

## Tuesday, May 11, 2010

### Stream D – Risk Assessment and Risk Management (Ecological and Human Health)

10:30 am – 11:00 am

#### Environmental Site Investigation and Human Health and Ecological Risk Assessment of Legacy DDT Contamination at Prince Albert National Park, Saskatchewan

Kyle Solomon,<sup>1</sup> Dr. Kenneth J. Reimer,<sup>1</sup> Nick Battye,<sup>1</sup>John Snell,<sup>2</sup> Ed McLean,<sup>2</sup> Fiona Moreland<sup>3</sup><sup>1</sup>Environmental Sciences Group, Royal Military College of Canada<sup>2</sup>Parks Canada, Western and Northern Canada Service Centre<sup>3</sup>Parks Canada, Prince Albert National Park

On behalf of Parks Canada Agency (PCA), the Environmental Sciences Group (ESG) conducted Phase I and II environmental site assessments (ESAs) at Prince Albert National Park (PANP), Saskatchewan. These focused on assessing the degree of dichloro-diphenyl-trichloroethane (DDT) contamination in the park. ESG's goal was to understand the impact of past activities at the park, specifically those activities related to the application of DDT in different locations within the townsite and surrounding areas.

From 1948 until the mid-1970s, DDT was used in PANP to control mosquitoes in areas frequented by park residents and visitors. Spraying activity was focused on, but not limited to, residential, commercial and recreational areas within the townsite of Waskesiu. Most studies regarding DDT contamination have focused on agricultural areas with widespread contamination. PANP provides a case study of numerous localized areas of DDT contamination within a residential setting.

The site assessment included a review of previous environmental reports and site records, a data gap analysis, and a review of historical aerial photographs to assess the im-

part of development on the environmental fate and transport of DDT in the park. Unfortunately, no detailed records were available regarding past use of DDT, or the decommissioning of the former maintenance compound in which DDT was prepared and stored. As a result, interviews with current and former PCA staff members who had been involved with DDT spraying were crucial to identifying areas of potential environmental concern (APECs).

ESG developed a sampling strategy that took into account the large geographical area of PANP, site access restrictions and changes in site characteristics related to development, and changes in land use that have occurred since spraying ended 30 years ago. Soil and sediment samples (approx. 500) were collected from each APEC, and were assessed using the appropriate environmental quality guidelines (EQGs), as set out by the Canadian Council of Ministers of the Environment (CCME). DDT concentrations ranged from below the analytical-method detection limit (<0.001 ppm) in both media, to more than 80 and 180 times the EQGs in soil and sediment, respectively.

The human health risk assessment (HHRA) was undertaken in an iterative manner, using a preliminary quantitative risk assessment (PQRA), followed by a site-specific risk assessment (SSRA) for residents of, and visitors to, PANP. The PQRA estimated an unacceptable risk to all receptor groups, while the SSRA did not. This study highlights the robust nature of the SSRA process, especially in cases in which the PQRA advocates remedial action.

An ecological risk assessment (ERA) is currently under way at PANP. It is anticipated that this project will lead to the creation of a remedial action plan that addresses the concerns of local stakeholders while meeting PCA's environmental obligations. In addition, it will be used as a template to assess the environmental impact of DDT use at national parks that share a similar history.

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



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TUESDAY, MAY 11, 2010

11:00 am – 11:30 am

### Soil Vapour Assessment

Simone Mol,<sup>1</sup> Will Gaherty,<sup>1</sup> Raman Birk<sup>2</sup> and Rae-Ann Sharp<sup>2</sup><sup>1</sup>Pottinger Gaherty Environmental Consultants Ltd.<sup>2</sup>Public Works and Government Services Canada

An environmental assessment generally involves the investigation of environmental media such as soil, sediment and water (e.g., surface water and groundwater). The Ministry of Environment (MOE) in British Columbia (BC), however, has recently included soil vapour as a regulated medium requiring assessment. Vapours from volatile and semi-volatile contaminant compounds can migrate into ambient air (both indoor and outdoor) from underlying contaminated groundwater and/or soil. These vapours may affect the health of humans at the site.

The development and implementation of soil-vapour standards have revealed a number of practical and scientific issues. In this paper, we have focused on the practical issues and the steep learning curve related to them, and pointed out some of the science issues that arise. Scientific validation of some of the coping mechanisms and pragmatic approaches remains a work in process. Discussion of these efforts is beyond the realistic scope of this paper.

The paper identifies the practical issues, and illustrates them with an actual site where soil-vapour assessment has been completed since about 2006. Although vapours have only recently been regulated in BC, the monitoring of vapours at four remote northern sites along the Alaska Highway in BC and the Yukon was historically assessed as part of the investigation, remediation and risk assessment.

Soil-vapour investigations conducted at these sites considered:

- (1) vapour source in soil and groundwater;
- (2) receptors likely to be exposed (e.g., onsite worker, residents, visitors); and,
- (3) route of exposure (e.g., pathways).

Based on the vapour source, receptors and route, a soil-vapour assessment program was developed.

During the sampling events undertaken at the sites, a number of challenges were encountered, including (but not limited to):

- (1) remote location;
- (2) changing site conditions;
- (3) changing guidelines; and,
- (4) cold weather.

A summary of the current guidelines, site investigations, vapour assessment, and assessment challenges is provided, tied in particular to one of the four sites.

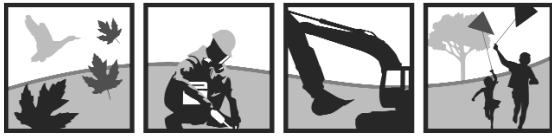
11:30 am – 12:00 pm

### Bioaccessibility in Human Health Risk Assessment: Method Development and Applications

Iris Koch, Shawn Milley, Breanne Gibson, Viviane Paquin and Dr. Kenneth J. Reimer

Environmental Sciences Group, Royal Military College of Canada

In the process of performing human health risk assessments, it has been shown that the assumption that all of a contaminant in a soil matrix poses risk is not always accurate. Specifically, not all of the contaminant is bioavailable, especially when ingestion – the predominant exposure pathway for contaminants in soils – is considered. Bioavailability, determined with *in-vivo* animal studies – and its surrogate, bioaccessibility, measured with *in-vitro* laboratory extractions – are thus important for risk assessment. The research consortium BioAccessibility Research Canada (BARC), formed to advance knowledge about bioavailability and bioaccessibility in risk assessment, initiated a round-robin experiment that involved testing a soil standard reference material using 16 different methods in 14 laboratories. The results revealed that, while the range of bioaccessibility results was quite large, reproducibility within and between laboratories was close to normal laboratory uncertainty. The design of additional studies to compare bioaccessibility-method results with bioavailability results (derived from animal testing) is under way. The application of selected bioaccessibility methods to soils from a Kingston brownfield site showed that bioaccessibility results confirmed the finding from the inter-laboratory experiment that lower pH is a determining factor in extracting higher proportions of contaminants. Bioaccessibility-method variables, including liquid-to-solid ratio and particle size, were studied using the brownfield soils, and the applicability of results to human health risk assessment was assessed. The optimization of bioaccessibility measurements is an important step towards the acceptance of bioaccessibility in risk assessment.



TUESDAY, MAY 11, 2010

1:30 pm – 2:00 pm

**Risk-Based Prioritization for Portfolios of Contaminated Sites: Lessons on the Integration of Risk-Based Information into Site Investigation**Ryan Hill and Beth Power  
Azimuth Consulting Group

Managers responsible for large numbers of contaminated sites face a significant challenge in effectively allocating limited resources to those sites. Azimuth Consulting Group accordingly developed a Risk Ranking Methodology (RRM) to assist the Crown Land Restoration Branch (CLRB) of the British Columbia Ministry of Agriculture and Lands in the Branch's efforts to prioritize its investigation and management of thousands of historical and abandoned mine sites across British Columbia. Based on that experience, this paper identifies lessons for portfolio managers and site investigators needing to integrate risk-related information into initial site investigation. The integration of risk-related information into site assessment can provide portfolio managers with relevant information when making management decisions regarding site prioritization.

2:00 pm – 2:30 pm

**What do we do with all these Phase II reports? A Case Study of Canadian Coast Guard Lightstations**Norm Healey, Gary Mann and Patrick Allard  
Azimuth Consulting Group

From 1999 to 2004, the Canadian Coast Guard undertook a major capital project to rebuild the network of staffed lightstations in coastal British Columbia. Early in this project, Phase II ESAs were commissioned, identifying environmental contamination at all 27 lightstations. This presentation will describe the practical, risk-based and cost-effective approach developed by the Canadian Coast Guard to assess and develop management plans for contamination within the time and budget constraints of a major capital project. A panel of expert risk assessors was convened to guide the development and implementation of an innovative risk-based assessment strategy that took advantage of common risk issues, operational histories, receptors and biophysical features among the sites. Management, regulators and stakeholders were consulted early and often. As a result of this innovative and collaborative process, Phase III ESAs and full risk assessments were not necessary at all 27 sites for the development of effective remediation and risk-management plans.

The lightstations were the first projects approved for risk management under FCSAP. The annual cost of risk management at the lightstations is approximately \$125,000. The estimated cost of remediation is \$30-60 million.

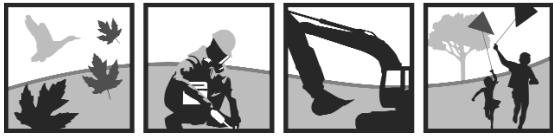
2:30 pm – 3:00 pm

**Risk Assessment and Risk Management of Contamination in the Aquatic Environment at Major Fisheries and Oceans Canada Facilities in the Pacific Region**Gary Mann and Patrick Allard  
Azimuth Consulting Group

Fisheries and Oceans Canada (DFO) is the custodian of approximately 8,200 properties nationally, many of which have the characteristics of contaminated sites. Of these properties, DFO has identified eight as major facilities and bases in the Pacific Region. A team of consultants was retained to develop and implement a five-year overall program that supports the implementation of consistent risk management plans to deal with contaminated-sites issues at these facilities. Key features of this process include:

- (1) developing and applying a unified risk assessment/risk management strategy to provide consistency among sites;
- (2) seeking input from federal agencies to ensure that implementation addresses key concerns;
- (3) using a standardized, defensible site-characterization approach across sites;
- (4) application of consistent risk assessment methods to facilitate informed risk management decisions across the eight sites; and,
- (5) identification and implementation of appropriate risk management options to address unacceptable risks.

This paper focuses on the approach used for assessing and managing ecological risks related to contamination in the aquatic environments at or adjacent to DFO's eight major facilities and bases in the Pacific Region.



TUESDAY, MAY 11, 2010

3:30 pm – 4:00 pm

### Risk Assessment When Background Exposures Exceed Toxicological Limits

Ian Mitchell and David Williams  
Meridian Environmental Inc.

The development of Canadian soil-quality guidelines for non-carcinogens includes subtracting background exposure, as represented by the Estimated Daily Intake (EDI), from the tolerable daily intake (TDI) to calculate a “residual tolerable daily intake”, which is used to represent allowable exposure from a contaminated site. Similarly, site-specific risk assessments often consider both background exposure and exposure from the site; when the sum of these exposures exceeds the TDI, further action is normally considered warranted.

For several substances, the EDI is greater than the TDI, meaning that background exposures are predicted to result in a hazard quotient greater than unity, even without consideration of site exposures. Soil-quality guidelines cannot be calculated under these circumstances, since there is no residual tolerable daily intake (RTDI). Addressing these substances at federal contaminated sites thus poses unique challenges.

In order to address the difficulties in conducting site-specific risk assessments or in developing soil-quality guidelines for substances with an EDI greater than the TDI, several different approaches were examined, including deterministic and probabilistic evaluations of the impact of increased soil concentrations on total exposures. It was found that, for many of these substances – particularly many metals – exposure from soil is a relatively minor contributor to total exposure, and that significant increases in soil concentrations may not have a noticeable effect on total exposure. Specific examples are presented, and implications for risk assessment and guideline development are discussed.

4:00 pm – 4:30 pm

### Human Health Risk Assessment of Country Foods from Victoria Harbour, British Columbia

Ross Wilson, M.Sc., DABT  
SNC-Lavalin Inc., Environment Division

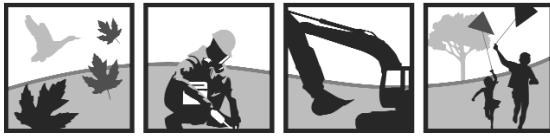
In order to assess the potential risks to human health associated with consumption of aquatic life, a human health risk assessment (HHRA) was completed for Victoria Harbour. The methods used to assess human health risks were based on risk assessment procedures commonly used by regulatory agencies such as Health Canada, the World Health Organization (WHO) and the U.S. Food and Drug Administration (US FDA). Exposures to chemicals were estimated based on a variety of assumptions relating to how

people may use the harbour. Dietary exposures were estimated using values represented by mean and maximum concentrations of contaminants in the various media sampled and analyzed. The toxicological literature was then reviewed to identify exposure rates that have been determined to be acceptable or “safe” (or more specifically, exposure rates without unacceptable risk of adverse effects to humans). Toxicological reference values were obtained from recognized health agencies, which included Health Canada’s Chemical Health Hazard Assessment Division as a primary source of information. For the purposes of this risk assessment of country foods, risks were deemed to be acceptable if Hazard Quotient (HQ) values were less than 1, or if Incremental Lifetime Cancer Risk (ILCR) estimates were less than  $1 \times 10^{-5}$ . This is similar to the approach used for the evaluation of chemicals in food by Health Canada’s Bureau of Chemical Safety.

The results of the HHRA indicated that there is little likelihood of unacceptable risk under current conditions from commonly consumed foods. The harbour is currently under a Fisheries and Oceans Canada-ordered sanitary closure for bivalve harvesting, commercial closure for crab fishing, and a recreational consumption advisory for crab hepatopancreas. Interviews with persons knowledgeable about harvesting habits confirmed that the advisories and closures seem to be well known and largely followed. With this in mind, it currently appears that the only foods that certain persons are likely to be commonly consuming are crab muscle and fish. These food groups contain relatively low concentrations of chemicals (at least for chemicals that may be associated with the seabed) and, consequently, no unacceptable risks were predicted for persons consuming these foods at rates ranging from once per week to once per month. It is noted that potentially unacceptable risks were predicted from consumption patterns for certain foods (e.g., once per week consumption of crab hepatopancreas, bentnose clams and sea lettuce); however, these foods are not known to be commonly consumed from the harbour. Consequently, the current environmental state of the harbour does not appear to be posing unacceptable risks to persons consuming foods collected from this area.

Overall, although the harbour contains sediments with elevated chemical concentrations, this does not appear to result in unacceptable health risks from country foods. Although there is no reason to suspect that environmental conditions will worsen with time, the risk assessment recommended continued monitoring of environmental conditions and harbour usage. If conditions change, it is recommended that revised results should be disseminated in a timely manner to the general public and various environmental agencies.

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TUESDAY, MAY 11, 2010

4:30 pm – 5:00 pm

**Soil Vapour Intrusion Investigation at a Site in Northern Manitoba, and Implications for Health Canada's Guidance for Vapour-Intrusion Assessment at Contaminated Sites**Lindsay Smith<sup>1</sup>, Ian Hers<sup>2</sup> and Audrey Wagenaar<sup>2</sup><sup>1</sup>Health Canada<sup>2</sup>Golder Associates Ltd.

Many federal sites with potential vapour-intrusion problems are located in northern Canada, where subsurface conditions and building properties differ from conditions as described in Health Canada's adaptation of the Johnson and Ettinger model for vapour intrusion. In order to obtain a better understanding of how northern conditions might affect vapour intrusion, site characterization was carried out for Brochet School in northern Manitoba. Study parameters included the formation of a thaw bulb underneath the school, foundation type, pressure differential, soil vapour gradients, and oxygen availability for biodegradation.

The investigation revealed that it was warm enough beneath the school for vapour to form (0.67 mg/m<sup>3</sup> to 315 mg/m<sup>3</sup> for CCME F2 petroleum fraction), with the average soil temperature being around 12–13°C. Typically, partitioning equations use chemical properties measured at higher temperatures than observed in either soil or groundwater at Brochet, which may be one reason that measured near-source vapours were lower than predicted for many compounds. It is uncertain whether temperature affected biodegradation of subsurface vapours: although sufficient oxygen (18%) was available for biodegradation, rates appeared to be lower than those observed at other sites. Low moisture content below the building footprint is another likely reason that biodegradation could have been impeded.

Background sources of VOCs within the school make a complete interpretation of the findings challenging, and confound the calculation of site-specific attenuation factors. However, based on the subsurface data, and a comparison of site parameters with model parameters, it is felt the model has value as a screening tool for sites in northern Canada.