# Tuesday, April 29, 2008
# Stream D – Environmental Risk Assessment / Risk Management

## Topic Keynote

**LOCATION: GRAND BALLROOM D**

8:45 am - 9:15 am

**Stephen Livingstone**, M.Sc., P.Geo.
**Franz Environmental Inc.**

Stephen Livingstone is a senior hydrogeologist and Vice-President of Franz Environmental Inc. He has over 19 years of experience managing environmental assessments, contaminant fate and transport evaluations, computer modelling, remediation and site specific risk assessment projects across Canada and internationally. Stephen is a licensed member of the Association of Professional Engineers, Geologists and Geophysicists of the Northwest Territories and Nunavut and Association of Professional Geoscientists in Ontario.

His work has included the assessment, evaluation, risk management and remediation of soil, groundwater, and sediment contamination from storage facilities, factories, brownfield sites, railway yards, landfills and mines. Mr. Livingstone has managed high profile and complex sites in Ontario, Atlantic Canada and Northern Canada including hazardous waste sites (PHCs, metals, PAHs), radiological impacts (uranium), off-site chlorinated solvent plumes (TCE, PCE and 1-4 dioxane) and "cancer cluster" sites. Mr. Livingstone has been responsible for environmental assessment and remediation projects in remote areas of the north which require innovative and novel approaches. He currently is the FRANZ Principal-in-Charge of the PWGSC Supply Arrangement for the Northern Contaminated Sites Program and National Capital Region and the INAC-CARD Yellowknife Standing Offer Agreement.

Mr. Livingstone has worked on several policy and guidance related projects on behalf of Environment Canada, Health Canada, DND and INAC. Mr. Livingstone was project manager and lead author for Environment Canada's development of the *FCSAP Contaminated Sites Classification System Guidance Document V. 1.6*; and project manager and lead author for Environment Canada's *FCSAP Ecological Risk Evaluation* tool for the evaluation of sites requesting FCSAP funding. Further, Stephen also helped develop the Contaminated Sites Management Plan (CSMP) for INAC–IIAP; DND's National Contaminated Sites Remediation Framework, and PWGSC's Contaminated Sites Risk Management Best Practice document. Currently, he is working with PWGSC on establishing a database and Portfolio Classification Tool for all federal Brownfield sites.

Mr. Livingstone has worked in the USA, Argentina, Brazil, Mexico, Sweden, China, Japan, Russia, Ukraine, Turkey, Greece, Kazakhstan, Guatemala, Haiti, Dominican Republic, Finland, and Norway. He has been responsible for host country training initiatives and capacity building/technology transfer development. He was a course instructor at the University of Ottawa teaching "Numerical Modelling and Computer Applications", Department of Earth Sciences, Graduate level course.

*All presentations will be delivered in English, unless noted otherwise.*

**TUESDAY, APRIL 29, 2008**

9:15 am - 9:40 am

## Problems with the Domenico Solution for Contaminant Transport in Groundwater and Regulatory Implications on Risk Assessments

Thomas Franz, Franz Environmental Inc.

The Domenico analytical solution (Domenico, 1987) of the three-dimensional contaminant transport equation is possibly the most widely used model for the simulation of contaminant transport in groundwater. The Domenico solution has been implemented in numerous, widely used and accepted risk assessment packages, including Atlantic RBCA, ASTM RBCA, and various models used to assess natural attenuation such as the United States Environmental Protection Agency's (U.S. EPA) BIOSCREEN and BIOCHLOR. The Domenico model relies on approximations rather than an exact analytical solution of the contaminant transport equation. Comparisons with exact analytical solutions have shown that the Domenico solution can differ significantly from the exact solution for very low concentrations, high dispersivities, high degradation rates, and for receptor locations off the centerline of the contaminant plume. This behaviour represents a significant problem because, in many risk assessments, acceptable solute concentrations at receptors are orders of magnitude lower than concentrations at the contaminant source; this puts many risk assessment calculations within the range where model errors can be significant and can lead to erroneous conclusions by risk assessors.

The problems with the Domenico solution may have far-reaching regulatory implications for risk assessments that have already been completed or are currently underway in many jurisdictions. For example, the controversy over the use of the Domenico model has recently resulted in a directive by the Michigan Department of Environmental Quality that prohibits the use of computer software for risk assessments that use this model.

This presentation will explain the conditions under which the Domenico solution provides unreliable results, discusses alternative models that are exact and unconditionally stable, and intends to provide a review of how regulatory agencies are dealing with this recently discovered problem.

9:40 am - 10:05 am

## Terrestrial Toxicity Testing in Support of Site-Specific Risk Assessments: An Integrative Tool for Contaminated Site Management

Gladys Stephenson[1], Natalie Feisthauer[1], Kathryn Bessie[2], Rick Scroggins[3]
[1]Stantec Consulting Ltd.
[2]EBA Engineering Consultants Ltd.
[3]Biological Methods Division, Environment Canada

Chemical characterization of soil at contaminated sites allows site managers to determine whether or not contamination at a site exceeds provincial or federal screening level soil quality guidelines. If the contaminant concentration at the site exceeds screening levels, remediation, risk assessment and/or risk management is required. While chemical characterization provides quantitative information about the contaminants of concern (COCs), it provides no information about the bioavailability or toxicity of the COCs at the site. Bioavailability and toxicity of COCs to ecological receptors at a site can be site-specific and can differ substantially from the literature-derived values used to derive soil screening guidelines. The contact time for COCs in site soils often spans years and even decades and as a result the COCs are usually well weathered, aged, and/or occluded within the soil colloids. In addition, chemical characterization provides no information about the confounding influences of soil physical-chemical characteristics (i.e., pH, texture, % organic matter, etc.) on toxicity and/or bioavailability of the COCs at the site. Without this knowledge, the extent and magnitude of the risk of the COCs to ecological receptors can be either under- or over-estimated. However, site-specific soil toxicity tests, with appropriate test methods and ecologically relevant species, provide data that integrates the toxicity and bioavailability of the COCs with the influence of soil physical-chemical characteristics to better estimate the potential risk to ecological receptors associated with the contamination. A case study will be presented where the use of soil toxicity testing, in support of a site-specific risk assessment of a petroleum hydrocarbon-contaminated site, was integral in facilitating site closure.

10:05 am - 10:30 am

## Decision Analysis of Field Sampling Strategies to Support Ecological Risk Assessment

Ryan Hill, Beth Power, Patrick Allard, Gary Mann
Azimuth Consulting Group Inc.

Ecological risk assessment (ERA) often involves the collection of multiple types of information. Each type of information provides a line of evidence that contributes to an

*All presentations will be delivered in English, unless noted otherwise.*

overall understanding of potential risks. For large and complex sites, multiple visits are often warranted, with each sampling program building on earlier results. Risk assessors use past experience and judgment to determine data needs and appropriate sampling intensity for each type of data. This informal process essentially weighs the pros and cons of various alternatives. While this is adequate for many sites, we believe that more formal consideration of field sampling strategies can be quite useful, particularly for large, complex and/or remote sites, as the number of factors that need to be considered is significant. Using a case study, we describe a simple workshop process for formally evaluating alternative sampling strategies to support ERA. This process employs the basic principles of decision analysis and is neither time consuming nor complicated.

10:50 am - 11:15 am

## Decontamination of Remote Properties Using Risk Management: Use of Environmental Assessment as a Decision Tool

Jean Pineault, Eng., M.Sc., Environmental Compliance and Greening Division, Department of Fisheries and Oceans

The Department of Fisheries and Oceans Canada (DFO) is the owner of several remote properties. Decontamination work was conducted in the late nineties in remote sites of the Quebec Region (QR) using the generic criteria approach. This method gave rise to a wide array of questions regarding its environmental benefits. Furthermore, this method was deemed to be costly.

Since the fall of 2005, decontamination work has been carried out at various lighthouse stations. With regard to these proprieties, DFO-QR chose to carry out punctual decontamination work which was based not only on risk analysis and archeological studies, but also on environmental assessments carried out in pursuance of the *Canadian Environmental Assessment Act.*

The environmental assessment was the tool selected to set up a balanced decontamination program which takes into account both the impacts of contamination and the consequences of decontamination work. As a result, this tool allowed not only for the identification of the zones selected for decontamination, but also for the validation of the lack of response in other sectors.

A project implemented by the DFO-QR will be used to illustrate this approach.

11:15 am - 11:40 am

## Abandoned Mine Sites: Is Risk Assessment an Option – Challenges and Concerns

Geetha Ramesh, WorleyParsons Komex

Although there have been few attempts at quantification, it is generally understood that the issue of abandoned or 'orphan' mine sites is a major unresolved environmental and social problem for the industry, for communities and for governments. Potential impacts include a range of health and safety problems, and extensive economic impacts due to resource degradation and water pollution. So far, there are only a small number of systematic programs to deal with the issue. However, experience with similar problems in contaminated industrial sites, and with rehabilitation of operational mines, has provided sufficient elements to allow for a serious start on the abandoned sites problem.

The legacy of abandoned mine sites carry with them centuries of old practices and of inadequate, insufficient or non-existent mine closures. The potential costs of rehabilitation, the lack of clearly assigned (or assumed) responsibility, the absence of criteria and standards of rehabilitation and other factors have delayed action by all parties – industry, governments and communities.

The impact of abandoned sites is significant, including: altered landscape; unused pits and shafts; land no longer useable due to loss of soil, pH, slope of land; abandoned tailings dumps; changes in groundwater regime; contaminated soils and aquatic sediments; subsidence; and, changes in vegetation.

Risk assessment, followed by remediation, is often thought to be a viable option for the abandoned mine sites. The following paper deals with the risk assessment option and how the science deals with the challenges, concerns and options of dealing with abandoned mine sites.

11:40 am - 12:05 pm

## Ecological Risk Assessment at a Northern Historical Site: Fort Conger, Ellesmere Island

Tamsin Laing[1], Iris Koch[1], Barbara Zeeb[1], Ken Reimer[1], Margaret Bertulli[2]
[1]Environmental Sciences Group, Royal Military College of Canada
[2]Western and Northern Service Centre, Parks Canada

Fort Conger is located on the shores of Discovery Harbour on the eastern side of Quttinirpaaq National Park, Northern Ellesmere Island, in Nunavut. The site was used as an overwintering base by a number of Arctic expeditions, most notably the Greely expedition, which established a semi-

permanent scientific research camp and meteorological base from 1881-1883. The foundations of a house built by the Greely expedition, as well as artifacts and debris from this era, may still be found on the site. Site investigations at Fort Conger have identified surprisingly high levels of inorganic contamination, with the most widespread contaminants being arsenic, copper, lead and zinc. Likely sources of these contaminants include arsenic trioxide used to preserve natural history specimens; mercury from weather recording instruments; lead from tin can solder; and, copper and zinc from batteries.

The Environmental Sciences Group is working with Parks Canada staff to develop a remediation plan for the site which is protective of the environment, but also takes into consideration the historical significance of the site. This presentation will discuss legacy issues potentially associated with historical sites, and the approach used at Fort Conger to determine remediation targets. The challenges of conducting an ecological risk assessment at a unique arsenic-contaminated Arctic site will also be discussed as will the inclusion of novel risk approaches (bioaccessibility).

1:30 pm - 1:55 pm

## A Practitioner's Perspective on the Challenges in the Application of Risk Assessment to Management Decisions

B.E. Halbert, H.A. Phillips, G.M. Wiatzka
SENES Consultants Limited

The application of risk assessment methodologies to site assessments at remote abandoned mine site locations has emerged as a powerful tool for evaluating potential risks to aquatic and terrestrial species from exposure to existing environmental conditions at the sites. In general, most mine sites are at great distances (greater than 100 km) from local populations so that adverse effects on humans are of lesser importance than potential ecological effects. While the application of the risk assessment methodologies is generally well understood by its scientific practitioners, incorporation of results into the decision framework for ongoing work or remedial actions is not as clear. This paper discusses three common dilemmas that face risk assessment practitioners, namely: i) What are the actions to be taken if sediment concentrations exceed Canadian Council of the Ministers of the Environment (CCME) guidelines? Are more studies needed? Should sediments be remediated? ii) How are tailings and waste rock evaluated in the risk assessment process and what are the remedial actions, if any? iii) How are tailings management areas (ponds or larger water bodies) considered within the risk assessment and remedial action plans?

Illustrative case studies at remote mine site locations are used to discuss these dilemmas and to pose possible solutions.

1:55 pm - 2:20 pm

## Risk Management at DFO Properties in the Maritimes and Gulf Regions: Application of Soil Screening Criteria for Metals Impacted Soil

Tasha Andrews and Odette Murphy
Environmental Management, Department of Fisheries and Oceans

The Department of Fisheries and Oceans Canada (DFO) in the Maritimes and Gulf Regions has several hundred contaminated sites, predominantly coastal lightstations, with metals impacted soil resulting mainly from the historic use of lead based paint on building exteriors, battery use and mercury baths. The metal impacted soil exceeds the generic Canadian Council of Ministers of the Environment (CCME) soil quality guidelines for the large majority of sites. However, these guidelines do not take into account site-specific information such as inconsistency with the land use categories used to derive the CCME guidelines. Therefore, a risk management framework was developed to prioritize any sites which may pose a risk to human health. A site classification decision tree was developed to categorize DFO properties according to five exposure assumptions ranging in sensitivity from residential settings with constant exposure to remote sites with infrequent exposure. Soil Screening Criteria (SSC) were developed for each of the exposure categories for select metals most commonly identified at DFO properties. The site classification and the application of the soil screening criteria include numerous benefits. The number of properties requiring remediation or risk management is significantly reduced, as is the extent of the surface area requiring corrective action for those properties that do require remediation. As a result, departmental funds are more effectively managed, while still protecting human health at DFO properties. The SSCs will also serve as a template for application in other DFO regions.

2:20 pm - 2:45 pm

## Risk Mitigation of Military Munitions in a Sensitive Ecosystem Environment

Josée Gagnon[1], Eng. M.Sc., Maj. Matt Braid[2], P.Eng.,
Jonathon Preston[1]
[1]Defence Construction Canada
[2]Department of National Defence

*This presentation will be delivered in French.*

Between 1952 and 2000, the Department of National Defence (DND) used Lac Saint-Pierre as a firing range. Certain shells that were fired over the lake and should have detonated did not. Other shells were inert and fired simply to examine ballistic performance. There are approximately 300,000 shells in the lake, 8,000 of which contain energetic

materials. The firing range comprises 160 square kilometres of shallow-water ecosystem. In 2000, the United Nations Educational, Scientific and Cultural Organization (UNESCO) recognized the Lac Saint-Pierre region as a World Biosphere Reserve. In 1998, Lac Saint-Pierre was designated as a Ramsar site pursuant to the Convention on Wetlands of International Importance.

In 2006, DND began an unexploded explosive ordnance (UXO) risk mitigation project in Lac Saint-Pierre to ensure public safety and to allow more open public access to the lake. This project will be implemented through annual ordnance removal campaigns, prioritized according to the risk index for the different areas of the lake. A Geographic Information System (GIS) was developed to prioritize areas of risk, an exercise that has been conducted in partnership with local stakeholders and the regulatory community.

This presentation will focus on the GIS and how the risk elements, from human interaction, to the UXO and environment, were synthesized to yield a relative risk index.

3:15 pm - 3:40 pm

## Environmental Site Assessment at CFB Gagetown, N.B.: Assessing 50 Years of Historical Herbicide Applications

François Lauzon, Dr. Christopher Ollson, Dr. Loren Knopper
Jacques Whitford Limited

Jacques Whitford Limited (Jacques Whitford) was retained by Public Works and Government Services Canada (PWGSC), on behalf of the Department of National Defence (DND), to conduct an Environmental Site Assessment (ESA) on the Range and Training Area (RTA) at Canadian Forces Base Gagetown (CFB Gagetown) in Oromocto, New Brunswick (NB), Canada. The ESA forms part of a commitment made by the Government of Canada to identify and report on the historical use of herbicides at CFB Gagetown from 1952 to present day. The ESA's main objective is to collect and interpret information that will allow DND to better understand and determine the existing environmental conditions of the RTA at CFB Gagetown, a large 110,000 hectare area of the army training base, specifically in order to determine the cumulative effects of historical herbicide applications.

The initial project deliverables included a detailed review of available information and the development of a strategic approach for conducting the ESA in order to establish current day "presence or absence" of chemicals of potential concern (COPCs) in a variety of environmental media. The information collected through the initial historical/document review provided a compilation of key scientific data related to all herbicides used, their active ingredients, as well as their manufacturing impurities. The detailed review of available historical field data was included in the development of a Geographic Information System (GIS) database allowing the mapping areas identified as having received herbicide applications (areas of potential environmental concern [APECs]), that accounted for over 55,000 hectares of the RTA, as well as in the selection of background sampling areas well outside of the influence of APECs, but still within the RTA.

The strategic approach was designed in such a way as to identify priority COPCs as well as priority APECs that would undergo a more statistically representative rigorous data collection and analysis program. Priority 1 COPCs were defined as chemicals that are carcinogenic, have the potential to bioaccumulate and are persistent in the environment. These included: dioxins, 2,4-D, 2,4,5-T, picloram, and hexachlorobenzene.

To determine representative COPC concentrations in surface soil, a soil screening methodology developed by the United States Environmental Protection Agency (US EPA, 1996) was adapted for the ESA. This approach provided a simple decision rule based on comparing the maximum contaminant concentrations of composite samples with a surface soil screening criteria (the Max test) to determine whether further investigation is needed for a particular sampling area/APEC in the current ESA context. Field collection of surface soils, soil cores, surface water, groundwater and vegetation was completed during a six-week field program that required the development of a site- specific health and safety plan. Special precautions were required because of the potential presence of unexploded explosive ordnance (UXO) throughout most APECs. A total of over 1,200 environmental samples were collected, from which over 380 samples were selected/composited for analysis for any one or multiple combinations of six analytical packages submitted to independent Canadian Association for Environmental Analytical Laboratories (CAEAL) accredited analytical laboratories.

This paper will outline the strategic approach developed for the Department of National Defence for this complex issue, as well as present the GIS/database management system specifically developed for compiling and reporting the results, and also present the results of the sampling program as released at a press conference in Fredericton, NB, June 1, 2006.

3:40 pm - 4:40 pm

## Panel Discussion – Live and Unplugged

*All presentations will be delivered in English, unless noted otherwise.*