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SMA Environmental Forum 2021

Book of Abstracts

(Arranged alphabetically by presenter's last name)

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CLIMATE CHANGE IN THE MINING INDUSTRY: WHERE WE ARE NOW AND WHERE WE ARE HEADING

Samantha Barnes[1], Victor Munoz[2], Christopher Stevens[3], Trevor Podaima[4]

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Climate change effects are beginning to make their mark on the Canadian mining sector. Occurrences of extreme heat waves and flood events that were projected for the 2050's and beyond are being observed today. Regulators and global practice guidelines are calling for an understanding and application of climate change, including the Global Industry Standard on Tailings Management (Global Tailings Review 2020). The state of practice is evolving through direct experience in dealing with changes, as well as with industry guidelines, such as the Guide to Climate Change Adaptation for the Mining Sector (MAC 2021). The definition in climate change projections is narrowing its focus from annual variability to seasonal and monthly variability, with an emphasis on characterization of extremes. In addition to the projected air temperature and precipitation, an understanding of climate-driven change to environmental conditions, including streamflow, evaporation, and ground temperature, is required to quantify effects and characterize risk.

This presentation will cover the latest mining standards and guidance to evaluate and apply climate change projections, including communication of uncertainty. Several advancements in good engineering practice and areas for improvement will be discussed in the context of mining project case studies.

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INTEGRATING MULTIPLE DATA STREAMS TO REFINE A CONCEPTUAL SITE MODEL

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Complex environmental site investigations often include many data types, and interpretations of the data can sometimes suggest conflicting results. A recent study was conducted to define the extent of an apparent groundwater brine plume, historically interpreted to originate from a mine's tailings management areas. The study compared geophysical, hydrogeological, and geochemical data, ultimately leading to a refined conceptual site model (CSM). Integration of multiple lines of data was used to demonstrate the validity of the revised CSM and to design a simple field study to address the remaining gaps. Results yielded a new interpretation from the full dataset, which showed a much smaller impact on surrounding shallow groundwater and resulted in a screening value that can be used to assess brine-related impacts in groundwater for other portions of the facility. Graphical depictions of the data played an important role in interpreting and communicating the results. This study underscores the importance of critical evaluation and comparison of the various data types from a particular site and the iterative approach to developing and supporting robust CSMs for optimizing project outcomes.

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UNDERSTANDING AND ADDRESSING HOW CLIMATE CHANGE CAN IMPACT YOUR OPERATIONS AND MINE PLANNING

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Mining companies and operators are under increasing pressures to address the Physical Risk of climate change. Regulators are requiring additional information as part of the Impact Assessment and permitting processes and stakeholders are demanding additional environmental, social and governance requirements and new disclosure frameworks such as the Task Force on Climate Related Disclosures. The tangible physical effects are increasing operating costs annually today; this will only get worse with time. Mines that fail to understand the risks and opportunities of a changing climate may lose their license to operate.

In response to these issues, both the International Council on Mining and Metals and the Mining Association of Canada have released guidance on adapting to a changing climate in the mining sector that provide a framework on how to characterize risk to both the corporate enterprise and the plant level of a changing climate, document the decision making processes around adaptation measures and implement of best practices and a continual improvement process to reduce and manage this risk.

This panel presentation will provide an overview of the drivers on mining companies, the available guidance documents, practical actions that operators can take now and case studies from mines that have completed risk assessments and successfully completed the planning process and are dealing with the recently released Strategic Assessment on Climate Change from the Impact Assessment Agency.

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ADAPTIVE WATER MANAGEMENT AND CLIMATE CHANGE RESILIENCY THROUGH PROBABILISTIC SIMULATION

Denise Chapman[1], Sitotaw Yirdaw [2], Dave Christensen[3], Gillian Allen[4], Lyndsey Thorson[5]

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In the face of climate change and extreme weather conditions, there is an increasing need for an adaptive management approach to the stewardship of fresh water at mines sites in the Canadian Shield. To address this challenge for the New Gold Rainy River mine in North-western Ontario, Okane Consultants (Okane) and New Gold Inc. (NGI) have developed a site-wide water balance tool using GoldSim Monte Carlo simulation software. The model has dual functionality, presenting deterministic or probabilistic simulation options for climate conditions to allow the user to select single solution output, or multiple solution output based on the probabilities of potential unknowns. The probabilistic simulations represent the inherent uncertain and stochastic nature of real-world systems, so that the water balance can be applied to estimate water requirements and discharge volumes under a variety of climate and operating conditions. Water level and quality data collected over the past three years has been used to calibrate the site-wide solute balance to improve the reliability of the model's predictions. The model has been updated monthly to represent current operational conditions and provide prediction into the short-term and long-term water conditions. An accessible interface developed by Okane will allow the Rainy River site operations team to maintain the site-wide water and load balance inhouse. This robust, probabilistic modelling approach allows the mine site to take a proactive approach to water management in both extreme wet and dry years, ensuring an adequate supply to the mill and sufficient capacity to discharge clean water from site.

GEOTEXTILE BAGS FOR ENHANCED DEWATERING AND ACCELERATED CONSOLIDATION OF FLUID FINE TAILINGS – LESSONS LEARNED

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The accumulation of large volumes of fluid fine tailings (FFT) has been a major concern for the mining industry. There are significant challenges involved in the conversion of FFT into trafficable deposits within a reasonable timeframe to facilitate reclamation. This paper describes some lessons learned from trials carried out to evaluate the use of geotextile bags (geobags) and their operational processes as a potential technology to enhance dewatering and accelerate consolidation of FFT. The success of tailings disposal in the geobags requires prior physicochemical treatment of FFT by combining coagulation and flocculation, called “recipe”. The recipe allows solids/water separation and fines agglomeration in the pipeline, prior to the discharge of the treated FFT in the geobags. Filling of the geobags is controlled by the tensile strength and hydraulic parameters of the geofabric material. The enhanced dewatering in the geobags is a function of the recipe and inline mixing process; short drainage path promoted by the geobag containment; internal pressure and gravity head during filling; hydraulic parameters of the geofabric material; evaporation; freeze-thaw; self-weight consolidation and stacking (loading) subsequently. This technology also allows geotechnically stable thick layer deposits by simply stacking the geobags. Supporting data include laboratory and field test results in the form of inherent and mechanical properties of the treated FFT.

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CLIMATE CHANGE AND HUMAN HEALTH RISK ASSESSMENT

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Climate change can influence a range of environmental variables that either directly or indirectly affect human health. Human health risk assessment (HHRA) is recognized as an effective scientific process in the mining industry to identify contaminant sources that may pose a potential health risk to people, and is used in support of effective risk management and decision making. The effects of climate change are complex and can influence every component of an HHRA, from the behaviour of chemicals in the environment, to how people use the land and the toxicity of the contaminants. The impact varies depending on the potential sources of contaminant release, location of the site, receptors and pathways, chemicals of potential concern (COPC) and the environmental conditions. It is important to understand these potential impacts, particularly when making decisions on the management of the site.

This presentation will summarize the results of a state-of-the-science review conducted on behalf of Health Canada to document the current state of knowledge on how climate change may influence human health risk assessments. This includes the identification of climate change-associated events and environmental processes that can affect the release and behavior of contaminants. There may also be a change in land use and food use patterns that can have a significant effect on the exposure assessment, particularly for Indigenous communities. Although our understanding of the effects of climate change is still developing, incorporating a recognition of the influence of these effects will help in the development of monitoring programs or remediation plans.

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FORAN MINING CORPORATION – MCILVENNA BAY: A CARBON NEUTRAL COPPER MINE IN SASKATCHEWAN

Denis Flood[1]

[1]*Foran Mining Corporation, Vancouver, BC*

Foran Mining is currently undertaking a Feasibility Study (FS) for the McIlvenna Bay Project near Hanson Lake in Northern Saskatchewan. As early adopters of emerging, proven technology such as battery electric vehicles (BEV's) in its' mobile equipment fleet, Foran envisions constructing the world's first carbon neutral copper mine in Saskatchewan. We are situated in the traditional territory of the Peter Ballantyne Cree Nation (PBCN) and are eagerly partnering with their members to maximize the economic benefit to the local communities. We are also conducting baseline environmental studies in preparation for submitting an Environmental Assessment to the Saskatchewan Ministry of Environment early in 2022.

McIlvenna Bay project is a near surface Volcanogenic Hosted Massive Sulphide (VHMS) deposit that will have a relatively small surface footprint as it will be mined using a combination of underground transverse/longitudinal longhole and Avoca stoping with a concentrator onsite. Low sulphur filtered tailings will be dry-stacked in a previously disturbed quarry on the property and high sulphur tailings will be placed underground in paste backfill.
Join us for an overview of the unique opportunities and challenges ahead as we embark on this ambitious journey.

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NEXGEN ENERGY – OVERVIEW OF THE ROOK I PROJECT

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The Rook I Project (Project) is a proposed new uranium mine and mill located adjacent to Patterson Lake in the southwestern Athabasca Basin in northern Saskatchewan. Owned and managed by NexGen Energy Ltd (NexGen), Rook I is the largest development-stage uranium project in Canada. The Project is currently undertaking a harmonized provincial and federal environmental assessment (EA) process and preparing the information necessary to support an initial application for a licence from the Canadian Nuclear Safety Commission (CNSC).

United in a shared vision of becoming a world-leading uranium producer, NexGen is focused on delivering the clean energy needs of the future. Guided by the values of honesty, integrity, accountability, and resilience, NexGen's purpose is to create as much positivity as possible for as many people as possible. As a proud member of the Province of Saskatchewan, NexGen is committed to making a lasting positive impact throughout the province, including for residents of Saskatchewan's North. NexGen believes in committing to excellence through responsible mine development that is underpinned by effort and dedication towards environmental protection, cultural respect, health and wellness, education, careers, and economic capacity building.

The Project aims to set new standards in environmental mine management by incorporating design features that optimize environmental performance such as storing all tailings underground as either stope backfill or in the purpose-built underground tailings management facility (UGTMF). This presentation will provide an overview of key Project features and an update on the status of Project activities related to Indigenous and public engagement, engineering design, and regulatory approval.

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PILOT-SCALE CONSTRUCTED WETLAND TREATMENT SYSTEM PERFORMANCE AT A FORMER URANIUM MINE

Jim Harrington[1,2], Rachelle Kleinberger[3], Andrew Gault[4], Rachel Martz[3], Vanessa Friesen[3], John Russell[5]

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The Schwartzwalder Mine is a former underground uranium mine near Golden, Colorado (USA) that was dewatered and mined between ~1950 and 2000, and flooded with natural recharge thereafter. In 2013, the mine was dewatered to prevent seepage into Ralston Creek as the mine water contained uranium levels up to 24 mg/L. Schwartzwalder mine remediation involves physical reclamation, mine dewatering, and in-situ and ex-situ water treatment. An ex-situ reverse osmosis (RO) and ion exchange system treats dewatered mine water. In-situ mine pool treatment is on-going since 2013, injecting residual RO concentrate mixed with soluble organic carbon into the mine. In-situ treatment encourages the development of sulphate-reducing conditions and transformation of soluble uranium species to insoluble uranium forms, decreasing uranium levels by ~80% (to ~5 mg/L) via precipitation within the mine.

Pilot-scale trials for passive biological treatment in constructed wetland treatment systems (CWTS) at Schwartzwalder are ongoing to evaluate alternative long-term water treatment options that could achieve reclamation targets without perpetual active (RO) treatment. Bulrush and water sedge plant species were tested for their ability to foster conditions within the CWTS that can sequester uranium (~6 mg/L) from mine discharge water. Bulrush and water sedge systems treated uranium to 0.5-4.2 mg/L (30-95% removal) and 0.01-1.2 mg/L (81->99% removal), respectively, depending on the hydraulic retention time (HRT) of the CWTS. Water sedge systems treated to lower concentrations than bulrush, particularly at a 5-day HRT versus 25-day HRT. The site-specific design and optimization of the CWTS and potential for scale-up is ongoing.

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ADAPTIVE / RISK MANAGEMENT OF OFF-SITE BRINE MIGRATION

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Adaptive / risk management plans (AMP/RMP) are formal and systematic approaches centered on rigorous planning and a sound understanding of site conditions and uncertainties, which encourage continuous re-evaluation and management of priority to account for new information and changing site conditions. It can be developed with the objective to provide an integrated plan to manage and/or mitigate impacts associated with off-site migration of contaminants, especially for operating sites, where potential environmental impacts are evolving.

The development of an AMP/RMP typically involves a team of environmental specialists from multiple disciplines including Site Assessment and Remediation, Hydrogeology, and Risk Assessment. This process incorporates several components of environmental site assessments including: site characterization for various environmental media (soil, groundwater, etc.), background data characterizing the natural settings of the site, contaminant fate and transport of priority contaminants, forward prediction of contaminant plume configurations, identifying human and ecological receptors, and applicable exposure pathways.

Based on this information, AMP triggers can be defined along with response actions and approximate timelines, which will guide the re-evaluation of any potential changes. For example, exceedances of groundwater benchmark standards could initiate verification of results and an increased monitoring frequency; if off-site risks are confirmed, further investigation, stakeholder notifications, implementation of mitigation options (e.g., engineering controls), and/ or management in place (e.g., administrative controls) will be completed.
For an operating site, the AMP/RMP is reviewed and updated as required, with the goal of incrementally reducing site uncertainties while supporting continued site operations.

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REGULATORY DEVELOPMENTS IN CANADA'S CLIMATE CHANGE EFFORTS

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This presentation will provide an overview of recent regulatory developments regarding the implementation of Canada's climate change efforts. This presentation will provide an introduction to recent regulatory developments and an assessment of their impacts to the mining sector in Saskatchewan. In particular, this presentation will focus on three pieces of recently passed or proposed federal legation: (1) *Canadian Net-Zero Emissions Accountability Act*; (2) *Greenhouse Gas Pollution Pricing Act*; and (3) proposed Clean Fuel Standard and possible directions for integration and offset protocols.

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DAM SAFETY INVENTORY AND SEMI-QUANTITATIVE RISK ANALYSIS FOR SASKATCHEWAN POTASH MINES

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Nutrien has six potash mines in Saskatchewan and has been pro-active at maintaining the integrity of their tailings facilities through ongoing assessment, design, operation, inspection, and monitoring. Nutrien commissioned a system inventory and semi-quantitative risk analysis (SQRA) of all dykes in an effort to further enhance environmental stewardship and understand degree of alignment with shifting industry standards and governance frameworks. This effort built upon a system that had been established by others for coarse tailings pile segments and was expanded to include fine tailings and brine containment dykes. The inventory assessed nearly 100 dykes. Each dyke was rated according to a probability and consequence factor and assigned a risk score. The risk scores were used to develop a risk matrix for each of the six sites and risk response actions for each dyke and segment. The inventories and SQRAs will help each site assess priorities for investigation and risk mitigation, if necessary. The study results will also help Nutrien refine corporate-wide tailings governance standards and a timeframe for compliance with various governance provisions that may be established in the future as the industry continues to advance its practices.

This presentation will discuss the inventories, the SQRA approach, and how the SQRA was applied at a representative potash mine.

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ENGAGING VIRTUALLY AND MEANINGFULLY WITH DIVERSE GROUPS

Nicola Lower, Principal Consultant, Scientist

ERM: Environmental Resources Management, Toronto, Ontario

Meaningful stakeholder and rightsholder engagement is among the most critical factors that can influence a mining project's success. Host communities can have a wide variety of communication preferences, technology capabilities, languages and cultures, and tailoring engagement practices to respect their unique needs is essential. Proponents of major projects must be able to engage with diverse stakeholder and rightsholder groups in substantive conversations, even during these unprecedented times. This session will explore emerging technology and practices for virtual engagement alongside other techniques. It will review how virtual engagement can be customized to reflect diverse stakeholder and rightsholder needs, including 'co-design' with communities and translation into local Indigenous languages. It will also highlight how technology can be used to help validate Indigenous Knowledge during project planning. Adopting this tailored approach is key for building community relationships and can strengthen local support for a project.

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ANALYSIS OF SURFACE WATER QUALITY AT LEGACY URANIUM MINES IN SASKATCHEWAN

Qiong (June) Lu[1], Alexis Harvey[1], Lindsay Du Gas[1], Thomas Lavergne[2] and **David Sanscartier[2]**

[1]SNC-Lavalin, Saskatoon, Saskatchewan; [2]Saskatchewan Research Council

A three-step approach was used to evaluate the surface water quality at seven legacy uranium sites where remediation is almost complete. The first step consisted of data screening (e.g., by locations in relation to source, upstream, and downstream) and statistical summary. The second step involved the identification of substances of potential concern (SOPCs) by comparing concentrations with applicable Saskatchewan Environmental Quality Standards (SEQS) and/or background concentrations, to identify if elevated concentration could be attributed to historical site activities. The third step consisted of an interpretation of the overall surface water quality. Multiple lines of evidence were considered in the interpretation of the significance of the results for the third step, including: identification of the number, frequency and magnitude of exceedances; comparison of statistical characteristics of SOPCs concentrations upstream and downstream; determination of potential loading of SOPCs in receiving environment; and identification of concentration trends using Mann-Kendall statistical analysis.

The CCME WQI was used in Step 3 which accounts for the number, frequency, and magnitude of regulatory exceedances and assigns an overall categorization or classification of the water quality specific to selected Tier 2 SEQS endpoints.

Surface water quality at these seven sites were evaluated and then ranked, based on the results of the interpretation of surface water quality data following the three-step approach. Recommendations were provided for each site, including additional sampling to support statistical analysis, assessment of potential endpoints; better understanding the connection between impacts in surface water and groundwater; and administrative controls to limit potential exposure.

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Using Multiple Accounts Analysis to Compare Mine Closure Options for Planning

Lisa May[1]

[1] *Golder Member of WSP*

An important step in mine closure planning is narrowing the options available for the closure of each mine facility and determining how these options interact with each other. Options selection can easily be influenced by past experiences, capital costs, and personal biases. This may result in a lack of innovation, greater cumulative impacts at closure, and disagreement among stakeholders and Indigenous communities on preferred closure options.

A multiple accounts analysis (MAA) is a framework that facilitates the ranking of different closure options that can be applied to the decision-making process during any phase of mine life. The MAA approach allows for consideration of multiple factors (e.g., social, economic, technical, environmental) based on quantitative and qualitative information. MAAs can be conducted with simple spreadsheets or more complex modelling tools. Golder has developed an internal tool for options assessment called GoldSET, that could be used to conduct an MAA process. GoldSET is a web-based, multi-criteria analytical tool to evaluate the strengths and weaknesses of closure options. The framework facilitates communication on the key impacts, benefits, and drawbacks of different options and provides traceability and transparency throughout the decision-making process. Whatever tools are used to conduct the MAA, the framework helps to filter out individual bias and effectively balance different factors to determine the most effective closure options for planning purposes from greenfield, to active closure. This approach has been successfully applied to many mine sites at different stages of planning.

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CARBON CAPTURE UTILIZATION AND STORAGE: MEETING GLOBAL GHG TARGETS WITH A SASKATCHEWAN-MADE SOLUTION

Erik Nickel[1]

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The International Energy Agency, in their most recent reports on greenhouse gas mitigation, indicate that the world will be unable to meet targets set at the Paris accord, without rollout of a significant number of Carbon Capture Utilization and Storage (CCUS) projects. CCUS is a term broadly used for the suite of scientific disciplines that involve the extraction of CO2 from industrial processes, compressing it to a dense state, and injecting it into porous formations deep underground.

In Saskatchewan, the march towards CCUS began before it was commonly discussed, in the late 1990's with a project at Weyburn. The combination of some visionary policy-makers, a willing resource company, and a newly minted research centre in the Province (the PTRC) gave us the opportunity to deliver one of the first true CCS projects in the world.

Weyburn was a unique project in that it brought together many different research entities, and academic disciplines all quarterbacked by the Petroleum Technology Research Centre. After a large multidisciplinary study that took the better part of 15 years, the conclusion was that CO2 injected at Weyburn for enhanced oil recovery, would remain stored permanently… and we could prove it.

The experience gained through Weyburn, lead the PTRC to the Aquistore project. Located near the SaskPower Boundary Dam CCS capture plant, Aquistore was to prove the viability of CO2 storage in a deep saline reservoir.

For many years after Aquistore was conceived, global CCUS was rarely discussed by policy-makers nor seen as a viable global GHG mitigation option. This problem was compounded by poor communication of onshore European projects that lead to the virtual destruction of the industry there. For this reason, it has become incredibly important to consider issues of communication of the science of CCUS, as important as the science itself.
Now, with new projects underway throughout the world, and an IPCC report that insists CCUS is necessary to meet emissions targets, the path forward clearly includes CCUS as an important part of the overall global strategy to mitigate climate change. Saskatchewan is very well positioned to meet that challenge.

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USE OF REAL-TIME CONDUCTIVITY DATA FROM AUTONOMOUS SENSORS TO DELINEATE EFFLUENT DISTRIBUTION ON A BOREAL LAKE DOWNSTREAM FROM A SASKATCHEWAN MILLING OPERATION

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The use of sensor technology to monitor water quality parameters on a real-time scale is growing worldwide. This technology allows for the continuous collection of aquatic data, with the description of trends and the identification of abnormal events. The aim of this study was to apply sensor technology (Libelium®) to delineate temporal changes in effluent distribution in a boreal lake (McClean Lake) with an unevenly mixed uranium mill effluent. To address this aim, eight Smart Water sensors measuring temperature and conductivity (EC) were deployed at McClean Lake East and West Basin (reference site). Sensors were programmed to report data twice a day for 5 and 7 consecutive weeks in 2018 and 2019, respectively. Prior to deployment, sensors were calibrated using standard solutions and tests performed to validate results by comparing hand-held meter readings with the ones reported by the sensors. Conductivity probes were used to trace effluent distribution across sites and over deployment periods. Data were subsequently used to generate EC-based ArcGIS maps of effluent distribution. An additional validation step included hourly in-situ measurements in the effluent mixing zone to compare EC values reported by sensors to those obtained with a handheld field meter. Results demonstrated accuracy of sensors EC readings relative to handheld field meter readings, and the successful use of real-time EC data to monitor effluent distribution within lake water overtime. Finally, a case study will be presented on the use of sensor EC data to estimate total aqueous selenium concentrations at different sites within McClean Lake.

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LITHIUM BRINE RESOURCES – A NOVEL PROSPECT FOR SASKATCHEWAN

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Lithium has garnered significant interest over the last decade to now being ubiquitously associated with lithium-ion batteries – a key component in energy storage technologies. These energy solutions are necessary to meet growing demands for electrified transportation and to better harness renewable energy sources to decarbonize energy production. Global supply of lithium is geographically concentrated and currently dominated by Chile, Argentina and Australia with China enjoying a near monopoly on refining and production of value-added battery grade products.

Canada has an opportunity to capture part of this supply chain as there is a significant gap between leaders in this segment and North American markets. This is exemplified in the recent declaration from both the United States and Canada that lithium represents a key strategic mineral essential for nations' future energy independence. Canada has only begun to catalogue its inventory of lithium resources, but it is clear that subsurface brines in sedimentary basins of western provinces present a potentially unique and elegant resource in jurisdictions with existing oil and gas infrastructure and expertise. This presentation provides an overview of the lithium market, resources, and the potential for Canada with specific attention to Saskatchewan opportunities and challenges. Saskatchewan hosts various geological elements which warrant further investigation for these resources and there exists potential for additional synergies such as with geothermal, CCUS and other emerging technologies to tap into a much broader value chain. Saskatchewan could become an important producer of lithium and a leader in state-of-the-art technologies for its extraction.

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FRESHWATER BIVALVES AS AN ALTERNATIVE TO FISH POPULATIONS IN CANADIAN ENVIRONMENTAL EFFECTS MONITORING (EEM)

Catherine L. Proulx[1], Bruce W. Kilgour[1], Sarah Benson[2], Arden Rosaasen[2]

Kilgour & Associates Ltd., Ottawa, Ontario[1], Orano Canada Inc., Saskatoon, Saskatchewan[2]

The Canadian Environmental Effects Monitoring (EEM) program assesses whether mines effluents are associated with environmental effects to fish and fish habitats. One requirement of EEM programs is assessment of survival (age), energy use (growth and gonad size) and energy storage (condition and liver size) of at least two sentinel fish species. Fish populations are not always amenable to assessment, in which case alternatives include mesocosm (artificial stream) and caged bivalve studies. Environment and Climate Change Canada (ECCC) approved Orano Canada's proposal of an assessment of wild bivalve populations (Pisidiidae) as an alternative for the company's McClean Lake Operations. In the Orano EEM program carried out in fall 2019, two species of fingernail clam (*Sphaerium nitidum, Pisidium casertanum*) were collected from both reference and exposure areas. Clam length, total weight and ash-free dry weight were determined. Clams were also dissected to determine the number of embryos and shelled larvae they contained. Length data were used to determine age classes and to support estimates of size at age. The collection of wild bivalves took only 1 day per sampling area, while the collection of length, weight and reproductive data was similar to the effort for fish dissections. The clam sampling program produced the required EEM data, eliminated impacts on local populations of Slimy Sculpin and Burbot, with an overall cost that was similar to that for a wild fish population survey.

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DECOMMISSIONING OF THE CLUFF LAKE URANIUM MINE, SASKATCHEWAN, CANADA

Tina Searcy[1], **Kebbi Hughes**[1], Tyler Lohman[1]

[1]*Orano Canada Inc., Saskatchewan, Canada*

The Cluff Lake decommissioned property was a former uranium mine and mill located in the Athabasca Basin of northern Saskatchewan, approximately 900 km north of Saskatoon, Saskatchewan. Uranium mining and milling operations commenced in 1980 and ceased at the site in 2002 after more than 20 years of production. During operation, facilities included open pit and underground mines, a mill, a tailings management area, a residential camp, and various other support and site infrastructure activities. In the time since the completion of mining and milling at Cluff Lake, Orano Canada Inc. (Orano) has focused on decommissioning activities and monitoring at the site. The property has achieved its decommissioning objectives and Orano is preparing to transfer the property into the Province of Saskatchewan's Institutional Control Program.

A decommissioning license was granted by the Canadian Nuclear Safety Commission (CNSC) in 2004. The majority of the physical decommissioning then occurred between 2004 and 2006. This work included mill demolition, decommissioning of the open pits, and covering of the waste rock pile and tailings management area. From 2006 to 2013, personnel remained on site for post-decommissioning activities and follow-up monitoring. The Cluff Lake Project reached a milestone in 2013, when the remainder of site clean-up work was completed, a permanent site presence was discontinued, and the site access restrictions were removed. Orano transitioned to conducting routine environmental monitoring of the Cluff Lake Project through quarterly campaigns that transitioned to annual campaigns, mobilizing a small team to site from Saskatoon to collect the required environmental data. Annual campaign environmental monitoring and site inspections continue to be carried out as Orano prepares to transfer the property into the Province of Saskatchewan's Institutional Control Program. An overview of the decommissioning history for the Cluff Lake Project site, with a focus on the transition into Institutional Control and preparation of the Long-term Monitoring and Maintenance Program, and related stakeholder engagement will be discussed.

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STATUS OF UNDRIP IMPLEMENTATION IN CANADA

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On June 21, 2021, Bill C-15 – *An Act Respecting the United Nations Declaration on the Rights of Indigenous Peoples* (UNDRIP) received Royal Assent. The new legislation will require the federal government, in consultation and cooperation with Indigenous Peoples, to take all measures necessary to ensure the laws of Canada are consistent with UNDRIP; prepare and implement an action plan to achieve UNDRIP's objectives; and table an annual report on progress to align the laws of Canada and on the action plan. The implementation of this legislation may lead to a variety of potential outcomes, some of which may have implications for the mining sector and its relationships with Indigenous communities.

Prior to the introduction of this legislation, UNDRIP was already influencing the way the mining sector conducts its business. Individual companies across the sector have developed policies and commitments that are guided by the principles of UNDRIP and have formed partnerships with Indigenous communities that are advancing reconciliation and contributing to implementation of UNDRIP on the ground. The Mining Association of Canada's (MAC) Towards Sustainable Mining (TSM) Initiative was recently updated with measurable criteria reflecting the Truth and Reconciliation Commission's Call to the corporate sector and establishes a standard for what is considered good practice in TSM that includes aiming to achieve free, prior and informed consent (FPIC) before proceeding with development where impacts to rights may occur and establishes requirements for shared decision making with Indigenous communities as a means of implementing FPIC.

This presentation will provide an overview of the status of UNDRIP implementation in Canada, including measures taken by the Canadian mining sector to implement engagement practices that are aligned with the principles of UNDRIP.

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COMMUNITY DRIVEN PROGRAM AT THE DECOMMISSIONED BEAVERLODGE SITE

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The Beaverlodge uranium mine/mill site in the Uranium City area was owned and operated by Eldorado Nuclear (a federal Crown corporation) and was decommissioned in the 1980's. The decommissioned site is managed by Cameco Corporation (Cameco) while the Government of Canada retains financial responsibility. Ongoing work includes routine environmental monitoring, targeted environmental investigations and remediation, maintenance work and community engagement. One way Cameco engages is through annual public meetings, where Cameco representatives meet with stakeholders in an effort to elicit feedback and strengthen relationships. At a recent public meeting, a local stakeholder raised concerns about hunting and eating moose that potentially graze on the plants growing on the Fookes Delta, an area where tailings were historically deposited and have since been covered. Previous studies have shown that living a traditional lifestyle and consuming country foods from the area, while respecting the water and fish advisories, is safe. Nonetheless, the community feedback offered Cameco the opportunity to actively address the concern and involve youth in environmental monitoring. Working with Canada North Environmental Services Ltd., the Fookes Delta Community Based Program was established to reinforce it is safe to eat moose potentially grazing on the delta. This presentation will provide a brief history of the decommissioned Beaverlodge site and Fookes Delta, discuss the importance of community engagement and youth involvement, outline the Fookes Delta Community Based Program components and share keys to success (e.g., preparation, safety, keen students and sharing of Indigenous knowledge systems).

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EFFECTS OF DUST DEPOSITION FROM DIAMOND MINING ON SUB-ARCTIC PLANT COMMUNITIES AND BARREN-GROUND CARIBOU FORAGE

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Dust produced from mining has the potential to reduce plant cover, alter plant communities, and increase metal concentrations in vegetation. These changes in plant communities may affect the amount, type, and quality of forage for barren-ground caribou (*Rangifer tarandus groenlandicus*). We quantified dust deposition from Diavik Diamond Mine (NWT, Canada) and investigated the changes on forage quality, type, and quantity for caribou. From 2002 to 2016, dust deposition was measured and vegetation cover and richness were assessed in permanent plots established adjacent to the mine and in reference areas 1 to 6 km from the mine. Lichen was collected from areas up to 100 km from the mine to determine metal concentrations. Dust deposition rapidly decreased within 4 km of the mine. Plant communities adjacent to the mine (within 500 m) had disproportionately increased cover of vascular plants and decreased bryophyte and lichen cover. Lichen sampled within 4 km from the mine had greater metal concentrations than those sampled farther afield. Concentrations of Al in lichen collected within 40 km of the mine exceeded safe exposure limits for consumption, assuming lichen comprised 100% of caribou diet. We conclude that dust deposition from mining is altering adjacent vegetation communities but that such changes to forage are unlikely to cause negative effects to caribou due to reduced lichen intake in summer and autumn, their migratory nature, and avoidance of mine-influenced areas. However, minimization and reclamation of mine-related disturbances will be important for maintaining sufficient quality forage and available habitat or space in caribou ranges.