2H, 3H, 3H-perfluorooctanoic acid	914637-49-3
7:3 FTCA	2H, 2H, 3H, 3H-perfluorodecanoic acid	812-70-4
NFDHA	Perfluoro-3,6-dioxaheptanoic acid	151772-58-6
PFEESA	Perfluoro(2-ethoxyethane)sulfonic acid	113507-82-7
PFMPA	Perfluoro-3-methoxypropanoic acid	377-73-1
PFMBA	Perfluoro-4-methoxybutanoic acid	863090-89-5

ALS Globally has been a market leader in the PFAS testing capabilities starting from the Australian Marketplace and actively explored and implemented in the North American region. ALS Waterloo is proud to release a new service offering in support of EPA's invested efforts in targeting the solutions needed to address PFAS in the environment and on-going PFAS studies and remediation. ALS will now offer an extended list of targets to reach a quantitative LCMSMS scan of up to 51 compounds.

This compound list and associated detection limits supports the rapid movement in the United States on control and ban of these contaminants in the environment. The extended suite can be obtained from the existing 60mL sample submission bottle for the regular suite of targets meeting all regulatory guidelines globally.

In order to continue obtaining a deeper knowledge of PFAS compounds and their fate, analytical laboratories need to continue to pursue the full scope of analytes. ALS Waterloo's extended suite offers analysis of PFECHS which is found in aviation hydraulic oils as well as fluorotelomer carboxylic acids 3:3 FTCA and 5:3 FTCA that are major components in legacy landfill leachates. The following targets not listed above are included in the extended list:

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Abbreviation	Name – Acid/Neutral Form
PFECHS	n-Decafluoro-4-(pentafluoroethyl)cyclohexanesulfonate
FHUEA	n—2H-perfluoro-2-octenoic acid (6:2)
FOUEA	n—2H-perfluoro-2-decenoic acid (8:2)
FDUEA	2H-Perfluoro-2-dodecenoic acid
6:2 FTCA	n-2-perfluorohexyl ethanoic acid (6:2)
8:2 FTCA	n-2-perfluorooctyl ethanoic acid (8:2)
10:2 FTCA	n-2-perfluorodecyl ethanoic acid (10:2)

ALS has always concluded that there is a need to expand analytical suites to cover other PFAS that may arise from weathering that might include some oxidation and hydrolysis and, ideally, to have better models for predicting environmental endpoints. Without measuring all of these compounds the potential for ongoing contamination, as these compounds go through weathering processes, is a large liability. New analytes of concern will be reviewed to show the impact of the never before measured targets on Canadian Sites. How will this change the on-going scope of PFAS remediation and site characterization? Product breakdown scenarios will be discussed and explored to highlight where these new compounds fit in the biodegradation of AFFF.

Darlene Hoogenes-Stastny

Darlene has been working in the environmental industry for over 30 years. Her experience working for environmental laboratories spans waters, soils and in the last 6 years has come to include tissue and air. From 2010 to present Darlene has been the contract lead for a standing offer agreement with the Department of National Defence (DND) which includes the Royal Military College-Environmental Services group. On a federal level DND has been instrumental in initiating PFAS testing and requesting expanded compound lists and lower detection limits which ALS has been able to provide. Darlene is currently the ALS Canada-National Air Quality Specialist. Her early career experience includes 7 years in health care (geriatrics), 3 years in the automotive industry, as well as 2 years in environmental compliance. She is a member of OOWA (Ontario On-Site Wastewater Association), OMA (Ontario Mining Association), an associate member of AWMA (Air & Waste Management Association), and a CET (certified environmental technologist). Her interests include spending time with family, horseback riding, travel, and she is a member of a Dutch language community theatre group

Destructive Technologies Overview for Complete PFAS Treatment Solutions

Paul Newman

Long term liability surrounding PFAS waste products and discharges has always been of concern to DOD and industry. This concern has only increased as regulations are developed with greater restrictions on PFAS management. In order to move beyond just sequestering per and polyfluoroalkyl substances (PFAS), many organizations are looking to find methods to completely break down the carbon-fluorine bond and achieve mineralization of PFAS compounds. ECT2 has developed technologies that concentrate PFAS to help make these technologies feasible. Due to our involvement in several different destructive technology bench tests and field pilot projects, ECT2 is in a unique position to provide an overview of the promising options for mineralization of PFAS compounds. This presentation will give a summary of what some of these technologies are and how they work. Discussions will include the basic mechanisms each employs for the destruction of PFAS, advantages and disadvantages of each, as well as who is currently working on these technologies. The following technologies will be highlighted: Plasma, Thermal, Electrochemical Oxidation, Electron Beam, Advanced Oxidation, Supercritical Water Oxidation, Hydrothermal Alkaline Treatment, Sonolysis, UV-sulfite, Zero-valent Iron, Alkali Metal Reduction, and Biodegradation. This briefing will include the advantages of concentrating PFAS to minimize the volumes requiring treatment. ECT2's Dr. Steve Woodard supported and co-authored a recently published article on an electro-chemical oxidation demonstration project conducted at Wright Patterson AFB. Additionally, field work was completed on a plasma destruction field demonstration at the former Pease AFB in the summer/fall of 2021. Discussion of these two promising technologies will be included.

Paul Newman

Paul Newman is the Department of Defense Market Sector Leader for ECT2 (Emerging Compounds Treatment Technologies). ECT2 is an equipment company focused on developing and implementing treatment technologies for PFAS and other emerging, difficult-to-treat contaminants, with full-scale PFAS treatment plants operating in the US and Australia since 2017. Paul's focus is currently on supporting the DoD in pilot- and full-scale water treatment deployment, and pairing our regenerable ion exchange process with destruction technologies. He received his Bachelor's Degree in Geology from the University of Windsor and his Master's Degree in Mineral Exploration Geology from McGill University.

Advantages in the Application of Thermal Desorption Tubes in Soil Vapour Investigations

Bryan Shaw, CARO Analytical Services

The scientific and regulatory communities have long been aware of the potential for migration of vapours from contaminated subsurface areas into buildings. However, incorporation of soil vapor analysis as part of a site investigation remains inconsistent across Canada. For example, exposure through the vapour pathway finds its way into Alberta's Tier 1 and Tier 2 Guidelines which utilize a risk-based assessments to determine acceptable contamination levels. The British Columbia Contaminated Sites Regulations take a more direct approach after including soil vapour as a regulated matrix in a 2009 amendment to the guidelines. As a result of this variability an understanding of testing protocols can also be challenging. There are two EPA methods available for the determination of volatile organic compounds (VOCs) in air, TO-15 and TO-17. TO-15 typically employs summa canisters, which are large stainless steel vessels. On the other hand, TO-17 uses a sorbent tube instead of a summa canister to collect the sample. A sorbent tube contains adsorbent material specifically selected to trap the analytes (or range of analytes) of interest. A known volume of vapor is sampled through the tube, whereby the contents are then desorbed onto a secondary trap into the analytical column to be analyzed by GC/MS. The tube technology was designed to overcome some of the challenges associated with soil vapor analysis such as high moisture content, proper cleaning of sampling media and the requirement for a greater number of analytes over a wide range of concentrations. This presentation will provide an overview of field sampling with thermal desorption tubes and provide a comparison to the summa canister approach. Laboratory data comparing the advantages and disadvantages of each method will also be presented along with tips for designing a sampling program.

Bryan Shaw

Bryan Shaw is Senior Technical Support Scientist with CARO Analytical Services. Bryan holds a Ph.D in Chemistry from the University of British Columbia as well as his Professional Chemist designation through the Association of the Chemical Profession of British Columbia (ACPBC). After gaining exposure in chemistry research through academia his career shifted to CARO Analytical Services in a client facing role that utilizes his technical background. Bryan joined CARO as a Client Service Scientist handling some of CARO's key accounts in the environmental industry. As a Senior Technical Support Scientist Bryan takes advantage of the industry knowledge gained while managing accounts to provide clients with technical support and provide operational guidance according to the latest environmental regulations and analytical practices. This role also affords the opportunity to collaborate on special project needs and the development of new analytical methods. Bryan also serves as President on the board of the Environmental Managers Association of BC.

Interactive App for GW Statistical Trend Analysis and 2D Plume Stability Visualization

Peter Solymos, Khalid Lemzouji and Brandon Smith
Analythium Solutions Inc.,

Data has quickly become one of the most valuable resources for any organization within the environmental industry. Field Sampling and GW remote sensors has made it possible to gather massive sets of GW/SW data. While this data has valuable information (trends, patterns, and correlations) for informed decisions makers, the manual extraction of that information is lengthy and laborious. The extraction traditionally uses various independent tools such as Excel spreadsheets, statistical software, and GIS software. One solution to simplify this lengthy fragmented process is to build a customized data visualization/analysis app that can stream the data directly from Excel spreadsheet or lab/client database into the app for data visualization, trending, and reporting.

In this presentation, we will showcase a fit for purpose data visualization, trending, and reporting app for Ground Water (GW), and Surface Water (SW). This customized app is built to visualize GW and SW patterns, run statistical trends analysis (e.g., Mann-Kendal trend test), estimate GW plume change over time and space, and present the results in a visual and intuitive way for decision makers. The app was able to reduce the time of GW trend analysis, in average, by 30-50%. The app is cloud-based accessible from any computer or smart phone with internet connection.

Khalid Lemzouji

Mr. Lemzouji is a senior statistician and data scientist. He has 15 years of experience in environmental, public health, and pipeline reliability risk decision. Khalid is skilled in using statistical and machine learning tools to transform data to knowledge. The knowledge is used for informed decision making by environmental scientists, cardiac surgeons, and pipeline engineers. As a professional statistician with double bachelor's in chemical engineering and statistics he specializes in sampling design and statistical modeling for environmental data for regulatory compliance in Canada and USA.

His work in the environmental sector focuses include surface water, hydrogeology, hydrology, soil, contaminated soils analysis, geophysics, air, fish and wildlife health evaluation. Most recently his work integrates public health statistics through automation, data streaming, statistical modeling, and machine learning. Khalid builds customized applications for the environmental industry which automate data analysis and visualization for better communicating the result to decision makers

Managing Environmental Data via Esdat Online to Meet Updated Regulatory Requirements, Support Efficient Workflows and Establish a Work-Life Balance Culture

Nick Tumney, Earthscience Information Systems
Sean Babulic, Gwaii Engineering

Gwaii Engineering ("Gwaii") values a flexible and work-life balanced culture and embraces the use of innovative technology to support their ESG corporate initiatives.

This means Gwaii wants the best available processes to support efficient workflows, and need to access their systems while staff work at various remote locations, including from home over the course of the pandemic.

Gwaii adopted ESdat Online ("EO"), a cloud-based package from EarthScience Information Systems ("EScIS"). EO is a specialized environmental database system; used to import, validate, analyze, and report a broad spectrum of environmental data.

EO interfaces with major Canadian environmental laboratories and is pre-populated with major Canadian regulatory guidelines including the recently updated Ministry of Environment Contaminated Sites Regulation B.C. Reg. 375/96.

Before EO, Gwaii experienced common data management challenges, including time-consuming manual data entry, missed regulatory guideline exceedances, bottlenecks, cut & paste errors, difficulties compiling large data sets, clunky borehole logging software, and problems sharing analytical data.

Adopting EO delivered the following benefits:

- Intuitive, automated, and user-friendly interface, allowing staff - from field technicians to project directors - the ability to import and interrogate data, no matter the location
- More consistency in data presentation with standardized table layouts and guideline exceedance formatting
- Automated laboratory report upload and checking of QA/QC - such as field and lab RPDs, blank analysis, and spike recoveries - saving time and increasing confidence in data quality
- Increased time to consider and interpret data, less time arranging and formatting it

Integrating EO into workflows has allowed Gwaii to put their time and effort into interpreting their data and providing their clients with the best advice possible.

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Jane Pirie

Jane is a registered Engineer in Training with a degree in Environmental Engineering from the University of Guelph in Ontario, Canada. Jane has over four years of experience working in environmental consulting including almost three years working in Vancouver in the air quality industry. Since the beginning of 2021, Jane has worked at Gwaii Engineering Ltd. as an environmental project engineer. Her roles with Gwaii have involved completing Stage 1 and Stage 2 Preliminary and Detailed Site Investigations including soil, groundwater and soil vapour sampling for contaminated sites, data analysis and management, and construction environmental monitoring.

Gwaii Engineering is an Indigenous-owned and operated Civil and Environmental Engineering consultancy based in Vancouver Island, serving communities throughout BC.

Nick Tumney

Nick, a Senior Implementation Specialist at ESclS Canada, oversees the implementation and client management of ESdat. This includes onboarding, developing & providing training services, and other support services. Prior to ESclS, Nick spent 10 years working as an environmental consultant in Melbourne, Australia. His roles included project management, environmental sampling & fieldwork, and data management tasks for various clients across the contaminated land sector. Nick has a B.Sc. specializing in Earth Science and a Masters of Spatial Information Science.

ESclS Canada, headquartered in Vancouver, provides environmental data management software, training, and other support services in industry.

Use of GIS and Custom Apps for Wind Farm Environmental Assessments (EAs)

Jeff Benjamin, Dillon Consulting

The project involved two large potential wind farms requiring a significant amount of fieldwork to support regulatory filings. In order to help collect, manage and report the data to support these filings GIS was used heavily. Dillon developed its own wet areas model using GIS (Geographical Information Systems) to predict potential watercourse and wetland crossings not mapped in provincial or wetland watercourse datasets. This process relies heavily upon the availability of LiDAR Digital Elevation Models (DEM). A flow accumulation analysis was completed to determine the area that flows into each cell within the study area. Using these data and applying a suitable threshold is a useful predictor of watercourses, potential watercourses, and drainage channels within a study area. The potential watercourses and drainage channels are then used as an input into potential wet areas modeling. Wet areas modeling involves comparing the elevations of each cell in a study area against the elevation of the nearest known mapped water features (lakes, rivers, wetlands, etc.). Where there are small differences in the ground elevation against these features (i.e. less than 1m) these areas can be good predictors of potential wet areas. The predicted watercourse crossings and wet areas were used to help plan and prioritize field work - and supplement gaps in areas not delineated in the field.

In addition to the wet areas model, biophysical data collection tools for plants, birds, mammals, wetlands and watercourses were developed to allow all data to be collected digitally in the field. The project, wet areas, and other relevant base data were all available to field staff in the field so they could make more effective use of their time. These tools were built specific to the provincial requirements and included AC CDC species rankings so that information was automatically attached to each data point collected. Traditionally this data would have been collected using paper and hand held GPS units. The bird point count tool alone allowed for the collection of over 6000 bird observations just on these two projects.

Dillon also developed field data collection and automated reporting applications for bird and bat monitoring on Wind Post-Construction (WPC) monitoring projects. A template has been developed that can be quickly rolled out via smartphones on new projects with minor project specific customizations. The apps were developed and tested on two New Brunswick and two Ontario wind sites in the summer of 2021. The apps were built to collect data and photos in the field, be reviewed/edited by PM/field staff in the office, and generate client reports on demand. This allows for a user-friendly interface for project team members to gain insights into the project data in real or nearly real-time. For one of these projects an automated report was provided to an external stakeholder on a bi-weekly basis to keep them informed on the project.

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Jeff Benjamin

Jeff is a GIS Specialist with a degree in Biology and 13 years of consulting experience supporting projects across Canada. He has worked on a variety of environmental management, planning, and risk assessment projects including; constraints analysis and site selections, environmental impact assessments, environmental protection and monitoring plans, and environmental site assessments. Jeff has considerable experience in GIS providing database design, data management, spatial analysis, and cartographic support on hundreds of projects of varying scope and complexity for numerous disciplines and industries. Jeff is the Technical Group Strategist (TGS) for the national Spatial Information Management (SIM) team.

What You Need to Know About Digital Transformation

Vincent Lam, Matidor.com

Digital transformation is undoubtedly one of most researched topics amongst the 21st century. It is being defined as the using of digital technologies to improve business processes, culture and client experiences. For energy and environmental organizations, it means a new way to convert physical findings from the field, into digital, actionable insights, in order to maximize operational efficiency, team collaboration and cost savings. To many, it may seem like a matter of adding more apps and software into their already bloated technology stack - but is it really the case?

Ironically, organizations often suffer not because of the lack of apps, but of having too many uncoordinated "silo" systems and databases. Studies have shown that average companies deploy over 100 apps and software in different areas of operations, and still find themselves constantly catching up with competition. So the question remains - what are key considerations when bringing in your next piece of technology? How can you remain agile without massive re-investment, while technologies are changing ever so quickly? During this presentation, Vincent Lam from Matidor.com will walk through the most common mistakes made by companies when adopting new software, and will provide some guidance to the latest technology landscape and deployment best practices.

Vincent Lam

Vincent Lam is the CEO and co-founder of Matidor.com. A visionary and 3x founder, Vincent built and sold his first Point-of-Sale system during his university years, and later joined Google to lead projects with the Google Earth team. Vincent has over 20 years of experience commercializing software innovations for environmental and energy companies, including GIS, marketplaces and AR/VR platforms. Vincent holds an MBA from the University of Ottawa and a BASc in Computer Engineering from UBC.

Hydrogen Development in Alberta: Policy, Regulation, and Future Development

Michael Barbero, McLennan Ross LLP

Hydrogen is touted as a clean way of addressing the world's current and future energy demands. This is particularly so in Alberta, where the Provincial Government views hydrogen as both a means of providing clean energy domestically while bolstering the natural gas industry in the years to come through natural gas based hydrogen production processes. Despite the Government's support, what are the future prospects for hydrogen development? Is the regulatory environment conducive to ongoing and future development? What issues or concerns should regulatory professionals and others be aware of when advising clients in this space? In the course of my presentation, I plan to address three objectives aimed at answering these questions. First, to examine the policy landscape behind hydrogen development in Canada, with particular focus on the Alberta Government's Energy Roadmap. Second, to examine and consider the regulatory framework that is currently in place and consider needed reforms. Lastly, to discuss the future prospects of hydrogen from a provincial, national and even international perspective

Michael Barbero

Michael is Co-Chair of the McLennan Ross' Energy, Environmental & Regulatory Practice Group. Michael provides legal advice on environmental issues, commercial transactions and litigation matters. He acts for a wide variety of clients including large industry players, municipalities, landowners, government departments and administrative tribunals.

Michael's representative experience includes acting for clients before regulatory bodies (including the Alberta Energy Regulator, Alberta Utilities Commission, Natural Resources Conservation Board and Canada Energy Regulator) in relation to project approvals and related regulatory matters. These include approvals for a large combined-cycle gas fired power generating facility, multiple wind farm applications, sour gas well applications, and other large scale natural resource projects.

Further, Michael's experience in the environmental sector extends to issues of climate change, environmental insurance, and surface rights.

A skilled litigator, Michael has appeared before all three levels of Alberta Courts (Provincial Court, Court of Queen's Bench, and Court of Appeal) representing or assisting in the representation of international, national, and midsized corporations, national financial institutions, national insurance companies, resource developers, and national political parties.

Licensee Life-Cycle and Liability Management Framework for Energy Projects in Alberta – Legislative, Regulatory and Case Law Update since *Redwater*

Chidinma B. Thompson, Borden Ladner Gervais LLP

Since the Supreme Court of Canada's decision in the *Redwater* case, Alberta has overhauled its Liability Management regime for licensees of the Alberta Energy Regulator. There are also a few court cases that have attempted to apply the *Redwater* principles in Alberta. This presentation will review the current status of the legal and regulatory regime for environmental liability for energy projects and how the *Redwater* principles fit into the new legislative framework.

Chidinma B. Thompson

Chidinma Thompson, PhD, FCIArb. is a Partner at the law firm Borden Ladner Gervais LLP. Her practice focuses on commercial litigation, domestic and international arbitration, regulatory and administrative law, environmental and climate change law. Chidinma works with a broad range of sectors including oil and gas, petrochemicals, electricity, renewable energy, utilities, municipal, and land development.

Chidinma is the current Chair of the Alberta Environmental Appeals Board, and oversees the administration of the Alberta Public Lands Appeal Board.

Chidinma has experience in regulatory hearings before the Alberta Energy Regulator and its predecessors, Alberta Utilities Commission, Canadian Energy Regulator and its predecessor, and other regulatory boards. She has appeared before all levels of Court in Alberta.

Chidinma has taught various law courses at the University of Calgary Law School, and Environmental Law in the Energy Sector at the Haskayne Business School's MSc. Program on Sustainable Energy Development.

She frequently publishes in law journals and blogs, and is a contributor of several book chapters.

Practical Implications of the Supreme Court of Canada's Decision in *References re Greenhouse Gas Pollution Pricing Act,* February 8, 2022

Mark Youden, Wally Braul and Josh Jantzi, Gowling WLG

The federal *Greenhouse Gas Pollution Pricing Act* ("GGPPA") sets minimum national standards for pricing greenhouse gas ("GHG") emissions. The law was challenged by several provinces over the span of the last few years on the basis that it infringed on provincial jurisdiction and was therefore unconstitutional. In 2021, the majority of the Supreme Court of Canada held that that law is in fact justified as a matter of national concern under the "peace, order and good government" clause of the Constitution. In doing so, the Court noted "the effects of climate change have been and will be particularly severe and devastating in Canada," with the Canadian Arctic facing a disproportionately high risk. Justice Wagner (writing for the majority) noted that "no one province, territory or country can address the issue of climate change on its own. Addressing climate change requires collective national and international action. This is because the harmful effects of GHGs are, by their very nature, not confined by borders."

The decision means that the *GPPAA* continues to be in force, and the federal backstop currently applies in full or in part in Ontario, New Brunswick, Manitoba, Nunavut, Yukon, Alberta, PEI and Saskatchewan. Those provinces with federally-approved pricing schemes for GHG emissions may also continue with their plans.

The implications of this decision are far reaching in the environmental industry. In this presentation, we highlight the arguments that swayed the majority of the Court, and provide insights into how the decision may impact the environmental industry moving forward.

Mark Youden

Mark Youden is a partner at Gowling WLG with a practice focused on environmental, regulatory, construction and Indigenous law matters in both an advocacy and advisory capacity. Mark is called to the bar in British Columbia, Alberta and Ontario, and services clients from industry, government and Indigenous groups.

As an advocate, Mark regularly appears in courts in British Columbia and Alberta, as well as the Federal Court. Mark also frequently advocates at administrative tribunals, such as the British Columbia Environmental Appeal Board, the British Columbia Utilities Commission, the Alberta Environmental Appeals Board and the Environmental Protection Tribunal of Canada. Mark also has experience in arbitrations and alternative dispute resolution forums.

Prior to joining Gowling WLG, Mark earned a Master of Environmental Science and worked as an environmental consultant for an international engineering firm.

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Josh Jantzi

Josh Jantzi is a partner in Gowling WLG's Calgary and Vancouver offices, practising in the Advocacy Group. As regulatory and litigation counsel, he has practised in Indigenous, environmental, transportation, constitutional, municipal and other administrative law for 13 years with a focus on energy and natural resource development. Josh has represented energy and mining companies in precedent-setting cases in the regulatory review and environmental assessment spaces, most notably before the Supreme Court of Canada in *Chippewas of the Thames First Nation v. Enbridge Pipelines Inc.*, 2017 SCC 41.

Josh was called to the bars of Ontario and Alberta in 2006 after serving as judicial law clerk to the Hon. Mr. Justice M.A. Kelen (Federal Court, Ottawa).

Josh's regulatory practice includes development, review and assessment of energy and natural resource projects including pipelines, upstream PNG production, LNG facilities, biogas and RNG facilities, hydro power plants, fracking operations and gas plants, wind farms, solar farms, marine terminals and shipping, water diversion works, open pit mines, forest product facilities, and waste management facilities.

Josh's environmental law practice includes environmental and impact assessment, land and water use, management of contaminated sites, the protection of species at risk, cultural heritage, transportation of goods, waste management, and prosecuting and defending against enforcement and related legal proceedings.

Josh's municipal law practice includes development, land use, assessment, licence and expropriation matters, and drafting legislation. He has presented these matters before municipal councils, SDABs, municipal government boards, other local regulators, and before the Courts.

Josh's civil litigation and arbitration practice includes contract, tort and IP disputes spanning the energy, construction, aviation, telecommunications, infrastructure and PPP industry sectors. He maintains a significant practice litigating matters before the Federal Courts.

Josh has instructed the University of Calgary Faculty of Law full credit Aboriginal Law course for several years and serves as a guest instructor of the law school's North American Energy Law, Transportation Law, and Negotiation courses.

Josh is an officer of the Canadian Bar Association (CBA)'s National Environmental, Energy and Resources Law section (Vice Chair), and sits on the executive of the National Aboriginal Law and Administrative Law sections. He is an officer of the CBA Alberta Administrative law section (Treasurer) and Aboriginal Law section (Legislative Review). Josh represents the practicing bar on the Federal Court of Appeal and Federal Court Bench and Bar Committee.

Through the Lens of Recent Environmental Decisions and Legislation: The Ever-Changing Practice of Environmental Law (Part 1)

Jacquelyn Stevens and Matthew Gardner
Willms & Shier Environmental LLP

Environmental law did not escape the ever-changing year that was 2021.

Part 1 - While the pandemic led to shutdowns and delays, Courts and Tribunals across Canada went virtual and decided several notable environmental civil and regulatory disputes.

During this 2 part presentation, Jacquie Stevens and Matt Gardner will provide highlights that speak to environmental risks and liability during changing and uncertain times.

Jacquelyn Stevens

Jacquelyn Stevens B.Sc. (Hons.), M.Sc., M.S.E.L., LL.B., is a Partner at Willms & Shier Environmental Lawyers LLP and is a Certified Specialist in Environmental Law by the Law Society of Ontario. Jacquie has significant expertise representing a wide range of clients in environmental civil litigation, defence of prosecutions by environmental regulators, and at administrative appeals and hearings. Jacquie also provides effective advice and solutions for environmental due diligence and compliance, brownfields/contaminated site remediation, and environmental approvals for air, odour, noise and waste. Jacquie advises on cross-boundary migration of contamination and remediation options and has significant expertise involving contamination issues at dry cleaning operations and gas stations. Jacquie is called to the Bar in Alberta and Ontario.

Matthew Gardner

Matthew Gardner B.Sc. (Hons.), LL.B., is a Partner at Willms & Shier Environmental Lawyers LLP and is a Certified Specialist in Environmental Law by the Law Society of Ontario. Matthew practices environmental law and environmental litigation. He provides advice and solutions about environmental due diligence and compliance to a wide range of clients including industrial corporations, the construction and land development sectors and municipalities. Matthew also provides advice and solutions about contaminated land issues, environmental risk management, environmental transactional due diligence and regulatory compliance. Matthew regularly appears before the Courts and administrative tribunals. He also assists clients under inspection or investigation by federal, provincial and municipal environmental regulators, and defends clients against environmental regulatory prosecutions. Matthew is called to the Bar in Alberta and Ontario.

Through the Lens of Recent Environmental Decisions and Legislation: The Ever-Changing Practice of Environmental Law (Part 2)

Jacquelyn Stevens and Matthew Gardner
Willms & Shier Environmental LLP

Environmental law did not escape the ever-changing year that was 2021.

Part 2 - Governments moved forward with the review, development and amendments of key environmental legislation.

During this 2 part presentation, Jacquie Stevens and Matt Gardner will provide highlights that speak to environmental risks and liability during changing and uncertain times.

Jacquelyn Stevens

Jacquelyn Stevens B.Sc. (Hons.), M.Sc., M.S.E.L., LL.B., is a Partner at Willms & Shier Environmental Lawyers LLP and is a Certified Specialist in Environmental Law by the Law Society of Ontario. Jacquie has significant expertise representing a wide range of clients in environmental civil litigation, defence of prosecutions by environmental regulators, and at administrative appeals and hearings. Jacquie also provides effective advice and solutions for environmental due diligence and compliance, brownfields/contaminated site remediation, and environmental approvals for air, odour, noise and waste. Jacquie advises on cross-boundary migration of contamination and remediation options and has significant expertise involving contamination issues at dry cleaning operations and gas stations. Jacquie is called to the Bar in Alberta and Ontario.

Matthew Gardner

Matthew Gardner B.Sc. (Hons.), LL.B., is a Partner at Willms & Shier Environmental Lawyers LLP and is a Certified Specialist in Environmental Law by the Law Society of Ontario. Matthew practices environmental law and environmental litigation. He provides advice and solutions about environmental due diligence and compliance to a wide range of clients including industrial corporations, the construction and land development sectors and municipalities. Matthew also provides advice and solutions about contaminated land issues, environmental risk management, environmental transactional due diligence and regulatory compliance. Matthew regularly appears before the Courts and administrative tribunals. He also assists clients under inspection or investigation by federal, provincial and municipal environmental regulators, and defends clients against environmental regulatory prosecutions. Matthew is called to the Bar in Alberta and Ontario.

Bioremediation - Eliminating the Entire Spectrum of Hydrocarbons Through a One-time Application

Myles Ethier, Long Chain Reclaim

We are pleased to announce that F4 Environmental Inc., has developed the bioremediation technology to transform hydrocarbon contaminants into water and a minute amount of carbon dioxide through a 100% environmentally sustainable and safe process.

In 2009, F4 Environmental Inc. began developing breakthrough processes and procedures in hydrocarbon bioremediation. Over the last 10 years, F4 Environmental Inc. has worked with a wide range of companies on over 80 different projects to continuously prove the efficacy of its unique technology.

Our technology can change the world's perception of oil contamination and waste generated from related industries by providing an environmentally sustainable bioremediation solution for not only the shorter- chain hydrocarbons, the BTEX, our bioremediation technology can remediate the long-chain hydrocarbons also.

Long Chain Reclaim Ltd. (LCR) is a majority Aboriginal owned Canadian company based in Alberta. Established in the early 2020, as the operations division of F4 Environmental Inc. and to market their bioremediation technology both nationally and internationally.

It is the vision of Long Chain Reclaim to expand remediation of hydrocarbon contaminated soil on-site, making remediation more affordable and environmentally sustainable.

LCR utilizes, a non-invasive, on site, in-situ drilling implementation soil treatment ($35-$55/m^3), and on-site ex-situ ($55-$85/m^3) soil treatment processes where the soil is excavated for remediation using our Earth Cleaning Machine. These processes eliminate the costly operations required to remove contaminated material from sites for 'storage' at landfills or other facilities, not to mention the liability that comes with long time "storage" in a landfill.

Bio-Reclaim is our highly purified, naturally occurring bacteria (Pseudomonas) that mineralize the petroleum hydrocarbons and toxic organics into water and a minute amount of carbon dioxide; their main nutrition is hydrocarbons. Bio-surf is the delivery agent for Bio-Reclaim. It is a surfactant that decreases the surface tension, allowing delivery of our microbes into soil contamination pockets. Bio-surf is environmentally friendly, and bio-degrades rapidly.
Long Chain Reclaim Ltd. welcomes projects in the oil and gas industry to remediate invert cuttings, contaminated soils such as sumps or mud pits, and effected bodies of water. LCR also has extensive experience in brownfield projects (commercial land, underground storage tanks, etc.) in densely populated regions where land and ground disturbances come at an inflated cost.

Both Bio Reclaim & Bio Surf are pathogen free, DNA tested, listed on the DSL (Domestic Substance Listing), TSCA approved, NCP approved, and approved for shipment worldwide.

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Project Profile #1

An old Fuel Station that is a now defunct fueling station with all associated support structures, involved in the fueling and maintenance of trucks and/or equipment have been removed. The plume of contaminated soil was estimated to be 8,000 cubic meters located in seven different subsites.

Issue: From the datasets collected by the Environmental Consultant, it was demonstrated that hydrocarbons from all four fractions were detected in differing concentrations throughout the site, in addition to BTEX, and miscellaneous aromatic compounds of definite human origin (i.e., trichlorobenzene isomers).

Solution: Instead of a traditional "dig and dump" remediation of the 8,000m3, a time and cost-effective in-situ solution with drilling and injection of the Bio-Reclaim program was selected. The injection of Bio-Reclaim was done in July 2021.

Outcome: Sampling conducted in September 2021 identified a significant reduction in the level of Petroleum Hydrocarbons. 5 of the 7 sub-sites was within Tier 1 thresholds and the 8,000m3 was reduced to an estimated 525m3. Confirmative sampling of the two remaining subsites is planned for July 2022.

Myles Ethier

Myles Ethier has over 10 years in leadership roles and business development in the hospitality, real estate, and environmental assessment/remediation/risk management sectors. His experience includes proposal, project, and site management, as well as technical support for a range of sites. Myles is the Vice President of Long Chain Reclaim and current responsibilities include portfolio management, client liaison, and stakeholder engagement.

Using Hydrous Ferric Oxide to Remediate Dissolved Arsenic (Case Study)

Jake Gossen, Langan International

Hydrous ferric oxide (HFO) or iron oxyhydroxide, refers to numerous mineral species of oxidized iron [Fe(III)] with varying amounts of hydrogen and oxygen, commonly referred to as 'rust'. Examples include ferrihydrite [$Fe(OH)_3$] and goethite [FeOOH] among others. HFO minerals exhibit strong affinity for a number of common metal contaminants including: arsenic, cadmium, copper, lead, nickel and zinc. HFO has emerged as an ideal remedial solution to address metals contamination in groundwater.

A unique property of HFO is its high surface area. Research by Dzombak and Morel (1990) concluded that 1 gram of HFO has up to 600 square metres of surface area. The combination of high surface area and high affinity for metals means relatively small quantities of HFO is able to sequester large masses of metals. The mechanism for metal removal is adsorption and/or co-precipitation. Dissolved metals adsorb, or "stick" to HFO surfaces when contaminated groundwater comes in contact with HFO. Metals are also incorporated into the crystal lattice of HFO if contaminated groundwater is in contact during precipitation of HFO.

Two options are typically used to introduce HFO into the subsurface and contact the contaminated zone: excavation and backfilling; or injection. For injection, ferrous iron (typically ferrous sulphate) is dissolved in water (commonly site groundwater) and injected with an oxidant to precipitate HFO. Various oxidants can be used based on the site specific conditions. For example, hydrogen peroxide can be used when the target HFO concentration is high and an aggressive oxidant is required. Alternatively, calcium peroxide can be used when the target HFO concentration is lower, a less aggressive oxidant is sufficient, but where additional buffering capacity is required to address acidity related to the metals contamination. Compressor air can also be used in certain settings.

Langan successfully remediated a dissolved arsenic plume using ferrous sulphate oxidized with air injected using an air compressor. An arsenic plume required rapid remediation to facilitate a property transaction. Ferrous sulphate was dissolved in site groundwater and injected under hydrostatic conditions. Air was injected using two 400 L/min air compressors into existing monitoring wells to oxidize to ferric iron and removed arsenic from solution via co-precipitation. The existing wells straddled the water table; packers were installed in the wells to isolate the screened interval below the water table to prevent short circuiting of injected air into the vadose zone. The remediation was completed in one week. The prevailing geochemical conditions at the Site was oxidizing; therefore, upon completion of iron oxidation HFO was anticipated to remain stable and not redissolve. Total cost of the program was less than $50,000 highlighting the low cost and quick turnaround of using HFO to remediate dissolved metals.

Jake Gossen

Jake Gossen is a Senior Project Engineer with Langan International LLC. Jake has 14 years of experience in environmental consulting and specializes in contaminant fate and transport, remedial design, performance verification, and risk assessment.

De Beers Victor Mine Demolition Project – Remote and Challenging Locations

Enrique Bayata, Priestly Demolition

The De Beers Victor Mine demolition project is part of the decommissioning plan of the former open pit diamond mine by the De Beers group of Canada. The full scope included the demolition of 55 buildings including the processing plant, primary crusher, mechanical shop, construction camps, mining offices, water storage tanks, maintenance shops, pumping modules, pit perimeter power lines, transfer station and reclaim station. The work site was located in the James Bay Lowlands of Northern Ontario, approximately 90km west of the coastal community of Attawapiskat First Nation.

One of the main challenges was the remote location of the site with no access roads and the closest urban center 515 kms away, the site developed as a "fly-in/fly-out project".

As part of the mobilization and demobilization to and from site, a Hercules plane program was developed to fly the necessary machines, material and attachments. Machines had to be disassembled and adapted to fit into the Hercules plane. A total of 34 loads (each approximately 40,000 pounds) were flown to and from the site during the two phases of this program.

In addition to the equipment and materials, a 2-week rotation shift, 7 days a week, 12 hour days schedule was developed that required all personnel and supplies to be flown in on -chartered flights. To reduce the manpower that had to be flown in, Priestly hired and trained workers locally providing skill development and job opportunities to a predominantly indigenous community. Additionally, there were zero recordable incidents in 88,571 man hours.

One of the priorities of the project was to have minimal environmental impact. To salvage as much material as possible, PDI developed a plan where all salvage materials were taken to a lay-down area where they were stored, processed and prepared to be shipped out via ice-road at a later date. Most of the demolition was carried out by heavy equipment and supported by a team of torch persons and fire watch personnel who cut and processed the heavy steel for shipment off site. The largest portion of the job was the demolition of the process plant. A 4,500 sq m, 28 meters tall building with a variety of mining equipment inside.

Another challenge faced was the extreme cold temperatures, its effect on the workers and the steel structures. The main heating system of the building was disconnected ahead of the demolition. Therefore, PDI managed to create a budget-friendly solution by reusing small heat cannons that were refitted from the mining site allowing the torching crews and machines to do bursts of work inside the plant so that no one was in the cold for an extended period of time.

The end goal of the project was to return the site to a functioning ecosystem, site closure objectives and site rehabilitation. PDI was awarded the World Demolition Award 2021 for this project.

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Enrique Bayata

Enrique Bayata is an experienced demolition professional that has worked for the last two decades across North America in the demolition and remediation industry. In 2019, he joined Priestly Demolition and is currently the General Manager of West Coast Operations. Enrique enjoys helping clients find innovative solutions in challenging projects and creating long-lasting partnerships. He has been part of several multi-million dollar projects including the 2021 World Demolition Award winner - The De Beers Victor Mine Demolition Project.

A native of Mexico City, Mexico he attended University of Cincinnati where he graduated with a Bachelor's degree and two Master's degrees. He swam internationally for the Mexico National Team and the University of Cincinnati. He currently lives in Calgary, AB with his wife Sara.

Waste Management for Northern Canadian Communities

Reanna Berg and Shawn Samborsky
CORE Environmental Consulting Inc.

Waste management has been and continues to be a challenge for Canada's remote, northern communities. With ever increasing transportation costs and less options for storage and processing of municipal solid waste, many communities use open air incineration as their sole method to manage solid waste. The drawbacks of this method are well understood and are driving communities to look for other options. CORE Environmental Consulting Inc. (CORE) is currently working with two remote northern communities that are motivated to improve the management of their solid waste, and serve as a model for sustainable waste management in the north.

In September of 2021, CORE partnered with a company specializing in developing innovative waste management solutions. Along with the partner, CORE completed an on-site municipal solid waste (MSW) audit for a community located in Nunavut. The audit consisted of separating a large sample size of MSW into specified categories over a three-day period. The categories reflected potential for different methods of waste sorting and diversion as alternatives to open air incineration. An analysis was completed to determine the proportional amounts of the different categories within the sample size. The findings of this audit allowed CORE to project waste generation in the community following the projected linear growth of the community's population. This information is now being used to help develop and guide a waste management strategy for the community. The strategy will potentially involve recycling, composting, or other handling methods deemed appropriate according to the findings of the waste audit. Some of the waste will still be incinerated, however a more efficient, enclosed incinerator designed to trap particulate matter will be used. The incinerator design is intended to be 'future-proof' with waste-heat trapping capabilities to potentially heat some of the communities' public buildings.

For another community located in the Northwest Territories, CORE is conducting a waste feasibility study. The purpose of this study is to propose and assist in implementing appropriate methods of waste management. There are many factors that must be considered when determining which options are viable, including location, types of waste that cause issue for the community, financial feasibility, climate dependency, among many others. Ideally the method(s) chosen would also generate additional industry for the community, augmenting their local economy.

The overarching goal with these projects is to have them serve as a waste management model for other communities in the north. Determining feasibility of more sustainable waste handling practices for similar locations will allow for easier integration in the future.

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Reanna Berg

Reanna Berg is a Junior Environmental Scientist with a broad environmental background. She completed her B.Sc. in Renewable Resource Management with a Soil Science Minor in 2020 at the University of Saskatchewan. Reanna has conducted fieldwork throughout rural Alberta and Saskatchewan which has included soil sampling, tree ring sampling, and land assessment with respect to wetland management.

Shawn Samborsky

Shawn Samborsky, M.Sc., P.Ag. is a project director with 27 years of experience in the environmental sector, specifically in the technical areas of waste management operations, site investigation and remediation. He has completed his diploma in Chemical Technology, B.Sc. in Environmental Management, and M.Sc. in Soil Remediation and Reclamation.

The team at CORE environmental have built an organization that finds ways for companies and communities to improve waste handling and environmental management practices.

Zeolite-Based Potassium Extraction from Potash Mine Tailings and Brines for Value-Added Soil Amendments

Brandon Stoner and WonJae Chang, University of Saskatchewan
Verne Hogg, ZMM® Canada Minerals Corp.

Resource recovery technologies which mitigate the environmental impact of industrial byproducts are in high demand. In Saskatchewan's potash industry, the conventional refinement of potash ore (KCl) to source potassium (K) in fertilizers, generates substantial volumes of mining byproducts (tailings and brines) which accumulate in the tailings management area. Significant quantities of unextracted K remain locked in the byproducts. In our prior research involving sodium (Na) salinity mitigation, we showed that zeolite exhibits a selective preference for K over Na ions, enabling the unextracted K from the potash byproducts to accumulate in the zeolite framework. Hence, in this study we investigate Canadian zeolite as a simple, rapid, and cost-effective medium for extracting the residual K from potash byproducts. We then evaluate the reusability of the recovered zeolite (K-form zeolite) as a low-cost amendment for soil remediation, reclamation, and revegetation to provide functionalized microbial habitats loaded with soil nutrients, water and/or augmented microbial populations. We evaluate the K-form zeolite as a value-added bioremediation agent for soils contaminated with petroleum hydrocarbons, which are the most frequently identified contaminants in Canada's Federal Contaminated Sites Inventory. Our research objectives include selecting the Canadian zeolite with the highest capacity for K-recovery, optimizing the K-recovery process to maximize K content in the K-form zeolite, and evaluating the biocompatibility of the K-form zeolite for contaminated soil bioremediation. Results indicate that Juniper High Purity Crystals (HPCs) are the best Canadian zeolite for K-recovery. Optimization experiments have shown a maximum of 70% K-recovery from 1:4 dilute brines using untreated Juniper HPC zeolite with a mass to volume ratio (m/v) of 0.5. Results highlight that K-recovery is significantly improved with increasing zeolite grain size, until a threshold of 2.0 mm is reached (70% K-recovery); afterwards K-recovery gradually diminishes with increasing grain size. Statistical analysis of current datasets reveals plateaus in brine dilution factor and polycyclic adsorption cycle experiments, where K-recovery tapers off after exceeding 1:10 dilution factor (66% recovery) and after 3 adsorption cycles (71% K-recovery). Experiments assessing the effect of m/v on K-recovery show a linear relationship between K-recovery and m/v. Preliminary biocompatibility experiments have revealed that incrementally increasing zeolite-soil content from 0 to 10% (w/w) substantially improves soil porewater retention. Elevated liquid water and nutrient retention is critical for extending the season of effective bioremediation beyond the conventional summer months (a stress-tolerant bioremediation strategy that we developed). Upcoming optimization experiments will explore pretreating the zeolite to maximize K-recovery and recovering K from granular tailings. Subsequent biocompatibility experiments will

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investigate how the K-form zeolite maintains heterotrophic, hydrocarbon-degrading bacteria under soil drying and freezing conditions for the stress-tolerant bioremediation strategy (demonstrating that the K-form zeolite provides crucial nutrients to the microorganisms to enhance bioremediation). Our research project is unique because it is of simultaneous interest to Canadian mining and environmental reclamation industries alike: it fosters a niche market for Canada's unheralded resource of zeolite minerals and lays the foundations of a circular economy in Canada's potash mining industry.

Brandon Stoner and WonJae Chang

Brandon Stoner and WonJae Chang are the designated presenters for the EnviroTech 2022 Conference. Brandon Stoner obtained a B.Sc. in Geology from the University of Alberta in 2016, worked as a junior geologist in Alberta's aggregate mining industry until 2019, and is currently an M.Sc. candidate in Environmental Engineering under the supervision of Dr. WonJae Chang at the University of Saskatchewan.

Advantages of Using Integrated Surface Water/ Groundwater Models Throughout the Planning and Evaluation Process of Low Impact Development (LID) Strategies for Land Development and Ecosystem Conservation

Chris Gabriel, Daron Abbey and Steve Murray
Matrix Solutions Inc.

In storm water management, to predict surface water runoff behaviour (volume, timing), engineers commonly apply event-based precipitation/runoff models that represent hydrological processes in each catchment through lumped parameters. These models usually simplify the groundwater portion of the hydrologic cycle; while assuming that a fraction of the surface runoff is lost into to the groundwater system, they provide limited feedback from soil conditions to the actual infiltration capacity. Integrated models on the other hand, use detailed representation of both the surface and sub-surface processes and allow for physically based feedback, such as rejection of infiltration once soils reach saturation.

In recent years, increased attention has been placed on incorporating Low Impact Development (LID) concepts into land development planning. These can range from small-scale distributed retention and infiltration features such as rain gardens and bioswales to larger-scale centralized infiltration structures such as wet ponds or underground infiltration tanks. Meanwhile, efforts to conserve groundwater-dependent ecosystem typically expect that groundwater recharge and discharge conditions are maintained at predevelopment levels.

Understanding the interaction between the surface water and groundwater system within catchments before and after development and evaluating the effectiveness of LID features as part of the proposed land use change are therefore critical for reducing runoff volumes, maintaining groundwater recharge/ discharge, and conserving important ecosystems (such as wetlands) successfully.

Physically based integrated models, through their spatially distributed representation of the environment and continuous simulation of several years of climate variability, provide powerful tools for gaining in-depth understanding of the interconnectedness of the surface water and groundwater system, potential impacts from future land development, and the efficacy of different LID strategies to mitigate these impacts and maintain predevelopment conditions.

Examples will be presented to illustrate how integrated modelling can be used at different scales and at different stages throughout the planning process to help landowners, developers, municipalities, and conservation authorities make well-informed planning decisions. On a larger (subwatershed) scale, models can be used to establish capture volumes required to reduce runoff volumes and maintain groundwater function based on the imperviousness of the proposed land use change. Through the iterative application of model scenarios, the level and distribution of capture is refined and can inform subsequent detailed planning. On a subwatershed scale, feature-based analyses

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can provide insights on the surface water/groundwater interaction in recharge areas, wetlands (hydroperiod), and streams (maintaining cold water conditions and/or habitat for species at risk). Finally, on a catchment scale, infiltration features (e.g., wet ponds, underground storage tanks) can explicitly be represented in the model and tested for their efficacy given the surrounding geology and groundwater conditions. Feedback between the surface water and groundwater system can identify unexpected conditions such as rejection of infiltration (underperformance) or elevated groundwater levels (potential basement flooding) around centralized infiltration structures.

The examples will also demonstrate different model outputs such as average and time-varying water budgets, maps of average and seasonal conditions (recharge, discharge, depth to groundwater), hydrographs of water levels, hydrographs of groundwater discharge (to streams and wetlands), and exceedance maps of ponded water (wetland hydroperiod).

Chris Gabriel

Chris is a Senior Environmental Consultant with over 17 years of experience in the development and application of hydraulic, hydrological, ecological, groundwater, and integrated groundwater/surface water models. Before working in consulting, he applied these technologies on several university research projects as a scientific researcher. For the last 10 years, Chris' work has been focusing on the application of integrated groundwater/surface water models for land development and wetland conservation projects.

Colin Hansen

Mr. Colin Hansen is a senior civil engineer with over 23 years of diverse experience spanning urban water and wastewater infrastructure design and analysis, water resources engineering, public sector utility planning and analysis, and oil sands mine water management and hydrology. His consulting experience includes the design of stormwater and sanitary trunks, site servicing and yard piping, hydrologic and hydraulic computer modelling, constructed wetlands and stormwater ponds, water and wastewater master planning, environmental impact statements, senior oversight for climate and hydrological monitoring programs, statistical hydrology, and frequency analysis. Mr. Hansen has over 8 years of experience with the City of Calgary Water Resources department, where he was involved in sanitary sewer computer modelling (MIKE URBAN), city-wide flow and rainfall monitoring programs, community drainage improvement studies, stormwater low impact development (LID) analysis and field investigations, climate change impact studies, and stormwater project delivery and construction. Mr. Hansen's oil sands experience includes open pit mine water management, watershed monitoring, reclamation soil cover monitoring and numerical modelling, river engineering projects, and surface water – groundwater interactions and numerical modelling (MIKE SHE).

Bioaugmentation Application for Enhancing the Performance of an RBC Wastewater Treatment Plant and Improving Ammonia Removal

Dimitris Chrysochoou, Tradeworks Environmental

A Rotating Biological Contactor [RBC] wastewater treatment plant was facing challenges with meeting the effluent ammonia criteria. It is a 4,500 m^3/day [1.2 MGD] wastewater treatment plant located in a residential area in Nova Scotia region. It utilizes screening, primary clarification, 2 parallel RBC trains, secondary clarification, and disinfection prior to discharge. The wasted sludge from the system is co-thickened in the primary clarifier and pumped into the anaerobic digester [AD]. Waste sludge from the anaerobic digester is hauled away for further processing and disposal. Due to the challenges, the facility was scheduled to be decommissioned and be used as a lift station to divert the flow to another facility nearby. The facility has different effluent ammonia criteria for the winter and summer seasons [5mg/l and 3mg/l respectively].

For this project it was suggested that the ideal solution would be to apply the bioaugmentation in the wastewater collection system. This way, the sewage conveyance system is leveraged to precondition the wastewater prior to its introduction into the treatment plant, which is also enhanced by the microbial addition. The project was started as a 4-month full scale demonstration, and it was proceeded on an ongoing basis based on success, until it eventually completed 1 full year of application. After completing 1 year, it was decided to integrate the bioaugmentation permanently as part of their standard operations.

Project objectives: The primary objective of this project was to enhance nitrification. Secondary objectives of the application included the general optimization of the facility, which is facilitated with Tradeworks Environmental on an ongoing basis when using the bioaugmentation.

Results: During the first year of application, it was demonstrated that the bioaugmentation assisted with enhancing the nitrification of the system, which was able to meet the ammonia effluent criteria and have the primary objective satisfied. As the system has different effluent criteria for winter and summer seasons, for the period of November 1, 2019, to April 30, 2020 [before the bioaugmentation] the average effluent ammonia values were 4 ppm, while for the period of November 1, 2020, to April 30, 2021 [after bioaugmentation] the average ammonia effluent values were 1.75 mg/l. Furthermore, for the period of May 1, 2020, to August 31, 2020 [before bioaugmentation] the average effluent ammonia was 2.92 mg/l, and for the period of May 1, 2021, to August 31, 2021 [after bioaugmentation] the average effluent ammonia values were 1.38 mg/l.

Secondary objectives included optimization of the system in various stages. It was shown, that after bioaugmentation application the biogas production was increased compared to the same months the year prior to the application, by 20-50%.

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The local Team demonstrated that through the assistance of the bioaugmentation they were able to provide a sustainable solution to the wastewater authority saving their facility from being decommissioned while also optimizing their system and process.

Dimitris Chrysochoou

Dimitris Chrysochoou is the Technical Specialist at TradeWorks Environmental Inc. He has been instrumental in supporting the development and adoption of IP of new innovative biotechnologies in the space of organic waste and wastewater treatment. Leveraging his Mechanical Engineering education in Aristotle University of Thessaloniki with a specialization in "Environmental and Antipollution Technologies" and using his vast experience in team building and elite performance as a former Balkan Badminton Champion and Coach, he demonstrates his leadership skills with his team in Europe, Canada, USA and Asia as they develop the methods and practices to enable for new standards in environmental, economic, and social sustainability and responsibility.

Wanting to live by example, he is an advocate of the Greek philosopher's phrase "healthy mind in healthy body" pointing out that to have a healthy mind you should take care of your body too, his extracurricular interests include the Wim Hof method, exercising [Calisthenics], and ice baths.

Dimitris is a young professional who is continuously seeking new challenges to enhance self-development, gain technical expertise and knowledge, acquire new skills, and to promote environmental education and stewardship.

Discharging of Industrial and Municipal Effluent in a Changing Climate

Robert Best, SLR Consulting

Over the past decade, Western Canada has experienced a great deal of significant and devastating weather events and the frequency and severity of these events appears to be increasing. We remember the Fort McMurray wildfire in 2016 and the 2021 wildfires in Lytton and surrounding regions that engulfed much of the southern British Columbia interior. These events are often exacerbated by apparent increases in drought severity or frequency throughout parts of British Columbia and Alberta. We are seeing reduced river flows or departures from historic values and unexpected atmospheric rivers of precipitation being dumped on the Pacific Coast, Lower Mainland, and parts of the Interior that has led to catastrophic flooding impacts to communities, industry, and ultimately the environment. Some of these significant weather events or changing precipitation patterns may be the result of our rapidly changing climate, in addition to our historic management policies related to forest fire prevention.

The intent of our presentation is to discuss important aspects of the potential impacts on water sustainability, or more specifically, sustainable use of our water resources for the benefit of communities, businesses, and the environment. We will briefly touch on the potential direct and indirect impacts on the communities, potential implications for industrial use of water resources, and how these significant weather events (when coupled with community and industrial need) may stress the environment. Our focus for this discussion will be limited to British Columbia and Alberta, however, there are broader implications that may be applicable across the continent, where annual and seasonal changes to historic weather patterns are being documented. We provide a high-level review of select water bodies in Western Canada and briefly look at the magnitude of high and low flow periods and how they have or may shift in the future.

When baseline conditions in the environment change, it is expected that water (e.g., backflush, dewatering, effluent) discharge permits or approval conditions may change as well. It is likely that water users may be able to negotiate these changes with the regulators, however, water users need to consider these scenarios to be sufficiently prepared. We will discuss proactive approaches that water users such as municipal and industrial operators should consider, to help facilitate the futureproofing of their approach.

Robert Best

Robert is a Senior Aquatic Ecologist with 12 years of experience leading and supporting teams in Canada and internationally. Robert regularly engages with regulators at all levels to coordinate permitting, negotiate approval and authorization conditions, and provide overall technical direction for project activities. During his Masters degree Robert focused on the physicochemical analysis of effluent, both municipal and environmentally sourced, to co-develop a novel wastewater treatment system for use in remote locations. Robert has extensive experience (>100 field inventories and assessments) leading, developing, and coordinating field programs including fish and fish habitat assessments, fish rescues/salvages, spawning surveys, linear and non-linear construction monitoring, biological sampling of species at risk, hydrological monitoring, bathymetric survey techniques, water quality monitoring, and working with federal and/or provincial species at risk.

In-Field Study Evaluating Rates of TCE Biotransformation Using Carbon-Based Biostimulation Additive ERDenhanced Alone vs. ERDenhanced Combined with Zero Valent Iron (ZVI).

Kent Armstrong, TerraStryke Products LLC

Site: Incidental releases of Trichloroethene (TCE) at former electronics manufacturer adversely impacted shallow overburden-bedrock groundwater. Hydrogeology consists of 15-20 feet of alluvial silty clay and/or gravelly sand overlying fractured sandstone with a 10-foot interval of dense non-aqueous phase liquid (DNAPL) trapped in primary/secondary porosity of shallow bedrock.

Concern: Baseline [TCE] in bedrock ranges from 55-550 milligrams per liter (mg/L), up to ≈30% aqueous solubility limit; dechlorination byproducts cis-1,2-Dichloroethene (cis-1,2-DCE) at ≤15 mg/L and Vinyl chloride (VC) detected below method detection limits (0.25-10 mg/L). Site pump & treat systems operate to manage plume migration. Responsible party desires low-impact, low-cost strategy that achieves sustainable enhanced reductive dechlorination (ERD) which targets DNAPL destruction.

Strategy: In 2021 an on-Site Proof-of-Concept (POC) study was implemented to evaluate ERDenhanced™, a carbon-carbohydrate based biostimulant formulated with proprietary blend of macro-micronutrients, and a modified ERDenhanced™ which included a small percentage of Zero Valent Iron (ZVi). The POC study evaluated the efficacy of each formulation to enhance indigenous microbial population's ability to support reductive dechlorination in terms of reducing/destroying both dissolved-phase concentrations and molar concentrations of the above noted chlorinated volatile organic compounds (cVOCs). Additional performance metrics include rates of residual mass solubilization, daughter cVOC generation/production and, Ethene production. Bioaugmentation was not performed.

Process: Two monitoring wells amended using Passive Release Sock (PRS) deployment units; one filled with ERDenhanced™ (MW-23A), a second (MW-24A), with ERDenhanced™ and 15% by weight ZVi. Baseline groundwater monitored and sampled for laboratory testing of geochemical and site contaminants of concern from each test well using non-purge low-flow techniques. PRS units were removed/replaced every 6-weeks. Groundwater monitoring/sampling and analytical testing performed concurrent with each replacement event. Overall 7 Baseline/replacement events performed during 12-month evaluation.

Results: The biotic ERDenhanced™ formulation and combined biotic/abiotic ERDenhanced™/ZVi demonstrated identical reductions in dissolved-phase parent TCE realizing, by month 3, >99.99% reductions. In terms of overall performance, the combined ERDenhanced™/ZVi formulation consistently outperformed the biotic formulation demonstrating introduction of a relatively small

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percentage of ZVi catalyzed biological performance. Overall, dissolved-phase concentrations of total cVOCs decreased 89.0% at MW-24A, ≈30% more efficient than MW-23A (65.9%). Additionally, reductions in dissolved-phase cVOCs from peak bioavailability started in June at MW-24A, 2-months before MW-23A and, total moles cVOCs decreased 50% at MW-24A vs. 30% at MW-23A. Production of Ethene, indicator of complete TCE biotransformation, was similar at each location; however, like other metrics it appeared 2-months faster at MW-24A than MW-23. Each performance metric noted indicates more efficient biological activity. Additionally, utilization of alternative electrons Sulphate, Manganese and Iron was observed to be expedited and in greater synchronicity at MW-24A vs. MW-23A, each metric a secondary indicator supporting the hypothesis of catalyzed/expedited biological activity.

Conclusion: Biostimulation alone with ERDenhanced™ achieves robust and complete TCE DNAPL dechlorination without "cis stall"; however, addition of relatively small percentage of ZVi catalyzed and beneficially increased overall performance. The modified ERDenhanced™ realized expedited solubilization (elimination of rebound), expedited daughter cVOC production and expedited, complete dehalorespiration with molar destruction; sustainably with less-impact, fewer deployments, no aboveground support equipment, and lower overall project costs.

Kent Armstrong

A Graduate of California State University Long Beach, 'The Beach'; B.S. Terrestrial Ecology (Zoology), minor in Philosophy/Religious Studies, with Graduate Studies in Palynology (fossil pollen) and Paleoecology.

Numerous jobs as a butcher, human anatomy instructor, ravioli maker, warehouse and parts dispatch operator...real work began with the Los Angeles County Sanitation District as Plant Laboratory Chemist and then as a Treatment Plant Operator.

Over the next 35 years, Kent would work for and aid both government and corporate businesses with remediation strategies as a contractor, consultant, and general nice guy.

The culmination of these experiences afforded Kent the opportunity to participate in a wide variety of environmental investigation, remediation, and management projects combining numerous methods of physical, chemical, and biological strategies. It also, 20+ years ago, led to the realization of a far-fetched concept in 2018, the inception of TerraStryke Products LLC.

Since then we have efforted the development of sustainable biostimulation additives designed to leverage existing site conditions and enhance indigenous microbial populations to realize safe, low-impact and cost-effective destruction of organic soil and groundwater contaminants, mimicking that which Mother Nature has done in every other ecosystem on the planet.

Muncipal Wastewater Treatment

Henk ten Wolde, Canstar Solutions

Brief Company History: Canstar Solutions (Canstar) was founded in 1996 and is a specialist manufacturer's representative. We have a long history of consulting, supplying and working with companies to provide precision measurement product solutions and design services.

Canstar provides these services to Fortune 500 type corporations like Westfraser, Tolko, Weyerhaeuser, McCain Foods, Old Dutch, Pepsico, Johns Manville, Owens Corning, Imperial Oil, Suncor, Syncrude, CNRL, Enbridge Pipelines, Pioneer, Gerdau MRM Steel, etc.

Canstar is the exclusive distributor for Bluecon International BV from the The Netherlands.

Technology Description: Bluecon has developed a unique, decentralized and scalable municipal wastewater treatment system. It is a stand-alone waste water treatment plant that can be supplied in a 40 ft sea-can for systems measuring 5 m^3 (22GPM) to 25m^3 (110GPM). Multiple parallel Bluecon systems can be used for higher effluent flows. The Bluecon technology is typically considered for communities, resorts, suburbs and camps servicing a few hundred to 15,000 people.

The Blueconizing technology treats municipal wastewater using modular systems and physical principles. Coagulation and flocculation is completed in the first module and results in raw irrigation water. Minerals are used to reverse the polarity of the surface water molecules in the organic material. In the second module ammonia is removed and disinfection takes place through oxidation and UV technology, resulting in clear irrigation water. The polishing process in the third module breaks down medication, hormones, and drugs to produce drinking quality water.

Market Applications:

- Municipal wastewater treatment for communities with populations of a few hundred to typically 15,000.
- Resorts / Country clubs: recycling water for irrigation and/or snowmaking
- Work camps: recycle waste water to produce non potable water for flushing toilets and/or showers
- Suburbs where it is not economical/feasible to connect to the current sewage system, or where there is a need locally for clean water.
- Festivals where highly concentrated wastewater ('manure') needs to be treated, with i.e. high drug content (this last application requires a calculated version of the Bluecon process system)
- Sanitary facilities in National and Provincial Parks

How is this technology Innovative:

- The Blueconizing process is a physical treatment and does not use biological, membrane or osmoses processes
- The Blueconizing process is a process which exploits the physics of the organic material using a small amount of minerals

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- The system is not wastewater temperature sensitive.
- The Bluecon has a relatively small footprint (40 ft sea can) and (a) buffer tank(s), which is typically underground
- The Bluecon process does not emit foul odours: It can be placed in close proximity to a residential area
- The plant produces nearly no noise

IP Profile: The Bluecon developed the Blueconizing treatment method that exploits the physical process of reversing the ions' polarity at the surface of the organic material to separate the material from the water, with a two-step process of Coagulation and Flocculation.

This is accomplished with a minimum of minerals: minerals are used in the ppm range

The energy consumption (electricity) is also minimal as the feed pumps are simply moving wastewater through the system at low pressures.

Sales History or Pipeline: The Bluecon technology is being introduced in North America with presentations and a demonstration system (arrival March 2022), with the first project designs expected in the second half of 2022.

Jacob Wiebenga

- President of Canstar Instruments Inc. since 1996;
- N.A.I.T. Northern Alberta Institute of Technology, 1994 Graduate with honours in Instrumentation Engineering;
- Extensive experience with consultation, design, commissioning of instrumentation and process systems

Henk ten Wolde

President of DWCC Dutch Western Canada Connection since 2006; Trade Commissioner for the Netherlands in Alberta; guided two Ministers of Environment of Alberta to the Netherlands on water related missions; present working on establishing business connections between Alberta and the Netherlands; connector between Businesses and Governments in both jurisdictions. Henk is very successful in finding solutions for issues.

Reuse of Stormwater and Municipal Effluent (Case Studies)

Bill Berzins, Aquen

Climate change has affected both the timing, quality and quantity of peak water flows throughout western Canadian watersheds. Especially on the eastern slopes of the Rocky Mountains as they are already particularly susceptible to water shortages and drought. This presents an issue of security in terms of water supply.

As population growth and increased industrial / agricultural presence increase demands on water supply, there is a requirement for additional storage and treatment capacity. The other implication is that municipalities and industry need to look to water conservation and reuse to ensure adequate supply.

Increased water recycling and reuse has additional benefits including reduced operating costs and positive ESG outcomes that are important to stakeholders and shareholders alike. The presenters will share case studies regarding reuse of both stormwater and municipal effluent for irrigation and industrial purposes. The discussion will draw on experiences gained throughout western Canada and North America with an emphasis on technology selection and operations. The discussion will also introduce new developments regarding the harvesting of nutrients and energy from wastewater sources.

Bill Berzins

Bill has almost 40 years of experience in the design, build and operate of water, wastewater and solid waste systems working across all industry and government sectors in western Canada. He was instrumental in the establishment of Alberta's leading environmental protection organizations including the Bow River Basin Council, the Alberta Water Council and the Environmental Services Association of Alberta. Recently he has played a lead role helping improve the security and safety of water supply for Indigenous Communities by providing expertise to these communities and all levels of government. Bill's operational background includes water reuse hubs, compost facilities, hazardous waste incineration, sewage treatment and potable water supplies.

Water Valuation: How to Put a Price on Priceless?

Sheila Duchek, SNC-Lavalin

Severe water stress and water scarcity can bring political disorder. Conflict, and even war, over water resources has been observed. According to UNESCO (UNESCO website accessed in 2022), "*Water is a unique and non-substitutable resource of limited quantity. As the foundation of life, societies and economies, it carries multiple values and benefits. But unlike most other valuable resources, it has proven extremely difficult to determine its true 'value'*". Because most of the world's freshwater supply is underground, known as groundwater, it is often overlooked and undervalued. In addition, there is a perception that groundwater is poorly understood, which further contributes to challenges in sustainable water resources management.

This talk will present methods and suggested approaches of how to estimate the value of groundwater, including aspects that should be considered and incorporated into the valuation. The talk will present recommendations for how water resources managers might communicate the resulting valuation to the public. This topic will be of interest to regulatory authorities, groundwater and environmental managers, and practising groundwater specialists.

Sheila Duchek

Ms. Sheila Duchek is a senior hydrogeologist with nearly 20 years of experience and her current focus is managing and providing senior technical support for groundwater assessment, monitoring, and operational compliance programs. As a lead technical advisor in hydrogeology, Ms. Duchek has reviewed, analyzed, and provided recommendations to various clients with varied groundwater assessment needs. Ms. Duchek is adept at groundwater assessments and working with regulators and the public in addressing concerns with respect to groundwater use and management. In addition to providing senior hydrogeology support to Environmental Site Assessment and Remediation Teams, Sheila is also a Board Director of the Environmental Services Association of Alberta.