August 2, 2016 Reference No. P1661112-001-P-Rev3-1000

David A. McCormick, MBA
Director, Public Relations & Business Development
Port Alberni Port Authority
2750 Harbour Road
Port Alberni, British Columbia
V9Y 7X2

PROPOSAL TO CONDUCT AN OPERATIONS AND EMISSIONS EVALUATION CANTIMBER BIOTECH, PORT ALBERNI, BRITISH COLUMBIA

Dear Mr. McCormick,

Golder Associates Limited (Golder) is pleased to present you with this proposal to assist with the evaluation of operations and emissions for the Cantimber Biotech facility at Port Alberni. Golder understands that the Cantimber is going through trials and commissioning of a new activated carbon manufacturing facility at Port Alberni. In the process of conducting these startup activities, there have been some concerns regarding emissions from the process, particularly odorous and potential sulphur dioxide emissions. There is some concern that there may be health effects associated with these emissions. Golder understands that the Port Authority is seeking a third party consultant that can review the process and assess the source of the emissions, the type of emissions, the potential for health impacts, and make recommendations regarding operational or emission controls to improve the conditions.

We have updated this proposal based on our further understanding of the process, and a preliminary review of the scope of the air modelling assessment undertaken by Levelton on behalf of Cantimber (provided to Golder). Based on this information, we expect that there will be additional compounds emitted to air by the facility above those considered in the air quality assessment. This potentially includes compounds such as Volatile Organic Compounds (VOC), including Poly-Aromatic Hydrocarbons (PAHs).

This proposal represents a modified version of the original proposal submitted to Port Alberni Port Authority, with commercially sensitive information removed. We understand that the Port Alberni Port Authority will share this document with relevant stakeholders.

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WHAT DIFFERENTIATES GOLDER'S CAPABILITIES TO HELP WITH THIS PROJECT?

- **Golder has extensive experience with the wood products industry and pyrolysis processes.** Golder is a member of the National Council of Air and Stream Improvement, the research organization for the forest products industry in North America. This provides Golder with access to research information and tools on wood products combustion and manufacturing processes for a wide variety of processes. Golder completed a project for the Ontario MoE developing cost and analysis tools for volatile organic compound emission controls to support proposed regulation. This included benchmarking over 100 wood products facilities. Additionally, Golder has developed emission inventories and process analysis for a wood pyrolysis syngas facility in the Pacific Northwest, whose objective was to develop oil from the condensed vapors of syngas. This involved extensive process understanding and engineering analysis to support the emission calculations and permitting.

- **Golder has process engineering and industrial ventilation design capabilities.** Golder's air quality team consists of air quality, civil, mechanical, and chemical engineers that evaluate process designs to determine unique emission capture systems. Golder designs the industrial ventilation systems in-house so we not only understand the source and capture of process emissions, but we know how to engineer solutions.

- **Golder conducts human health risk assessments for air pollutants and has a risk assessment specialist that is a Diplomate of the American Board of Toxicology (DABT) (i.e., a board certified toxicologist) as part of our air quality team.** Golder routinely develops emissions inventories for hazardous air pollutants and conducts dispersion modeling to determine potential ambient concentrations. Our staff of human health risk assessors assist our air quality engineers in assessing the human health risks. Our air quality team routinely conducts these type of environmental assessments to assist with permitting of industrial facilities.

- **Golder has conducted odour studies and developed monitoring and contingency plans for a number of unique operations.** Golder has conducted odour studies for sewage treatment, fish processing, landfills, anaerobic digesters, waste transfer stations, oil and gas facilities, painting operations, and even porta-potty facilities. We assess the impacts of operations, location, and meteorology to help develop contingency plans and we assist in engineering emission control solutions. Often we have worked with the public to assist in assessing and reporting odorous conditions so we could correlate wind direction with the timing of specific facility actions to pinpoint activities that could be modified or controlled. Golder's air quality team includes a meteorologist trained in dispersion modeling.

- **Golder's air quality team has extensive experience with industrial projects that are causing public concern, particularly at ports.** Golder's air quality team is experienced in working on controversial projects with diverse groups of stakeholders. We are currently working on projects in the Pacific Northwest (oil transfer terminals) that have garnered over 200,000 public comments (and counting). One of Golder's strengths is our objective ability to take complex air quality issues and explain them to stakeholders in terms that everyone can understand and appreciate. While this does not always alleviate concerns, we find that involving stakeholders in the understanding of the issues and the public value of the project is the first step in finding collective solutions that have stakeholder support. Concerned stakeholders often have valuable suggestions even when they don't know how to implement a solution. Golder appreciates the value that adds to the process of resolving issues.

- **Our team has experience of third party review of high profile projects, including facilities on Port Authority land.** The Fraser Surrey Docks Coal Transhipment Project involves a direct load-out facility for coal brought by train and shipped by barge to a lightering operation at Texada Island. The project is locally controversial for a number of reasons and Golder was retained by the Port of Vancouver, in its regulatory role, to provide a third party review of Air Quality, Human Health Risk Assessment and Aquatic Toxicology. Golder prepared a third party review report that focused on substantive issues (not editorial) and was written in a manner that was focused and impartial. The report identified the key issues in a way that was brief but effective. Golder also provided advice and recommendations to Port of Vancouver on various issues as well as briefing materials for Port of Vancouver's senior management and external communications.
- **Golder has state-of-the-art air quality dispersion modeling capabilities.** Golder has implemented cluster computing to reduce the time spent on complex dispersion modeling tasks involving thousands of data points. Golder uses AERSCREEN, CALPUFF, AERMOD and numerous other numerical models to assess the impacts of emissions from industrial processes. With cluster computing, modeling tasks that took up to a week to process can now be completed in hours. This helps our clients run more potential operating scenarios and make faster decisions when timing is of the essence. It also means Golder understands dispersion modeling and can quickly review the work of others to assess the adequacy of the model setup and source descriptions.

A small sample of Golder's relevant project work is provided in Attachment 1.

Resumes of key personnel proposed for this project are provided in Attachment 2. The work will be overseen by Rachel Wyles, an Air Quality Engineer in Golder's Vancouver office who is a Professional Engineer in the province of BC, in good standing with APEGBC. Rachel will lead the team of air quality and human health risk assessment professionals, whose extensive experience will be available to Port Alberni Port Authority.

SCOPE OF WORK

Golder understands that the Port Alberni Port Authority is seeking an independent review of the Cantimber Biotech operations, their impact assessment (Levelton 2015), and the delivery of a summary report with specific objectives. Golder received a requested scope of work via email. For clarity, that scope of work initially provided is shown in italics below with an explanation of Golder's proposed response to the tasks. We have also included an initial task to review the modelling undertaken by Cantimber, and provide recommendations on actions that could be taken by Cantimber to strengthen the robustness of the assessment such that it addresses current concerns.

For additional clarity, Golder has divided the requested scope and our proposed approach into three phases: Initial Review, Assessment and Analysis, Recommendations. The proposed scope/questions will be addressed in a final report to the Port Authority.

Task 1: Initial Review

- Consider the Air Quality Assessment undertaken by Cantimber:

  Golder will review the emissions characterization section in the existing air quality assessment, and provide a third party opinion on the following:

  - Work that would be required to 'ground truth' the emissions used in the modelling to confirm whether actual emissions are higher or lower than modelled. The modelling was done prior to the facility becoming operational, and are therefore based on 'expected' rather than 'actual' emissions. There could be a difference in the actual emissions, and therefore difference in the air quality impacts predicted in the report. To assist in determining if stack emissions have changed compared to modelled emissions, stack testing at Cantimber will be incorporated into the assessment. Stack testing will be limited to two stacks. It is anticipated that the stack testing will be undertaken after Golder's site visit as described in Task 2.
  - Identify additional emissions that could be emitted from the facility (beyond those currently assessed).

- *Clearly explain the existing process and where improvements could be made in terms of emissions control*

  This is a multi-faceted task that will require review and analysis. To begin, Golder proposes to conduct a site visit with two staff members, including engineering staff. During the site visit Golder would like to review engineering designs and the existing modelling undertaken, participate in a thorough tour of the operation, review internal and external communications to date and corrective actions that have been taken, and discuss with facility personnel any thoughts they have on next steps and emission controls that have been considered. Obtaining a clear understanding of what has transpired to date will enable Golder to assess the situation more quickly. If possible, Golder would like to see the process operating. If there has been any correlation between complaints and specific operations, Golder will benefit from knowing that during the site visit.

  The process description and recommendation of improvements, including emission control, will be part of the final report prepared in Task 3.

Task 2: Assessment and Analysis

- *Emissions characterization during start-up and during normal operations.*
  - *Characterize the emissions causing the current odour problem.*
  - *Characterize the source of the odorous emissions.*

    As part of the site visit, Golder will review the potential sources of odour emissions, which will provide clues as to their type. Golder will review the type of feedstock being used and the design of the pyrolysis system. The review of the process will attempt to identify the locations from which emissions can emanate. Golder will also conduct a literature review of pyrolysis emissions to see if there is any new emerging information on odours related to producing activated carbon.

    In the interest of acting quickly to assess the situation, Golder assumes that a qualitative assessment of odours and their sources will be sufficient at this time. However, if the issues are not resolved, Golder has the capability to support the Port Authority with emission testing and odour studies designed at specifying pollutants, their specific location of origin, their concentration, and their odour thresholds.

- *Are there health concerns associated with the release of those pollutants?*

  Based upon the types of emissions likely escaping from the activated charcoal process, Golder's human health risk specialist will assist in assessing the potential for health concerns. Golder assumes that a qualitative discussion of potential health concerns is adequate at this time. If any concerns lead to a request for additional quantitative assessment, Golder has the capacity conduct monitoring and/or detailed dispersion modeling and a human health risk assessment. Quantitative dispersion modelling or human health risk assessment is not included in the current scope of work.

- *Are there process design deficiencies that allow those pollutants to escape from the batch retort vessels (in accordance with common Canadian design practices)?*

  Golder's engineering staff will evaluate the process on-site, note any observations to date, and conduct further design review off-site. Based on our engineering analysis, Golder will provide observations and where possible, suggestions for improvement where design deficiencies are noted. While this information will be included in Golder's final report with recommendations, Golder will communicate observations with the Port Authority as they are noted so that actions may be taken as soon as possible. Based on preliminary discussions with Cantimber, they are currently working on upgrades to their process to reduce escaping emissions from the batch retort vessels.

- *Feedstock characterization and optimization.*

  - *Characterise the feedstock.*

  - *How do feedstock characteristics affect VOC emissions in the current plant configuration?*

    During the site visit, Golder will review the feedstock mix and may take samples for further analysis. Golder assumes that a qualitative discussion of the feedstock characteristics and their impact on VOC emissions is all that is needed at this time. However, Golder has the capability of having feedstock analysis conducted. Golder will rely heavily on any pilot testing/bench scale testing data that the developer has collected in analyzing feedstock for use in the process.

  - *Does pre-heating the retort vessels prior to carbonization bring feedstock MC down to acceptable levels (<20%MC) to optimize the system and reduce emissions?*

    To the extent that it is possible to shut down the retorts and pull samples prior to carbonization, Golder recommends that actual samples be taken for moisture analysis. It has been our experience that feedstock for these types of processes can vary considerably based on the type of biomass, species, where it originated, and how long since it has been collected. It may not be possible to make a theoretical determination to answer this question. However, if samples can be pulled Golder can have the analysis conducted. For this proposal, Golder assumes that an assessment will be approached with existing data review. Golder may make recommendations for subsequent testing if necessary. As part of the assessment, Golder would like to review and understand the 20%MC requirement to assess how critical that is to emissions reduction. While moisture content does correlate with when the VOC emissions occur, it doesn't necessarily have a bearing on emissions reduction.

Task 3: Recommendations

- *Recommend:*
  - *Why are those pollutants leaving the facility? Solutions/remedies?*
  - *Options to ensure optimal feedstock characteristics to minimize emissions?*
  - *Preferred options for syngas/VOC control during commissioning/start-up and during normal operations.*
  - *Preferred options for reducing smoke from the operation (e.g., eliminate the use of cord wood as a source of fuel to get furnace up to temperature during start-up and replace with an auxiliary natural gas burner).*
  - *Preferred options to achieve optimal feedstock conditions and minimize emissions.*
  - *Stack testing requirements that should be added to the existing occupational Licence (VOC?).*
  - *Additional ambient air monitoring requirements – recommendations for continuous VOC monitoring (warranted if?); instrumentation?*
- Golder will prepare a final technical memorandum with recommendations. The memorandum will include, but not be limited to:
  - overview of the process description;
  - discussion of emissions generation and sources (i.e., what is likely being emitted, and from what sources – stacks or building vents);
  - The stack tested results and sampling methods provided by the stack testing sub-contractor will be included as an attachment to the memorandum;
  - discussion of emission dispersion and impacted areas;
  - evaluation of potential health concerns, if any;
  - discussion of design considerations and adequacy;
  - discussion of any observations on operational considerations to reduce emissions, including feedstock choice and preparation;
  - evaluation of the potential for optimizing existing emission controls (equipment and practices);
  - options for reducing smoke from the operation;
  - potential additional emission control options;
  - recommendations for stack testing and/or ambient monitoring requirements that should be added to the occupational licence; and
  - recommendations for additional ambient monitoring for air pollutants and/or odours.
- *Draft an odour and contingency plan:*

  Golder will prepare a draft odour and contingency plan that will include, but not be limited to:
  - recordkeeping and response to odour complaints;

- routine odour assessment activities;
- investigation of odour complaints (including process and meteorology);
- remedial corrective actions for odour complaints that are correlated to process conditions; and
- notifications.

PROPOSED SCHEDULE

Golder understands that the Cantimber Biotech facility may not currently be operating. Golder assumes this means that timing for resolving the issues is critical. Golder is available and prepared to begin immediately upon authorization. A site visit could be conducted within 14 days of authorization. A draft report could be submitted for review within 45 days of authorization, provided the site visit is conducted on schedule and all information requests are answered in a timely fashion.

SCOPE OF WORK ASSUMPTIONS

For the purposes of developing the scope of work, we have made the following assumptions:

- We have assumed two Golder staff will attend the site visit (a senior air quality specialist and a mechanical engineering specialist to provide a suitable range of technical support).
- We have assumed that a person knowledgeable of the current Cantimber process operations will be available during the site visit.
- The site visit will take a maximum of 5 hours.
- For the literature review of pyrolysis emissions (in Task 2) we have assumed that a maximum of 10 documents will be reviewed in detail.
- The scope of work includes onetime stack testing of two stacks, undertaken by a subcontractor.
- The scope of work does not include any ambient monitoring or feedstock testing.

CLOSURE

We look forward to working with Port Alberni Port Authority on this high profile project and trust that the work plan provided herein will meet your current needs. If you have any questions or require additional information, please contact the undersigned.

This proposal for Port Alberni Port Authority is confidential and proprietary to Golder Associates Ltd., and is provided for the sole and express purpose for permitting the recipient to evaluate the proposal. In receipt of this proposal, the recipient agrees to maintain the information contained in this proposal ("Proprietary Information") in confidence and to not modify, reproduce, distribute, use (except as expressly permitted herein) or otherwise disclose the Proprietary Information to any person outside the group or team directly responsible for evaluation of its contents, without the prior and express written consent of Golder Associates Ltd. The Proprietary Information of Golder Associates Ltd. is protected under law in Canada and other countries throughout the world and under international treaties. The recipient may not remove this proprietary notice from the proposal.

Yours very truly,

GOLDER ASSOCIATES LTD.

Jeffrey Ramkellawan, M.Sc., P.Eng.
Air Quality Specialist

Rachel Wyles, M.Eng., P.Eng.
Associate, Senior Air Quality Engineer

CD/JR/RW/ls/it/bb/it

Attachments: Attachment 1: Selected Relevant Project Work
Attachment 2: Key Team Resumes

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ATTACHMENT 1
Selected Relevant Project Work

PROJECT PROFILE
Industry-Wide VOC and PM Emission Control Evaluation

Client

- Ontario Ministry of Environment

Project Location

- Ontario, Canada

Key Elements

- Industry Benchmarking
- Emission Control Evaluation
- Process Engineering Evaluation
- Emission Control Cost Algorithm Development

Key Personnel

- Chad Darby
- Geoff Scott, P.E.

Project Duration

- 2 months

ONTARIO MINISTRY OF ENVIRONMENT – WOOD PRODUCTS VOC AND PM EMISSION CONTROL BENCHMARKING

To support policy development for smog reduction, Golder Associates was retained by the Ministry of Environment to participate in a collaborative evaluation between the Ministry and industry of emission control options for VOCs and PM. Golder prepared a report intended to provide the Ministry with an evaluation of the technical options to reduce VOC and PM emissions from the Wood Product Manufacturing (WPM) sub-sector. The Ministry intends to use the results of this study to evaluate VOC and PM emissions reduction scenarios, the effectiveness of each of the scenarios and the cost of each scenario for this industrial sub-sector in support of future policy evaluations.

The scope of this study consisted of the following process:

- Developing an industry sub-sector profile, which included engineering analysis of diverse operations;
- Preparing emission estimations from the sub-sector for the 1990 base year, 2006 reporting year and future years 2010 and 2015 (the reporting years);
- Evaluating emission control technologies and strategies and preparing control technology profiles;
- Developing sizing and costing algorithms;
- Conducting pilot test(s) to evaluate/refine the sizing and costing algorithms;
- Conducting site visits;
- Preparing confidential site-specific facility profiles;
- Preparing sector roll-ups; and
- Participating in stakeholder meetings.

Reduction of PM and VOC emissions from wood products manufacturing can be accomplished by reducing the generation of emissions through pollution prevention or the control of emissions using add-on control technology. A comprehensive list of applicable add-on control technologies was developed. Using a decision making framework, technologies were selected for further assessment. Based on stakeholder feedback and practical limitations at the facility, detailed sizing and costing algorithms were developed in order to provide an estimate of the costs for the identified pollution control technologies.

The algorithms were developed to provide the following:

- Capital costs
- Operating and maintenance costs
- Total Annualized costs (capital and O&M)
- $/tonne cost effectiveness

Thirty (30) facilities, out of 247, were profiled to assess the sources of PM and VOC emissions. The collected data was used in the algorithms to assess the costs for additional emission reduction.

PROJECT PROFILE
Lumber Kiln Capacity Expansion Permitting

Client

- Oroville Reman & Reload

Project Location

- Oroville, Washington

Key Elements

- Development of organic emission factors representative of specific wood species
- Dispersion modeling

Key Personnel

- Brian Eagle
- Chad Darby

Project Duration

- 18 months

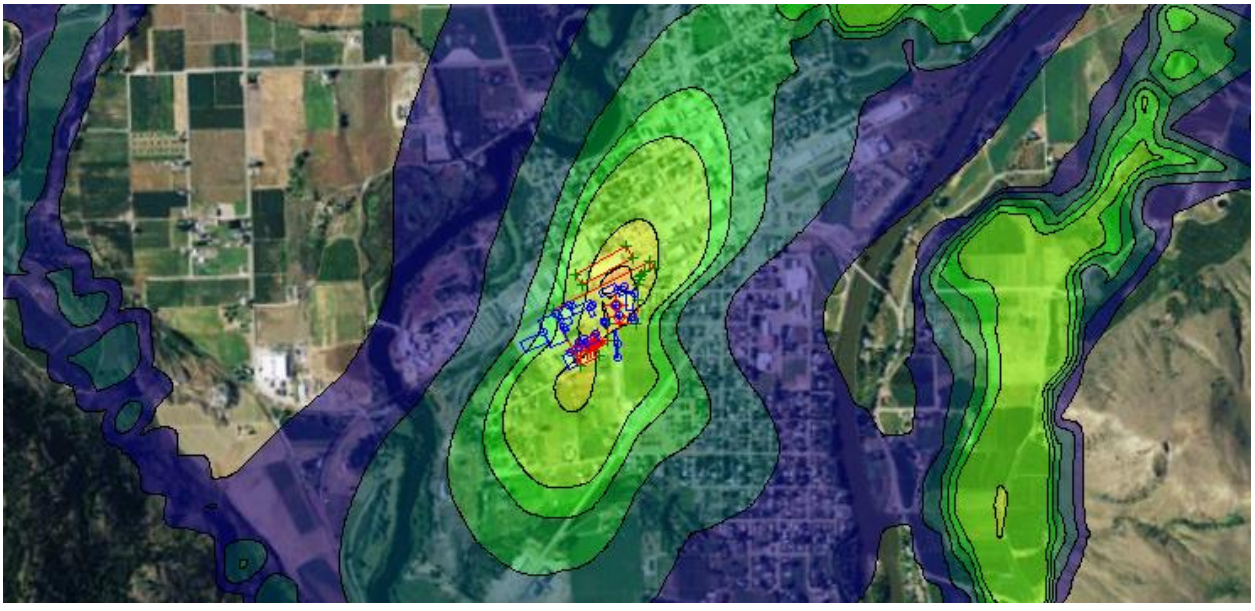
OROVILLE REMAN & RELOAD – KILN CAPACITY EXPANSION

Golder provided permitting and modeling support for the expansion of the lumber drying capacity at Oroville Reman & Reload in Oroville, WA. Permitting the expansion involved development of refined kiln drying emission factors, using data from multiple kiln studies, to represent the specific mix of species processed by the facility.

The primary pollutants of concern for the kiln were hazardous organic compounds, which were emitted in quantities that required a dispersion modeling assessment. Modeling of the facility emissions was performed using AERMOD to demonstrate that the project would not exceed applicable standards or thresholds.

Golder utilized the refined emission factors as the basis of the emissions used for the dispersion modeling assessment, which resulted in predicted concentrations below the applicable thresholds. Golder was able to utilize a modeling program that allows results to be generated for different emissions rates using a single model run, which allowed for efficiency when performing multiple iterations of emissions estimates.

The result of the emission estimations and dispersion modeling was the development of a revised permit for the facility that allowed maximum flexibility for drying different species of wood.



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PROJECT PROFILE
Gold River - Waste to Energy Facility Air Permit Amendment

Client

- Covanta Energy Corporation

Project Location

- Golder River, British Columbia

Key Elements

- Characterize emission sources and emission rates for the facility
- Emission rate comparison against air emission regulations
- Predict offsite effects from the project

Key Personnel

- Rachel Wyles, Jeffrey Ramkellawan

Project Duration

- 2008-2010

Assisted Covanta Energy Corporation with a provincial waste discharge permit amendment application for a proposed waste to energy facility. The facility successfully received an approved amended waste discharge permit; however, the Project was not developed.

The following tasks were undertaken as part of the permit amendment.

- Quantified the air emission rates for parameters of interest at the facility for the combustion of refuse derived fuel. Refused derived fuel is composed of municipal solid waste mixed with wood products to establish a required carbon content in the combustion chamber. Parameters of interest included, but not limited to:
  - Criteria air contaminants - nitrogen dioxide, sulphur dioxide, carbon monoxide, total suspended particulate matter, particulate matter with a nominal aerodynamic diameter less than 2.5 and 10 microns.
  - Polychlroniated dibenzodioxins and polychlorinated dibenzofurans
  - Metals - lead, cadmium, mercury, arsenic and chromium
  - Hydrogen chloride, ammonium, and hydrogen floride.
- Compared facility emission rates against regulated emission rates for municipal solid waste incinerators and wood combustion within BC, Canada and internationally.
- Liaised closely with the BC Ministry of Environment (MOE) on the emissions characterization from the facility and the dispersion modelling approach.
- Using an air dispersion model (CALPUFF in three dimensional mode), predicted offsite effects for parameters of interest. As part of the air dispersion model submitted both a conceptual and detailed model plan to the BC MOE for review and approval of the dispersion modelling approach and model inputs.
- Qualified project offsite effects by comparing predicted concentrations against provincial ambient air quality criteria. Where BC did not have air quality objectives other provinces and territory air quality objectives were referenced.
- Summarized assessment methods and findings in a technical assessment report that was submitted to the BC MOE to support the waste discharge permit amendment.

PROJECT PROFILE
Vancouver Fraser Port Authority - Third Party Review of Air Quality Report and Human Health Risk Assessment

Client

- Vancouver Fraser Port Authority

Project Location

- Surrey, British Columbia

Key Elements

- Review of emission inventory and source characterization
- Review of modelling approach, model inputs, and outputs
- Review and comment on model result interpretation and assessment conclusions

Key Personnel

- Rachel Wyles, Jeffrey Ramkellawan

Project Duration

- 2015

The Fraser Surrey Docks Coal Transhipment Project involves a direct load-out facility for coal brought by train and shipped by barge to a lightering operation at Texada Island. The project is locally controversial for a number of reasons and Golder was retained by Vancouver Fraser Port Authority, in its regulatory role, to provide a third party review of Air Quality, Human Health Risk Assessment and Aquatic Toxicology. Golder prepared a third party review report that focused on substantive issues (not editorial) and was written in a manner that was focused and impartial. The report identified the key issues in a way that was brief but effective. Golder also provided advice and recommendations to Vancouver Fraser Port Authority on various issues as well as briefing materials for the Port Authority's senior management and external communications.

Specific tasks included:

- Detailed review of air emission estimation techniques, assumptions and literature values.
- Comment on the overall assessment approach, including consideration of the dispersion modelling approach, input and input data.
- Review of the Human Health assessment approach, and the coordination between the air quality and Human Health disciplines. For example, was the air dispersion modelling undertaken in a way so that the results are appropriate for use in a subsequent Human Health Risk Assessment.
- Reviewed specific elements of the Human Health Assessment such as the estimation of chemicals of potential concern in soil and vegetation, calculation of the hazard quotient and incremental lifetime cancer risk and calculation of the risk estimates.
- Met with the Port Authority and other stakeholders to provide succinct initial feedback on review findings.
- Summarized review findings in a plain English language report. Outlined inconsistencies found during the review and provided a comment on the materiality (i.e., would this inconsistency change the conclusions of the assessment) of the inconsistency.

PROJECT PROFILE
Confidential Client – Ambient Air Monitoring for Odour and VOCs, and Contingency Plan Development

Client

- Confidential Client

Project Location

- Lower Mainland, British Columbia

Key Elements

- Ambient Monitoring of Odour and VOCs
- Contingency Plan development

Key Personnel

- Rachel Wyles, Jeffrey Ramkellawan

Project Duration

- 2015 – Ongoing

Golder have undertaken periodic ambient monitoring for a confidential client at a number of industrial facilities associated with oil transport, storage and marine loading within the Lower Mainland. Monitoring was undertake during periods of routine and unexpected maintenance to confirm that nearby residential areas are not impacted. A detailed monitoring plan was developed for each monitoring event that outlines contaminant action levels and procedures and notifications to be followed should monitoring reach action levels.

The following tasks were undertaken as part of the monitoring work

- Prior to monitoring, prepared a detailed monitoring plan to document:
  - Monitoring compounds of interest, methods (instruments) and locations.
  - Defined monitoring trigger levels for odorous compounds, and other Volatile Organic Compounds (VOCs) based relevant ambient air criteria.
  - Determined actions to be taken, and notification procedures should action levels be reached.
  - Outlined record keeping procedures.
- Undertook ambient monitoring for odorous compounds, VOCs, and meteorological parameters including wind speed and direction.
- Summarized monitoring activities in a technical memorandum. The memorandum outlined monitoring activities, any instances where action levels were met, and the response and notification activities undertaken if action levels were met.

PROJECT PROFILE
Ventilation System Analysis

Client

- ATI SAC Millersburg Operations

Project Location

- Albany, Oregon

Key Elements

- Ventilation System Troubleshooting
- Process Engineering

Key Personnel

- Geoff Scott
- Brian Eagle

Project Duration

- Two years – ongoing

ATI Chlorination Process – Ventilation System Analysis

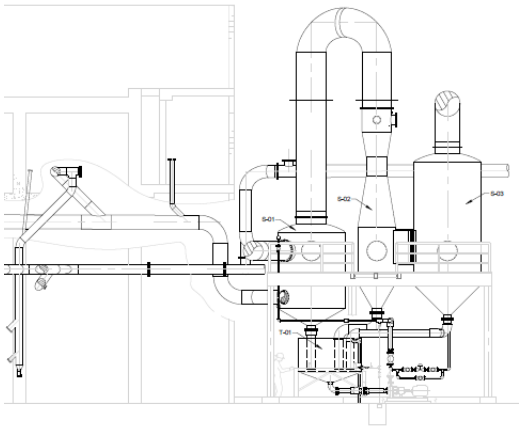
Golder assisted ATI with a multiple phase ventilation system troubleshooting and optimization project for the ventilation system on the chlorination process at their facility in Albany, OR. The ventilation system was in need of improvement, and at the same time in the process of being expanded.

For the first phase of the project, Golder reviewed the capacity of the scrubber system installed to mitigate both particulate and acid gas emissions from the chlorination process. This was done to determine whether the system had sufficient capacity to accommodate additional emission sources. As part of the first phase, Golder constructed a detailed model of the chlorination process and ventilation system in 3D using CAD software.

For the second phase, Golder assessed the ventilation system requirements of the individual emission sources, both those currently included in the system and the additional emission sources. Golder utilized their spreadsheet-based computational balancing model to identify potential deficiencies in the ventilation system.

It was discovered that deficiencies in the ventilation system were due in large part to the nature of the process itself. Because the ventilation requirements were dictated by process parameters, Golder developed a thorough understanding of the process engineering through independent research and data analysis. Golder then worked closely with ATI to help them improve their understanding of the chlorination process ventilation system.

Golder is currently working with the facility to replace the existing venturi scrubber, which was proven to have design deficiencies, with a more effective unit. This will ensure that adding new emission sources to the ventilation system will not overload the scrubber system, and will not have an adverse impact on stack emissions.



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ATTACHMENT 2
Key Team Resumes

Golder Associates Inc. – Portland

Education

MS Mechanical Engineering (Environmental Emphasis), University of Minnesota, Minnesota, 1991

BS Physics, Grinnell College, Iowa, 1988

Languages

English – Fluent

Professional Synopsis

Chad Darby has 25 years of professional experience in the air quality science and engineering field, with project management in 35 states and 3 Canadian provinces. This includes construction and operation permitting; field source testing; ambient sampling and meteorological station design and installation; pollution control evaluation (Best Available Control Technology [BACT]/Reasonably Available Control Technology [RACT]/Lowest Achievable Emission Rate [LAER]); historical compliance investigations (New Source Review [NSR]/Prevention of Significant Deterioration [PSD]); multi-media compliance auditing; risk management planning (RMP); compliance assurance monitoring planning (CAM); Maximum Available Control Technology (MACT) applicability; strategy development; and compliance demonstration. Additionally, Chad has worked on numerous projects involving process engineering, emission control performance evaluation, and public engagement of stakeholders on controversial projects. As needed, Chad also supports clients with expert testimony on air quality issues.

PROJECT EXPERIENCE

Confidential Client Wood Pyrolysis Syngas
Oregon

Project Manager for an emissions characterization and permitting project for a proposed pyrolysis process that would utilize woody biomass to produce char and condensed organic gases that would be refined into heating oil. Conducted a process engineering evaluation, working closely with the vendor of the proprietary technology, to develop an emissions profile for the various stages of the pyrolysis and condensation process. Characterized emissions as well as solid waste and wastewater streams. Assessed impacts from ash, wastewater, and product handling as well as emissions from control of non-condensable gases. Analyzed applicable regulatory requirements to prepare a permit application and provided consultation on the implications of emissions types and quantities as well as emission controls.

Particulate Material (PM) and Volatile Organic Compound (VOC) Benchmark Study; Ministry of the Environment
Ontario, Canada

Completed a province-wide study of the wood products industry sector, with a technical evaluation of emission controls for volatile organic compounds and particulate matter. This involved detailed analysis and description of pollution control equipment options, pollution prevention techniques, and product substitution. Developed algorithms and conducted a detailed economic impact analysis for individual facilities and processes, and performed a province-wide economic analysis of pollution control impacts if regulatory requirements were implemented. The economic analysis involved evaluating not only the individual and province-wide economic impacts of emission control, but also evaluating the health of the industry based on historical and projected numbers and sizes of facilities in operation. Project involved informing hundreds of stakeholders, surveying 247 facilities, conducting economic analyses and profiles on 30 facilities, and visiting 10 facilities. Economic algorithms developed were provided to the Ministry for proprietary Ministry use after they were calibrated with actual cost data from the industry.

Control System Evaluation and Enforcement Negotiation; Challenge Door of Indiana Indiana	Examined the pentane capture system to make recommendations to increase capture efficiency. Additionally, made recommendations on a source test protocol for future evaluation of capture and destruction efficiency. Also negotiated and conducted an evaluation of Best Available Control Technologies (BACTs) for an expanded polystyrene manufacturing process. Evaluation included the design of retrofitted total enclosures and lower explosive limit safety systems for a process that currently exists with controls that meet only 50 percent capture efficiency. Involved justification for BACT from projects in surrounding states and the US Environmental Protection Agency (EPA) clearinghouse database, as well as research into the cutting-edge development of low pentane beads and adsorption control systems for polystyrene processes that are not fouled by styrene monomers.
Emission Testing; Neste Resins Various Locations in Alabama, Louisiana, North Carolina, Ohio, Oregon, and Washington	Managed a multi-state source testing program to determine control efficiencies of regenerative thermal oxidizers and catalytic oxidizers in combusting formaldehyde, methanol, and phenol. Utilized National Council for Air and Stream Improvement (NCASI) test method IM/WP-98.01. Additionally, prepared risk management plans for ammonia and formaldehyde storage tank farms and truck delivery stations. Estimated areas of downwind impact, population affected, and public facilities within the critical areas.
Emission Testing; Hawaiian Cement Oahu, Hawaii	Conducted emission testing for flow rate, dioxins/furans, multiple metals, PM/PM10 particle pollution, nitrogen oxide (NOx), hydrogen chloride (HCI), sulphur dioxide (SO2), and carbon monoxide (CO) using US Environmental Protection Agency (EPA) methods 1-7, 10, 23, 26, and 29. Involved a 10-day simultaneous, multi-stack test protocol conducted under hazardous fume and temperature conditions at a cement manufacturing facility that was required to burn used tires for the State of Hawaii. Personnel were required to wear flame retardant clothing due to direct exposure to exhaust from lower emission points.
Emission Testing; Tidewater Barge Lines Vancouver, Washington	Calculated emissions of volatile organic compounds (VOCs) from barge cleaning performed with a vacuum truck. Using the ideal gas law, the total emissions of VOCs from vacuum truck exhaust and barge hold air displacement were determined for situations where barge holds containing gasoline are cleaned and filled with new product. Completed a Best Available Control Technology (BACT) analysis for control of barge venting emissions.
Enforcement Negotiation; Confidential Client United States	Conducted a multi-media compliance audit to identify historical violations regarding capture and control system effectiveness. Assisted the facility with enforcement negotiation, control system design, Best Available Control Technology/Lowest Achievable Emissions Rate (BACT/LAER) determinations for volatile organic compounds, economic benefit calculations, and final permitting. Completed a facility-wide emissions inventory as part of the audit, including the evaluation of emissions from product cutting, molding, product storage, product griding and recycling, raw material storage, and expansion.

Columbia Pacific Biorefinery
Clatskanie, Oregon

Provided expert testimony in the case of Northwest Environmental Defense Center, Center for Biological Diversity, and Neighbors for Clean Air vs. Cascade Kelly Holdings, LLC, d/b/a Columbia Pacific Biorefinery, and Global Partners. Reviewed air quality permit documentation for the oil terminal and transloading facility, reviewed case files, interviewed facility personnel, observed facility operations, prepared independent emission calculations, and prepared an expert report and rebuttal report. Provided a deposition and testified in court.

Coal Terminal Permitting ; Coyote Island Terminal LLC
Oregon

As project director, prepared a complex emissions inventory that included trains, tugboats, ocean-going vessels, transloading equipment, and stationary sources. Calculated methane emission decay rate for coal during transport and handling. Assisted with the air quality permitting and dispersion modeling for the proposed Coyote Island Terminal at the Port of Morrow, which is designed to handle 8.8 million tons of coal as a US west coast export terminal for Powder River Basin coal. Prepared toxicological literature evaluations of coal in air and water; project recommendations for emission control systems; and public comment support to agencies involved in addressing public concerns, including coal dust, diesel exhaust, and train and tug impacts. Studied and evaluated greenhouse gas emissions during transport and handling of coal, spontaneous coal combustion hazards, and dispersion of coal dust to air and water. Agencies involved include Oregon Department of Environmental Quality (DEQ), Department of State Lands (DSL), National Marine Fisheries Service (NMFS), US Army Corps of Engineers (USACE), State Historic Preservation Officers (SHPO), and four area tribes.

BACT Analysis and Emissions Inventory; Confidential Client
Massachusetts

Performed a Best Available Control Technology (BACT) analysis for the largest emitting sources for a membrane manufacturing facility. Developed an emissions inventory to estimate emissions due to solvent evaporation losses and transfer losses. Cost effectiveness values were calculated for wet scrubbing, oxidation (thermal and catalytic), carbon adsorption, and condensation control technologies.

TRI Reporting; Roseburg Forest Products
Oregon, Montana, California, Mississippi, Louisiana, South Carolina, and Georgia

Developed and prepared Toxic Release Inventory (TRI) applicability and reporting spreadsheets for 11 plywood and particleboard facilities. The spreadsheets included calculations for chemicals manufactured during fuel combustion, manufactured in plywood and particleboard processing operations (steam vats, drying, pressing, sawing and sanding, blending, cooling), processed within the raw wood and in chemicals used, and otherwise used in the fuel usage. Fugitive, excess, and dioxin emissions were calculated.

Construction Permitting; Roseburg Forest Products
Missoula, Montana

Prepared a construction application for thermal oxidizer installation to comply with Maximum Available Control Technology (MACT), which included an emissions inventory, emission modeling, a Best Available Control Technology (BACT) determination, and state application forms because the oxidizer was permitted as an incinerator. Provided oversight and management of preliminary modeling and human health risk assessments for a “low risk” demonstration as part of the Plywood and Composite Wood Products (PCWP) MACT rule, which included AERMOD modeling and human health risk assessment for a particleboard facility. Land Use Land Classification (LULC) data and aerial photos were used to derive highly accurate input data into the AERMET processing. Evaluated Federal Aviation Administration (FAA) regulations for stack height to determine the allowable height of potential construction.

MACT Tool Development; Boise Cascade
Kettle Falls, Washington

Developed a site-specific automated Plywood and Composite Wood Products Maximum Available Control Technology (PCWP MACT) look-up table spreadsheet for evaluating the pollutants and sources that will contribute most to potential chronic carcinogenic and non-carcinogenic risk for the facility. The spreadsheet allows the facility to instantly evaluate the impact of various operating scenarios on the toxicity weighted emission rates and compliance with the look-up tables of the PCWP MACT.

Corporate Training; Timber Products
Medford, Oregon

Provided a corporate workshop on Maximum Available Control Technology (MACT) compliance options, delisting and/or avoidance for the Boiler MACT and Plywood and Composite Wood Products (PCWP) MACT.

Title V Permitting; JELD-WEN
White Swan, Washington

Developed a comprehensive Part 71 Title V Operating Permit application for doorskin and window treatment manufacturing plant located on Indian lands of the Yakama Tribal Nation. A site-wide inventory was developed to include boiler, resin blending, saw, planer, moulder, press, spray-booth coating, tank, truck dump, and road emissions. Coordinated comments and submittals between the US Environmental Protection Agency (EPA), the Yakama tribal environmental coordinator, and the client.

Regulatory Analysis; Bend Millwork
Bend, Oregon

Evaluated a proposed pressure-treatment process. Conducted a multi-media review of applicable regulations affecting development and implementation of a new pressure-treatment process for decorative wood mouldings for exterior windows. Included evaluation of multi-state and US Environmental Protection Agency (EPA) air permitting regulations; Resource Conservation and Recovery Act (RCRA); Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA); and consumer product safety labeling requirements. Environmental air issues involved fugitive emissions and combustion products of pesticide-containing wood wastes. Evaluated the implications for Title V and New Source Review (NSR) permitting. Permitted the facility with the first NSR permit in Oregon using the Pollution Control Exemption guidance from EPA.

Title V Permitting; JELD-WEN
Everett, Washington

Completed a Title V Permit Application, conducted an emission inventory, and measured flow rate. Developed a comprehensive emission inventory using a mass balance of raw wood materials received, finished doors and contract lumber, wood waste burned, wood furnish sold, and emissions of wood particulates. A model was developed that balanced the input and output of materials through the facility to determine the magnitude of waste streams to various cyclones and baghouses. To verify compliance with grain loading standards, the flow rates of 20 baghouses and cyclones were measured. Other sources in the emission inventory and Title V Permit Application included a hogged fuel boiler, veneer slicing machines, glues, adhesives, road dust, and drying kilns. Oversaw source testing and coordinated on-site source testing activities to assure quality control and accuracy. This approach helped deflect the Puget Sound Clean Air Agency's demands for the installation of continuous emissions monitoring equipment.

Emissions Estimation; Bend Millwork Bend, Oregon	Developed emissions estimates for a new treatment process using pesticidal agents and other hazardous compounds. Prepared the process flow diagram and construction permit application. Evaluated regulatory programs that would affect the process, including disposal, shipping, waste combustion, labeling, and other regulatory issues. Assisted client in obtaining permitting as an environmental beneficial process to avoid New Source Review (NSR).
Control System Evaluation; Door Manufacturer Chiloquin, Oregon	Examined the pentane capture system to make recommendations to increase capture efficiency. Additionally, made recommendations on a source test protocol for future evaluation of capture and destruction efficiency.
Emissions Inventory Development and Permitting; Columbia Forest Products New Freedom, Pennsylvania	Conducted an emissions inventory for hazardous and criteria air pollutants and volatile organic compounds. Sources included debarking, steaming, flitching, sawing, planning, grooving, hogged fuel boiler, and truck traffic. Submitted a revised Title V Operating Permit application based on the results of the emissions inventory.
MACT Evaluation; Roseburg Forest Products Russellville, South Carolina	A hazardous air pollutants (HAPs) emissions inventory was developed to estimate emissions of pollutants identified in the Plywood and Composite Wood Products Maximum Available Control Technology (PCWP MACT) rule. A digital representation of the facility was input into the AERMOD atmospheric dispersion model. Pre-processed meteorological data was provided by the State of South Carolina. A human health risk assessment was performed with the predicted concentrations from the AERMOD model. Predicted concentrations were also compared to applicable state toxic threshold values.
Facility Support; Pope & Talbot Halsey, Oregon	Provided two months of on-site engineering support while the facility conducted a search for new staff. Responsible for daily and semi-annual reporting, opacity observations, health and safety issues, and accuracy of automated environmental calculations for the DCS system.
Facility Support; West Linn Paper Oregon City, Oregon	Provided two months of on-site engineering support while the facility environmental manager was on leave. Prepared semi-annual monitoring and compliance reports, conducted training for operators, provided support for capital planning meetings, and supported health and safety related issues.

PROFESSIONAL AFFILIATIONS

Air and Waste Management Association (AWMA)

National Council of Air and Stream Improvement (NCASI)

Education

M.Eng. Class I, Environmental Engineering (Hons), University of Nottingham, UK, 2001

Registered Professional Engineer in BC

Member of the Air and Waste Management Association (AWMA)

Golder Associates Ltd. – Vancouver

Employment History

Golder Associates Ltd. – Vancouver, BC
Associate, Air Quality Specialist (2006 to present)

Rachel is an Associate and Senior Air Quality and Carbon Management Specialist with the Golder Vancouver office. Over the past thirteen years, Rachel has been involved in numerous air quality projects at a variety of industrial facilities and mine sites. Rachel typically acts in technical lead role providing direction on projects and strategic advice to companies. More specifically this work has involved air emissions characterization, dispersion modelling assessments, third party review, design and implementation of monitoring programs, regulatory approvals and provision of strategic advice on air quality and GHG aspects. Rachel has acted as the atmospheric discipline technical lead on numerous BC, Canadian and international Environmental Assessments. Rachel has undertaken a number of third party review projects and has provided expert air quality technical advice to support legal proceedings.

Golder Associates (UK) Ltd. – Nottingham, UK
Project Manager/Environmental Engineer/Supervisor (2001 to 2006)

PROJECT EXPERIENCE –PROJECT MANAGEMENT

Technical Project Management,
Newmont, Nunavut

Retained by a large mining company to provide project management and coordination services on a specialized environmental study that includes an air related component. Involves the coordination of various technical leads from a number of different consulting firms, as well as the mining company staff. Responsible for budget and schedule tracking using MS Project.

Project Manager/Coordinator,
Rio Tinto, NWT

Between 2006 and 2008 acted as Project Coordinator for a large scale project work undertaken by Golder Associates at a mine site located in the NWT. Main duties involved the coordination of budget and schedule tracking, proposal coordination, progress reporting using MS project, identifying and managing scope change, annual contract re-negotiation and site visits. Involved the coordination of geotechnical, mining, environmental, hydrogeology and hydrology work undertaken at the site by Golder Associates offices across Canada, USA and South America.

Co-Author-Mine Feasibility Study
Rio Tinto, NWT

Co-Author for large open pit and underground feasibility study for a diamond mine located in the NWT. Involved technical writing skills to summarize various technical reports into chapters of the feasibility study. Involved the coordination of reviewers and documents using a web based system. Developed a high level of trust between myself and client.

Project Manager Baseline Data Collection

Project Manager coordinating various technical disciplines undertaking baseline work prior to the project application for an Environmental Assessment. Responsible for coordinating technical disciplines, budget and schedule tracking, and act as the air quality discipline lead.

PROJECT EXPERIENCE –AIR QUALITY/GREENHOUSE GAS

Waste to Energy Air Permit Application
Vancouver Island, BC, Canada

Technical lead for an air quality technical assessment undertaken to support a waste discharge permit amendment application for a proposed 90 MW waste to energy facility. Involved development of a detailed emissions inventory, comparison of emissions to existing emission criteria from numerous jurisdictions, air dispersion modelling in complex terrain with land/sea interface considerations using CALMET/CALPUFF and preparation of technical assessment document.

Port Metro Vancouver,
Air Quality Advisor
BC, Canada

Retained by Port Metro Vancouver to undertake a third party review of an air quality dispersion modelling assessment that was undertaken using CALPUFF to support an EA prepared for a project within the BC lower mainland. The project involved a technical review of the air quality assessment, review of dispersion modelling input parameters, emission inventory and results.

Confidential Client
Third party review and expert support in legal process

Retained by a confidential client to provide third party review of air emissions from a neighbouring facility. Provided expert technical support to the ongoing legal process.

Morrison Hershfield Anaerobic Digester Odour Assessment
BC, Canada

Technical lead for an assessment of ambient odour concentrations of a proposed anaerobic digestion facility. The CALPUFF model was used predict compliance with odour criteria, notably 1 OU/m^3 for a 10-minute with a compliance frequency of 99.5% on an annual basis. The model was used to optimize stack design parameters that resulted in lower ambient concentrations. Modelling was undertaken in consideration of the BC air dispersion modelling guidelines.

Smelter Operation Air Emission Inventory review
BC, Canada

Technical lead for the review of the NPRI site-wide air emissions inventory for the base metals smelter. Included a technical review of quantification methodologies for emission sources including smelter stack emissions, coal and natural gas combustion emissions, effluent and fugitive dust emission sources. Included criteria air contaminants such as SO_2, NO_2, particulates and VOC emissions.

Coarse Particulate Risk Management Measures
Canada

Air Quality technical lead for a literature review undertaken for Health Canada to identify control measures for coarse particulate matter emissions. Involved identification and compilation of control measures including a literature review and interviewing subject matter experts. Compiled a matrix to identify positive and negative effects, and subsequent ranking of the control measures.

Proposed LNG Project Pre-EA Support
BC, Canada

Atmospheric discipline lead for work undertaken in preparation of a facility formally entering into the Canadian/BC Environmental Assessment process. The work included providing strategic advice and support on the type of air quality assessment required to support the EA process, review of available air quality and meteorological monitoring data and provision of recommendations on baseline monitoring requirements to support the EA application. Provided support on facility GHG emissions quantification, and strategic advice on the Canadian and BC carbon regulatory system.

Woodfibre LNG Project Environmental Assessment
BC, Canada

Technical lead for initial work undertaken on the air quality assessment prepared to support the Environmental Assessment application. Specific work included determining the scope of the baseline and air quality assessment, led the development of the dispersion modelling plan, worked closely with the engineering team to develop the emissions inventory, and preparation of reasonable assumptions in the absence of engineering data.

WesPac Tilbury Marine Jetty Environmental Assessment
BC, Canada

Air quality technical lead for the baseline and effects assessment to support the Canadian/BC Environmental Assessment process. Led the preparation of the emissions inventory for the facility and associated hipping activities, dispersion modelling plan (CALPUFF) and coordination with other Environmental Assessment discipline teams. Project is ongoing.

BC GHG Reporting Regulation Guidance Document
BC, Canada

One of the main authors of the British Columbia Ministry of Environment GHG Reporting Regulation Guidance Document to assist stakeholders to achieve compliance with the requirements of the BC GHG Reporting Regulation. Involved the development of a concise, reliable document.

Minera Media Luna Morelos Gold Mine
Nuevo Balsas, Mexico

Technical lead for an air quality and meteorological monitoring program to characterize existing air quality and meteorological conditions. Involved development of the monitoring program and associated data interpretation. The monitoring comprised continuous and periodic particulate monitoring.

Minera Media Luna Morelos Gold Mine

Air quality and meteorology discipline lead for an impact assessment undertaken to support an Environmental Assessment. The Environmental Impact Assessment (EIA) was completed based on International Finance Corporation and World Bank Group guidelines and objectives. Technical lead for the emissions inventory, modelling in complex terrain using CALPUFF and the GHG inventory prepared to support the climate change discipline. Included dispersion modelling to support other disciplines including the health and aquatic risk assessments.

Large Mining Operation
NWT, Canada
(March 2011- January 2012)

Technical lead and project manager for the air dispersion modelling of the entire mine using CALPUFF to assess the impact of SO_2, NO_2, particulate deposition and potential acid input deposition on potentially sensitive receptors in the vicinity of the mine. Undertook a site visit to develop the detailed air emissions inventory including diesel power generation facility, boilers, incineration, underground mine heaters, vehicles and numerous fugitive particulate emission sources and preparation of modelling report. Involved liaison with Environment Canada and local regulators. Model results were interpreted and an air quality monitoring plan for the mine was developed.

Large Mining Operation
BC, Canada

Provided technical support and strategic advice to a mining operation on air quality management and monitoring of a tailings dam area. Involved strategic discussions with the mine, and subsequent discussions with regulators to support regulatory applications. Technical lead for the preparation of a dust management plan for the tailings area. Prepared technical documents to support regulatory discussions on future air quality monitoring and management at the mine.

Large Mining Operation
Study of Wind Blown Tailings

Undertook a study of the potential for wind blown tailings to inform the air quality assessment of the mining operation. The potential for wind blown tailings was identified as a potential major source of dust. Samples of tailings were dried in a lab to form a crust similar to what would be expected in the real environment. Testing was then undertake using a fan to simulate different wind speeds to see what the corresponding particulate concentrations were.

Air Dispersion Modelling Carmacks Project
Yukon, Canada

Lead air quality technical specialist in the dispersion modelling undertaken to support the regulatory process for the proposed Carmacks mine. Involved dispersion modelling and subsequent preparation of a technical data report.

NPRI Reporting/Air Emissions Calculations
Various locations, Canada

Senior review for the quantification of air emissions from diesel generating facilities within Canada for six calendar years. The project involved quantifying annual criteria air contaminant emissions from the four facilities, evaluating each facility's reporting requirements and uploading reportable substances to the NPRI.

Smelter Operation
BC, Canada

Developed a fugitive dust risk assessment tool in conjunction with a client stakeholder group for specific areas/activities at the smelter facility. The tool was developed as a management tool to assist prioritization of fugitive dust management. Included an aspect of cost benefit analysis for various control measures.

Walter Energy Wolverine Mine
BC, Canada

Technical lead for the air quality assessment undertaken to support an air emissions permit and mines act permit amendment for a coal mine expansion project. Work included a review of available baseline data, preparation of a site wide emissions inventory and dispersion modelling using CALPUFF in complex terrain.

NICO Mine NWT, Canada	Technical lead for the emissions estimation for the mine and process plant. Work was undertaken to support the Environment Assessment application process.
Confidential Gold Mine Project BC, Canada	Developed an air quality and meteorological monitoring program scope to characterize existing air quality and meteorological conditions, including particulates and metals. Project is ongoing.
Air Monitoring Siting Assessment Meadowbank Mine, Nunavut, Canada	Air quality lead for the development of an air quality monitoring siting assessment. Developed recommendations regarding monitoring locations and provided specifications of sampling equipment for the mine.
Burnco Aggregate Mine 2010-Ongoing EA Air Quality Assessment BC, Canada	Provided technical input for the air quality assessment prepared to support the BC/Canadian Environmental Assessment process. Provided senior guidance and review on the approach, CALPUFF dispersion modelling in complex terrain, and modelling undertaken to support other EA disciplines including water quality and human health risk assessment.
Air Dispersion Modelling Vancouver Island, BC 2009	Undertook air dispersion modelling of stack emissions from a coal mine. Involved the development of an air emissions inventory and use of site-specific meteorological and terrain data to determine the predicted impacts upon local receptors using the AERMOD dispersion model.
Raven Coal Mine Third Party Review	Undertook a third party review of the scope of the air quality assessment included in an Environmental Assessment.
Environmental Baseline Gap Analysis Chu Mine, BC, Canada	Air quality lead for environmental baseline gap analysis. Undertook a review of existing information, and provided recommendations for further meteorological and air quality monitoring baseline studies to support the preparation of an Environmental Assessment.
Burnco Aggregate EA Climate Change Assessment BC, Canada	Technical lead for the preparation of a climate change assessment prepared to support a BC Environmental Assessment application for a proposed aggregate mining operation.
Air Quality Impact Assessment, Biogas Installations, UK	Managed and acted as the technical lead on numerous air quality assessments for a number of installations including boilers, combustion processes, landfill Sites and biogas installations. The assessments were undertaken using AERMOD, an advanced new generation air dispersion model. Undertaken Site-specific meteorological data processing, using AERMET, a pre-curser for the AERMOD model. Undertaken a review of engineering options including stack height, diameter and other options to enable air quality standards to be met.

Air Quality Emissions – Feasibility Project Underground Natural Gas Storage Facility
Lincoln, UK

Lead air quality engineer for an underground natural gas storage facility. Involved emission derivation, modelling and sensitivity analysis of natural gas turbines. Involved collaboration with other industry experts, culminating in project presentations.

Guest Lecturer Advanced Contaminated Land Course, Warwick University, UK

Lectured on the contaminated land aspects of ground gas. The course was an advanced course in all aspects of contaminated land. Attendees included local authorities, consultants, regulators and others involved in contaminated land.

Landfill Gas Risk Assessment Review,
Various Locations, UK

Wrote, reviewed, and project managed landfill gas risk assessments for numerous landfill permit applications. Involved the assessment of air emissions from the landfill surface and combustion emissions using GasSim risk assessment software and AERMOD dispersion modelling.

PROFESSIONAL AFFILIATIONS

Registered Professional Engineer in the Province of British Columbia

Member of the Air and Waste Management Association

PUBLICATIONS

Wong, C., Wyles, R. Methane Oxidation and Generation Rate Measurement at a Landfill using the AMM Method. Proceedings of the Air and Waste Management Association (AWMA) Conference, Raleigh, North Carolina, 2015

Wyles, R., Ramkellawan J., Life Cycle Inventory as a Tool for Waste Management Method Comparison. Accepted for presentation at the 15th International Union of Air Pollution Prevention and Environmental Protection Associations (IUAPPA) World Congress, 2010.

Wyles, R. Ramkellawan J., Wong, C. “Determining Fugitive Methane Emission Rates at the Springhill Landfill Site. Proceedings of the Air and Waste Management Association (AWMA) Conference, Calgary, 2010

Hamilton, N., Wyles, R., New Rules: An article regarding the rules around reporting emissions from tailing’s ponds under the Canadian National Pollutant Release Inventory Program, Canadian Mining Journal, April 2010.

Wong, C.L.Y, Wyles, R., Ramkellawan, J., Lam, K., Methane Collection and Oxidation Efficiency Assessment at the Cache Creek Landfill. Proceedings of the Solid Waste Management Association Annual Conference, 2010.

Wong, C.L.Y., Lam, K., and Wyles, R., "GHG Emission Reductions – Getting Credit for Every Tonne", Proceedings of 31st SWANA Annual Landfill Gas Symposium, Houston, Texas, March 10-13, 2008, 5 pages.

Wyles, R. and A.D. Bradley. 2004. "Can We Accept Local Air Quality Impacts To Reduce Global Warming Emissions?" Accepted for Proceedings: Urban Air Quality 2005, Valencia, Spain, March 2005.

Contributing Author to GasSim Manual V2.01, February 2006.

Education

M.Sc. Medicinal Chemistry, University of Sussex, U.K., 1992

B.Sc. Combined Honours Chemistry and Biology, University of British Columbia, Vancouver, BC, 1990

Certifications

Diplomate of the American Board of Toxicology (DABT)

British Columbia Contaminated Sites Approved Professional Society – Contaminated Sites Approved Professional (CSAP - Risk Assessment)

Association of the Chemical Profession of BC - Professional Chemist (PChem)

Project Management Institute - Project Management Professional (PMP)

Qualified Professional in Risk Assessment (Ontario) QPRA

Golder Associates Ltd. – Vancouver

Ms. Audrey Wagenaar is an Associate and Senior Environmental Scientist with Golder Associates' Vancouver Office. Ms. Wagenaar has twenty-three years of experience in human health and ecological risk assessment, human health toxicology and environmental chemistry. Ms. Wagenaar is a Diplomate of the American Board of Toxicology (i.e., a board certified toxicologist). Ms. Wagenaar was also appointed to the British Columbia Roster of Contaminated Sites Approved Professionals for Risk Assessment and is a Project Management Professional (PMP).

Her technical skills include specialized human health toxicology assessment, human health exposure and risk modelling, development and modification of toxicity reference values, quantitative fate and transport modelling, development of air quality standards, development of environmental health and safety guidelines, and provision of expert advice/peer review and expert witness testimony. Ms. Wagenaar is also an experienced project manager.

Ms. Wagenaar has conducted and managed numerous human health risk assessments in accordance with Canadian federal and provincial guidelines. She has completed a number of public health risk assessments on US Superfund sites for the Agency of Toxic Substances and Disease Registry and the US National Oceanic and Atmospheric Agency.

Ms. Wagenaar has significant experience conducting detailed quantitative human and terrestrial wildlife health risk assessments to support environmental impact assessments for mining and other development projects in Canada and abroad.

She has considerable experience in managing complex multi-stakeholder processes involving industrial clients, government regulatory agencies, medical officers of health, and the public. Ms. Wagenaar is also experienced in human health risk communication.

Employment History

Golder Associates Ltd. – North Vancouver and Burnaby, BC
Associate, Senior Environmental Scientist (2004 to Present)

Responsibilities include conducting human health and ecological risk assessments; providing expert advice on potential health effects based on evaluation of toxicological information; developing chemical-specific toxicological criteria; providing senior review; managing projects; business development and marketing; and managing and mentoring staff.

EVS Environment Consultants – North Vancouver, BC
Senior Environmental Scientist (2002 to 2004)

Conducted human health risk assessments, managed and provided senior review for ecological risk assessments; managed projects; business development and marketing.

Golder Associates Ltd. – Mississauga, ON
Senior Risk Assessor/Toxicologist (2001 to 2002)

Conducted site-specific human health risk assessments and developed remediation criteria; peer reviewed site-specific risk assessments; provided expert advice on potential health effects; and managed projects.

Ontario Ministry of the Environment – Toronto, ON
Senior Regulatory Toxicologist (1999 to 2001)

Provided expert human health toxicological advice for community-based risk assessments; developed provincial air standards based on human health toxicological data; and reviewed site-specific risk assessments to determine compliance with the Ontario Guideline for Use at Contaminated Sites; and risk communication.

Eastern Research Group – Lexington, MA
Environmental Scientist (1997 to 1999)

Provided technical advisory services to various government and corporate clients in the areas of human health risk assessment, ecological risk assessment, medicinal chemistry, and database development.

Environment Canada – North Vancouver, BC
Toxic Substances Evaluation Scientist/ Controls Program Officer (1993 to 1997)

Evaluated the environmental toxicology of chloramine - a drinking water disinfectant - under the Priority Substance List (PSL) of Canadian Environmental Protection Act (CEPA). The project involved collecting chloramine-related toxicological data, developing of a Microsoft Access database, evaluating data and data quality, and determining appropriate assessment endpoints. In addition, general advisory and consulting services in the area of toxicology were provided to senior management, other departmental scientists, federal/provincial agencies, industry and the general public.

University of British Columbia, Department of Soil Science – Vancouver, BC
Laboratory Technician, Soil Chemistry Lab (1992 to 1993)

Conducted chemical analyses of soil and supervised graduate student experiments.

PROJECT EXPERIENCE – HUMAN HEALTH RISK ASSESSMENT (HHRA)

Head Technical Report – Human Health Risk Assessment
Melbourne, Australia

Principal toxicologist responsible for planning, managing, and conducting a detailed quantitative human health risk assessment to assess the uptake of contaminants (metals, PAHs, and pesticides) from sediment by ecological receptors (three species of fish and mussels) as the result of proposed dredging activities in Port Phillip Bay, and the subsequent consumption of these fish and mussels by recreational and subsistence fisher populations. The human health risk assessment was developed as part of Environmental Impact Assessment for regulatory approval. Responsibilities included providing direction for data screening, problem formulation, development of site-specific bioaccumulation factors and food chain modelling, toxicity reference value selection as well as conducting the HHRA, report writing, and quality assurance/control. The head technical report was presented at an independent panel hearing as part of the process for the Australian government to decide whether to proceed with the project and was accepted. (2006 – 2007).

Petaquilla Mine Baseline Environmental and Social Impact Assessment
Panama

Technical lead for human health and ecological risk assessment developed as part of an Environmental and Social Impact Assessment for regulatory approval of a proposed mine development in Panama. Responsibilities included the development of the problem formulation, sampling and analysis plan, and data quality objectives for human health and terrestrial components of the project and conducting the baseline and impact case human health risk assessments. Primary contaminants of concern included in the assessment were metals, PAHs, PCBs, and pesticides. Key elements of the study included assessment of multiple types of traditional foods (including fish) used by three distinct populations of subsistence users, a detailed toxicity assessment, and the use of fate and transport modelling in conjunction with measured soil, sediment, surface water, fish and air data and site-specific bioaccumulation factors to predict future conditions. (2007 – 2010).

Morelos Gold Environmental and Social Impact Assessment
Mexico

Technical lead for human health and ecological risk assessment in support of an Environmental and Social Impact Assessment for regulatory approval of a proposed mine development in Mexico. Responsibilities included the development of the overall approach and strategy for the human health and terrestrial components of the project, overseeing the baseline and impact case risk assessments and conducting senior review. Primary contaminants of concern included in the assessment were metals as the project was located in an area containing naturally elevated arsenic concentrations in soil and water. Key elements of the study included assessment of multiple types of traditional foods (including fish, corn and other backyard produce), a detailed arsenic toxicity assessment, and the use of fate and transport modelling in conjunction with measured soil, sediment, surface water, fish and air data and site-specific bioaccumulation factors to predict future conditions. (2012 – 2014).

Liquefied Natural Gas Facility Environmental Assessment
South Western BC

Technical lead for public health assessment developed in support of an Environmental Impact Assessment for regulatory approval of a proposed liquefied natural gas (LNG) production, storage, and marine carrier transfer facility in south western BC. Responsibilities included the development of the overall approach and strategy, overseeing the public health assessment, conducting senior review and responding to information requests from government expert reviewers or key stakeholders and presenting technical materials to government representatives and stakeholders. Key elements of the study include a detailed air quality risk assessment and an assessment of key determinants of health for the local population. (2013 – 2015).

Human Health and Terrestrial Wildlife Risk Assessment, Jay Pit, Diamond Mine
Northwest Territories

Technical lead for the human health and terrestrial wildlife component of a risk assessment developed in support of an Environmental Impact Assessment for regulatory approval of the expansion of an existing diamond mine. The main contaminants of potential concern were particulate matter and metals. An air quality risk evaluation (acute, chronic, and particulate matter assessments) was conducted to evaluate the inhalation route and a multi-media risk evaluation was conducted to determine the chronic effects associated with chemicals that might be present in both air and food pathways. A detailed toxicity assessment was completed for air quality parameters, including particulate matter, as well as the multi-media contaminants. For the multi-media assessment, measured soil, sediment, vegetation, surface water and fish concentrations were used to derive site-specific bioaccumulation factors. The site-specific bioaccumulation factors and predicted future concentrations were used to calculate the predicted concentrations in fish and vegetation consumed by people. The risk assessment included the evaluation of the Base, Project and Cumulative cases. Responsibilities included responding to information requests from government expert reviewers and key stakeholders (2013 – 2016).

Human Health Risk Assessment, Baker Creek
Yellowknife, Northwest Territories

Principal toxicologist responsible for human health risk assessment of sediment, surface water and fish for recreational users of Baker Creek, part of the former Giant Mine property. The risk assessment focused on the assessment of arsenic trioxide, and other metals identified in the sediments of Baker Creek and included the evaluation of both sub-chronic and chronic exposure scenarios for recreational users. (2011 – 2013).

Human Health Risk Assessment, Giant Mine
Yellowknife, Northwest Territories

Principal toxicologist responsible for human health risk assessment of workers at the Giant Mine exposed to soil, dust and air containing arsenic trioxide as part of their daily activities. The risk assessment evaluated several different types of workers (those involved in remediation works, underground stabilization of the waste and maintenance activities). Current and future conditions were assessed using soil and air quality monitoring data to determine potential risks. The risk estimates were compared to biomonitoring data and recommendations for on-going worker health and safety were provided. (2015 – 2016).

Human Health and Terrestrial Wildlife Risk Assessment, Gahcho Kue, Diamond Mine
Northwest Territories

Technical lead and project manager for the human health and terrestrial wildlife component of a risk assessment developed in support of an Environmental Impact Assessment for the regulatory approval of a proposed diamond mine. An air quality risk evaluation (acute, chronic, and particulate matter assessments) was conducted to evaluate the inhalation route and a multi-media risk evaluation was conducted to determine the chronic effects associated with chemicals that might be present in both air and food pathways. The main contaminants of potential concern were PAHs and metals. A detailed toxicity assessment was completed for air quality parameters, including particulate matter, as well as the multi-media contaminants. For the multi-media assessment, measured soil, sediment, vegetation, surface water and fish concentrations were used to derive site-specific bioaccumulation factors. The site-specific bioaccumulation factors and predicted future water concentrations and soil deposition rates allowed for the calculation of predicted concentrations in fish and vegetation consumed by people. Human receptors in five community locations were assessed in the multi-media risk assessment. The risk assessment included the evaluation of the Base, Project and Cumulative cases. Responsibilities in included responding to information requests from government expert reviewers and key stakeholders (2007 – 2012).

Rat Lake, Former Con Mine, Development of Site-Specific Clean up Criteria
Yellowknife, Northwest Territories

Human health risk assessor responsible for an evaluation of the potential human health risks associated with arsenic in residual soil that remains in place at the south end of Rat Lake on the former Con Mine property. The site has been impacted by mine tailings and future use is likely to include a low activity park area. After remediation of the arsenic in soils to site-specific guidelines, several confirmatory samples indicated arsenic concentrations above these guidelines. Additional confirmatory soil samples were collected and analyzed for chemical content and bioaccessibility using the Relative Bioaccessibility Leaching Procedure. The relative bioaccessibility was used to adjust the toxicity reference values. The results of these analyses were used in a risk assessment to determine the potential for adverse health effects to recreational users of the property. (2008 – 2012).

Human Health Risk Assessment, Former Whitehorse Tank Farm
Whitehorse, Yukon

Principal Human Health Risk Assessor and project manager responsible for the development of site-specific soil standards for industrial land use at the former Yukon Pipelines Limited Upper Tank Farm, Whitehorse, Yukon. Vapour intrusion modelling was used to derive the site-specific standards. Confirmatory soil samples, which were collected at the time of remedial excavation works conducted in 2001, were screened using the site-specific standards for industrial use. These site-specific soil standards for industrial use were developed in response to conditions imposed by the National Energy Board (NEB) their review of an Abandonment Order and subsequently accepted by the NEB. (2009).

Aggregate Mine Project Environmental Assessment
South Western BC

Technical lead and project manager for human health risk assessment developed in support of an Environmental Impact Assessment for regulatory approval of a proposed aggregate mine project in south western BC. Key elements of the study included a detailed air quality assessment for local residents and recreational users, a risk assessment of recreational use of pit lake and a baseline assessment of the quality of traditional foods. (2013 - ongoing).

Human Health Risk Assessment, Doris Camp, Hope Bay Mines
Nunavut

Principal Human Health Toxicologist responsible for evaluating potential health risks associated with consumption of microcystis in drinking water from the Hope Bay Doris Camp Domestic Water Supply. Currently, drinking water concentrations are in compliance with the Health Canada drinking water quality guideline for microcystin. However, cell counts are also highly variable (i.e., they do not appear to be correlated to the microcystin concentration). As a result, a site-specific toxin quota was developed for use at Hope Bay so that toxins other than microcystin produced by microcystis and other strains of cyanobacteria (i.e., anatoxin-A and cylindrospermopsin) can be related to the drinking water guideline for microcystin. The site-specific toxin quota was initially developed with preliminary data and updated using seasonal data, targeting both non-bloom events (i.e., winter die-off of cyanobacteria) and bloom events (i.e., sampling during and directly after the bloom event which will likely occur in the summer) to determine whether the water supply was suitable for potable purposes. (2010 – 2013).

Human Health and Terrestrial Wildlife Risk Assessment, Line Creek Phase II Extension
South Eastern BC

Technical component lead and project manager for a human health and terrestrial wildlife risk assessment developed to support an Environmental Impact Assessment for regulatory approval of a coal mine extension in south eastern BC. Responsibilities included development of the problem formulation, sampling and analysis plan, soliciting input from local First Nations regarding country food consumption and conducting the baseline and Project case risk assessments and risk communication (including responding to information requests from government expert reviewers and key stakeholders and presenting technical information to government officials, Aboriginal organizations and the public). Primary contaminants of concern included in the assessment were metals and PAHs. Key elements of the study include an air quality assessment, inclusion of multiple types of traditional foods (including cougar) consumed by First Nations subsistence users, a detailed toxicity assessment of arsenic and selenium in country foods, and the use of fate and transport modelling in conjunction with measured soil, sediment, surface water, fish, and air data as well as site-specific bioaccumulation factors to predict future conditions. The risk assessment included the evaluation of the Base, Project and Cumulative cases. (2009 – 2013).

Human Health and Terrestrial Wildlife Risk Assessment, Greenhills Operations – Cougar Pit Extension
South Eastern BC

Technical component lead and project manager for human health and terrestrial wildlife risk assessment in support of a Mines Act Permit Amendment for regulatory approval of a coal mine extension in south eastern BC. Key elements of the study included an air quality assessment, inclusion of multiple types of traditional foods consumed by First Nations subsistence users, a detailed toxicity assessment of cobalt and selenium in country foods, and a focused wildlife assessment for aquatic-feeding receptors. The risk assessment included the evaluation of the Base, Project and Cumulative cases. Responsibilities included responding to information requests from government expert reviewers and key stakeholders and presenting technical information to government officials, Aboriginal organizations and the public. (2013 – ongoing).

Human Health and Terrestrial Wildlife Risk Assessment, Fording River Operations – Swift Project Extension
South Eastern BC

Technical component lead and project manager for human health and terrestrial wildlife risk assessment developed in support of an Environmental Impact Assessment for regulatory approval of a coal mine extension in south eastern BC. Operable exposure pathways included direct contact with soil (incidental ingestion, inhalation of dust and dermal contact), air inhalation (human health), consumption of surface water for potable purposes, dermal contact and incidental ingestion of sediment and surface water while swimming, consumption of fish, berries and wild game. Key elements of the study included an air quality and multi-media risk assessment for people and wildlife in the region, incorporating multiple types of traditional foods consumed by First Nations subsistence users into the human health risk assessment, a detailed toxicity assessment of arsenic and selenium in country foods, and the use of fate and transport modelling in conjunction with measured soil, sediment, surface water, fish, game and air data as well as site-specific bioaccumulation factors to predict future conditions and detailed food chain model to assess risks to terrestrial and aquatic feeding birds, and mammals as well as identified listed species. The risk assessment included the evaluation of the Base, Project and Cumulative cases. The project involved extensive communication with consultants for the local First Nations and working group participants (federal and provincial regulators). Responsibilities included responding to information requests and presenting technical information to government experts/representatives, Aboriginal groups and the public (2011 – 2015).

Risk Assessment of Rural Public Water Supplies
Mexico

Risk assessment of downgradient community water supply wells in rural Mexico to determine if groundwater plume migrating from tailings storage facility has impacted public water supplies. Arsenic, nitrate and sulphate were primary contaminants of potential concern and analysis indicated that potable water supplies were not currently impacted. (2015 – ongoing).

Human Health Risk Assessment – Lead-Zinc Mine Tailings
Mojkovac, Montenegro

Principal Human Health Risk Assessor responsible for a multimedia screening-level risk assessment of the tailings management facility adjacent to the community of Mojkovac. The tailings management facility was constructed to manage tailings from a former lead-zinc mine. Although capped, portions of the tailings are flooded and infiltration has occurred, causing migration of metals into adjacent surface water bodies. The cap is no longer intact in other areas, causing erosion and wind-generated dust. The tailings management facilities have been used for recreational purposes including fishing and swimming. The multimedia screening-level risk assessment included the assessment of dust migration to the adjacent village and impact on soil, crops and livestock as well as ingestion of water, dermal contact with water and ingestion of fish associated with the recreational uses of the flooded portion of the site. The risk assessment was used by the World Bank to address community issues/concerns and prioritize risk management options. (2004 – 2005).

Human Health and Terrestrial Wildlife Risk Assessment, Elkview Operations Extension
South Eastern BC

Technical lead for the human health and terrestrial wildlife component of a risk assessment developed in support of an Environmental Impact Assessment for the regulatory approval of an extension of an existing coal mine in south eastern British Columbia. An air quality risk evaluation (acute, chronic, and particulate matter assessments) was conducted to evaluate the inhalation route and a multi-media risk evaluation was conducted to determine the chronic effects associated with chemicals that might be present in both air and food pathways. The main contaminants of potential concern were particulate matter and metals. A detailed toxicity assessment was completed for air quality parameters, including particulate matter, as well as the multi-media contaminants. Operable exposure pathways included direct contact with soil (incidental ingestion, inhalation of dust and dermal contact), air inhalation (human health), consumption of surface water for potable purposes, dermal contact and incidental ingestion of sediment and surface water while swimming, consumption of fish, berries and wild game. For the multi-media assessment, measured soil, sediment, vegetation, surface water and fish concentrations were used to derive site-specific bioaccumulation factors. The site-specific bioaccumulation factors and predicted future water concentrations and soil deposition rates allowed for the calculation of predicted concentrations in fish and vegetation consumed by people. Human receptors in twenty five community locations were assessed in the multi-media risk assessment and specific dietary survey information for the First Nations was utilized in the exposure assessment. The role also included presentations to and consultation with First Nations living in the area as well as various regulators. Risks to wildlife were evaluated using a food chain model that included 20 species of terrestrial and aquatic feeding birds, and mammals as well as identified listed species (e.g., least chipmunk, little brown bat). The risk assessment included the evaluation of the Base, Project and Cumulative cases. Responsibilities included responding to information requests and presenting technical information to government experts/representatives, Aboriginal groups and the public. (2012 – ongoing).

Human Health Risk Assessment, Manufacturing Facility
Kentucky, US

Senior Human Health Risk Assessment Advisor and Reviewer for a multi-media human health risk assessment of a manufacturing facility which is a US EPA Superfund site. The risk assessment was part of the process to apportion environmental liability between the current and historic owners of the facility. Primary contaminants of concern included in the assessment were volatile organic compounds, metals, PAHs, and pesticides, which are currently found in site soils, sediment, seep water, and surface water. The risk assessment also included detailed air quality assessment for adjacent residential communities from facility emissions and vapour intrusion to outdoor air resulting from on-Site groundwater contamination. The risk assessment was conducted to CERCLA standards and involved a complex multi-stakeholder (US EPA, State of Kentucky Department of Health, current and former owners) and regulatory review process. (2012 – 2013).

Radiofrequency Safety Assessment
Canada

Senior discipline lead for a safety assessment on the potential conversion of the Royal Canadian Navy radiofrequency hazard safety standard to that of a controlled environment from its current uncontrolled environment application. The assessment included interviews with various personnel working in positions that involve radiofrequency hazards at the Esquimalt and Halifax naval bases as well as site visit and review of current radiofrequency health effects and regulations to determine a policy that was protective of human health. The safety assessment included determining health effects associated with the potential change to a controlled environment. (2013 – 2014).

Public Health Risk Assessment for Superfund Site - Mountain Home Air Force Base
Mountain Home, ID

Scientist responsible for preparing the human health risk assessment of a drinking water supply containing elevated levels of trichloroethene at Mountain Home Air Force Base. The risk assessment was prepared for the US Agency for Toxic Substances and Disease Registry (ATSDR) and involved consultation with ATSDR and U.S. Army officials. (1998 – 1999).

Human Health Risk Assessment – Recreational Water Use
Wabamun, AB

Principal Human Health Risk Assessor responsible for risk assessment of sediment and surface water impacted by an oil spill into a large freshwater recreational lake, as the result of a train derailment. The primary contaminants of concern were PAHs, novel alkylated PAHs, and selected VOCs. The risk assessment involved the development of toxicity reference values for alkylated PAHs, as well as a complex peer review and multi-stakeholder consultation process. The results were presented to the local medical officer of health, who subsequently removed the non-water use advisory for recreational purposes. (2006 – 2007).

Human Health Risk Assessment of Former Plant Nursery Operations
Washington, DC

Principal Human Health Risk Assessor responsible for a multimedia risk assessment of a 44-acre former plant nursery operation located in Washington. The site was to be redeveloped into a passive recreational park within the US National Park system and included a sensitive wetland area. Primary contaminants of concern included in the assessment were metals, PAHs, PCBs, and pesticides, which were found in site soils, sediment, groundwater, and surface water. The risk assessment was conducted to CERCLA standards and involved a complex multi-stakeholder (NOAA, Architect of the Capital, EPA, and District of Columbia Department of Health) and regulatory review process. (2002 – 2004).

Public Health Risk Assessment for Superfund Site – Marine Corps Logistics Base Barstow
Barstow, CA

Scientist responsible for preparing the human health risk assessment of a drinking water supply containing elevated levels of trichloroethene, vinyl chloride, and cis-1,2-dichloroethene at Marine Corps Logistics Base. The risk assessment, which was prepared for the US Agency for Toxic Substances and Disease Registry (ATSDR), addressed both on- and off-Site impacts of the chlorinated solvents. The health risk assessment involved extensive communication with ATSDR and U.S. Marine Corps officials. (1999)

Environmental Assessment of the Lower Churchill Hydroelectric Project
Newfoundland

Senior Human Health Risk Assessor and reviewer for a human health risk assessment of baseline exposure for residents of five communities living close to the dam site, who may be affected by consuming fish with increased mercury concentrations. The human health risk assessment was completed as part of the Environmental Assessment of the Lower Churchill Hydroelectric Project. The risk assessment included the evaluation of historic and current fish tissue data as well as information for other types of traditional foods, the results of a community views analysis and the review of area specific food preferences and exposure patterns. The risk assessment was conducted to support an environmental hearing for project approval. (2009 – 2013).

Cowichan Communities Health Profile
Vancouver Island, BC

Project director for a community health profile for the Cowichan communities on Vancouver Island which focused on the key determinants of health. The project was intended to help raise awareness and improve engagement of citizens with respect to improving their overall health. The project involved a participatory approach and included a number of workshops and survey tools. Data analysis on social determinants of health were conducted and detailed map packages showing health indicators were compiled, and were used to create an interactive web-based community asset maps showing locations of facilities and programs that support community health. (2013 – 2014).

Development of Human Health Toxicity Reference Values
North Haven, CT

Principal Human Health Toxicologist responsible for evaluating and/or developing toxicity reference values for 38 novel substances found in soil, groundwater, and surface water at a former chemical manufacturing site. The site is undergoing a US RCRA evaluation in consultation with state government. The evaluation process included determining whether toxicity reference values (TRVs) were available for a substance, conducting a comprehensive literature search to obtain current toxicological information for the substances, and then assessing the non-carcinogenic, carcinogenic, and mutagenic effects of the substances. The assessment also involved application of modifying factors to account for potential mutagenicity and carcinogenicity to existing reference values and developing oral and inhalation reference doses for chemicals which currently lack toxicity reference values. Toxicity profiles were prepared to document the assessment of each substance and provide a rationale for selection/derivation of TRVs for each substance. The TRVs were subsequently utilized to develop site-specific risk-based clean-up standards for these substances. (2006 – 2008).

Development of Human Health Toxicity Reference Values
Sweden

Principal Human Health Toxicologist responsible for evaluating and/or developing toxicity reference values for four substances (2-ethyl-1-hexane, hexanal, isophorone and phorone) found in soil and groundwater at a former fabric manufacturing facility in Sweden. The project included the evaluation of existing toxicological data for these substances and also choosing chemical surrogates for substances for which insufficient data were available to derive a toxicity reference value. The project involved a review of uncertainty factors used by various organizations in their derivation of toxicological reference values including the US Environmental Protection Agency, The World Health Organization and the European Community's Registration, Evaluation, Authorization and Registration of Chemical Substances (REACH) Programme. (2010).

Review of Human Health Toxicity Reference Values for Ammonia
BC

Senior Human Health Toxicologist responsible for reviewing the current basis for BC Ministry of Environment soil vapour quality guidelines for ammonia to support an assessment of indoor air quality in a community impacted by an ammonia in groundwater plume. The assessment also included a review of the inhalation toxicity reference values for ammonia from various regulatory jurisdictions and also the literature to determine whether there might be more current information available that could be used to update the ammonia inhalation toxicity reference value. (2012).

Human Health Risk Assessment, Aurora Oil Sands Mine Expansion
Northern Alberta

Technical lead for the human health component of a risk assessment in support of an Environmental Site Assessment Update of a proposed expanded Oil Sands Mine Development. The risk assessment was used to determine whether there would be potential human health risks associated with the expansion compared to the background scenario as well as a cumulative impacts scenario which accounted for the combined effects with other proposed projects. An air quality risk evaluation (acute, chronic, and particulate matter assessments) was conducted to evaluate the inhalation route and a multimedia risk evaluation was conducted to determine the chronic effects associated with chemicals that might be present in both air and food pathways. Site-specific bioaccumulation factors for fish and vegetation were derived to assess potential uptake into traditional foods. (2009 – 2010).

Quantitative Health Risk Assessment of the First Nations Communities of Tsay Keh and Kwadacha, BC
Tsay Keh and Kwadacha, BC

Project manager and Senior Human Health Risk Assessor responsible for conducting a quantitative risk assessment of particulate matter for two Northern BC communities impacted by seasonal dust storms related to "draw down" effects from a large water reservoir. The quantitative assessment of fine and coarse particulate matter included the following approaches: (1) SUM15/SUM25 Approach - Comparison to a Health Threshold Effect [Health Canada and Environment Canada 1999], (2) comparison to Background Concentrations (BC Lung Association 2003), and (3) comparison to key epidemiological studies focussed on health effects associated with particulate matter from crustal sources. (2009 – 2010).

Risk Assessment of Stormwater Run-off from a Copper Mine on Native American Reserve Gardens
Arizona

Risk Assessor responsible for determining potential impact of human consumption of vegetables irrigated with stormwater run-off containing elevated levels of metals from a copper tailings area. Risk assessment was prepared for the Agency of Toxic Substances and Disease Registry (ATSDR) and involved consultation with ATSDR and the local Native American government. (1999).

Human Health Risk Assessment – Impact of Landfill Leachate on Community Drinking Water Supply
Mission, BC

Principal Human Health Risk Assessor responsible for risk assessment of a community drinking water supply and recreational swimming area impacted by landfill leachate runoff as the result of a severe rainfall event. The primary contaminants of concern were metals, PAHs, PCBs, pesticides, and dioxin/furans. The results were presented to the local medical officer of health, who subsequently removed the non-water use advisory for drinking water and recreational purposes. (2006 – 2007).

Human and Ecological Health Risk Assessment, Chromium Plating Facility, Prince George, BC

Senior health risk assessor and reviewer for a human and ecological health risk assessment of a chromium plating facility for due diligence purposes. Metals in groundwater and soil were the primary contaminants of concern. A human health risk assessment was conducted for hexavalent and trivalent chromium exposure from air, dust and soil. The ecological evaluation focused on the effects of copper to soil invertebrates, plants and small wildlife. (2016).

Human Health Risk Assessments, Former Canada Creosote Site, Calgary, AB

Technical lead for several human health risk assessment of off-site contamination originating from the former Canada Creosote Site, in Calgary. Preliminary Quantitative Human Health Risk Assessments (PQRA) were conducted for the residential areas north of the Bow River as the area south of the Bow river in anticipation of future redevelopment of the Canada Creosote Study Area. The PQRA conducted for the northern portion of the site included the development of risk-based screening criteria for soil vapour and indoor air that are being used to screen ongoing monitoring results obtained from residential homes in the area. (2011 – 2015).

Human Health Risk Assessment - Former Port Facility Uranium City, Saskatchewan

Principal Human Health Risk Assessor and project manager responsible for risk assessment of a historic oil spill at a former port facility into a large freshwater lake in northern Saskatchewan. The assessment included the evaluation of sediment, fish and surface water. Recreational, residential and First Nations receptors were evaluated and operable exposure pathways included consumption of fish, dermal contact with water and sediment, dermal contact with surface water, inadvertent consumption of sediment during recreational activities and consumption of surface water as a source of potable water. The primary contaminants of concern were PAHs and alkylated PAHs. The risk assessment also involved the assessment of and modification of toxicity reference values for alkylated PAHs. The risk assessment was used to prioritize potential remedial options including whether the impacted sediment could be managed in-place. (2007 – 2010).

Human Health Risk Assessment, Dover Commercial Oil Sands Project Northern Alberta

Technical lead and project manager for the human and wildlife health component of a risk assessment in support of an Environmental Site Assessment for the Dover Commercial Oil Sands Project. The risk assessment was used to determine whether there would be potential human or wildlife health risks associated with the development of the proposed project. An air quality risk evaluation (acute, chronic, and particulate matter assessments) was conducted to evaluate the inhalation route and a multimedia risk evaluation was conducted to determine the chronic effects associated with chemicals that might be present in both air and food pathways. (2010 – 2013).

Human and Ecological Risk Assessment Northern Saskatchewan

Project manager responsible for a human and ecological risk assessment to support an Environmental Impact Statement for the expansion of a gold mine in Northern Saskatchewan. The human and ecological risk assessment included the assessment of aquatic health for baseline and project scenarios, a quantitative assessment of terrestrial health and a quantitative assessment of consumption of fish for baseline and project scenarios by recreational users of nearby lakes. (2009).

Preliminary Quantitative Human Health Risk Assessment, Shopping Mall
Kelowna, BC

A preliminary quantitative human health risk assessment was conducted for shopping mall which contains a dry cleaning facility. Due to historic operations, a plume of trichloroethene and tetrachloroethene is present in the soil and groundwater beneath the shopping mall and the adjacent laneway. Some remedial works have been undertaken to remove accessible soil beneath the laneway. A vapour mitigation system is present inside the dry cleaning operation. The risks to workers, visitors to the shopping mall and local residents were assessed. The risk assessment included an evaluation of current trichloroethene and tetrachloroethene toxicological data particularly with respect to short-term exposure. The risk assessment was submitted to the British Columbia Ministry of Environment for regulatory review and a certificate of compliance was issued. (2014 – 2016).

Preliminary and Detailed Quantitative Risk Assessment, Community Centre
Ft. Nelson, BC

Senior discipline lead for a preliminary quantitative risk assessment (PQRA) and detailed quantitative risk assessment (DQRA) associated with re-development of a historic site on the Alaska highway to a community centre and swimming pool. The PQRA was conducted prior to remedial activities to identify potential health risks to people and wildlife from metals and petroleum hydrocarbons in historic fill. The PQRA was utilized to inform the need for remedial activities. The DQRA was completed post-remediation to determine whether the remedial activities had been sufficient and the site was safe for use by people and wildlife. (2011 – 2015).

Preliminary Quantitative Human Health Risk Assessments, CN HubAlta Station,
Calgary, AB

Technical lead for a Preliminary Quantitative Human and Ecological Health Risk Assessment (PQRA) for the CN HubAlta station in Calgary, AB. The PQRA was conducted to determine the potential health effects associated with the current use, an interim construction scenario and a hypothetical future commercial land use. The main contaminants of potential concern for each of these scenarios were metals and petroleum hydrocarbons. (2011).

Preliminary Quantitative Human and Ecological Health Risk Assessment, CP Alyth Yard,
Calgary, AB

Technical lead for a Preliminary Quantitative Human and Ecological Health Risk Assessment (PQRA) for the CP Alyth Yard in Calgary, AB. The PQRA was conducted to determine the potential health effects associated with the current use, an interim construction scenario and future industrial land use. The main contaminants of potential concern for each of these scenarios were metals and petroleum hydrocarbons. Risks were assessed to both people and wildlife receptors (limited terrestrial wildlife receptors based on a habitat assessment) and aquatic receptors due to the proximity of the site to a major river. (2013 – 2014).

Preliminary Quantitative Risk Assessment, Vanier Park
Vancouver, BC

Senior discipline lead for a preliminary quantitative risk assessment (PQRA) for Vanier Park associated with metals and petroleum hydrocarbons remaining in soils from historic military use of the Site. The risk assessment evaluated potential health risks to people and wildlife exposed to the Site soils to determine whether the soil could be managed in place. (2007 – 2009).

Preliminary Quantitative Human Health Risk Assessment, Commercial/ Residential Building, Kelowna, BC

A human health risk assessment was conducted for a commercial/residential building to be built and the adjacent roadway which had been impacted by historic fuel handling operations on the property. As much of the impacted soil was removed as possible but a small quantity remains beneath the roadway as the presence of utilities precluded the removal of all the impacted material. The risk assessment included the evaluation of vapour intrusion of volatile organic compounds to indoor (on-Site) and outdoor air (off-Site) as well as the potential to impact soil invertebrates and plants. A construction worker scenario was also included in the evaluation. The risk assessment was submitted to a Contaminated Sites Approved Professional in Risk Assessment for regulatory review on behalf of the British Columbia Ministry of Environment and certificate of compliance was issued. (2012 – 2015).

Preliminary Quantitative Risk Assessment, Former Baldy Hughes Canadian Forces Station Prince George, BC

Senior discipline lead for a preliminary quantitative risk assessment (PQRA) for the former Baldy Hughes Canadian Forces Station associated with metals and petroleum hydrocarbons remaining in soils and groundwater from historic military use as a landfill. The risk assessment evaluated potential health risks to recreational users of the site exposed to site soils and off-site users utilizing groundwater for potable purposes that had potentially been impacted by the Site activities. The ecological risk assessment evaluated potential risks to terrestrial and aquatic wildlife. The PQRA was used to support the development of a long-term management plan for the Site and was updated using additional groundwater and surface water monitoring data. (2009 – 2010; 2016).

Preliminary and Detailed Quantitative Risk Assessments, Works Yard Steamboat, BC

Senior discipline lead for a preliminary and a detailed quantitative risk assessment for a highway maintenance facility on the Alaska highway. The site includes a residential area, a maintenance shop and a salt storage area. The risk assessments included determining potential health risks to workers and their families who might be present on the Site as well as terrestrial and aquatic wildlife. The risk assessments included an evaluation of contaminants in soil, soil vapour, indoor air, surface water and groundwater. Follow-up soil vapour and indoor air monitoring were conducted for several years in the maintenance shop. (2009 – 2012).

Preliminary and Detailed Quantitative Risk Assessments, Royal Canadian Mounted Police Training Academy Regina, SK

Senior lead for a preliminary and a detailed quantitative human and ecological risk assessment for a portion of the Royal Canadian Mounted Police (RCMP) Training Academy which contained fill imported from a former rifle range. Contaminants of potential concern included metals, particularly lead and selenium. The human health risk assessment evaluated the risks to cadets and visitors. The ecological risk assessment included a habitat assessment and co-located soil and vegetation sampling that were used to derive site-specific bioaccumulation factors. A food chain model was used to determine risks to wildlife present on Site. (2012 – 2015).

Preliminary Quantitative Risk Assessments, Royal Canadian Mounted Police Depot
Lutsel' Ke, NWT

Senior lead for a preliminary quantitative human and ecological risk assessment for a Royal Canadian Mounted Police (RCMP) depot which was impacted by a ruptured fuel tank. Contaminants of potential concern included petroleum hydrocarbons and volatile organic compounds. The human health risk assessment evaluated police officers working in the facility and citizens detained in the jail located on the premises who were exposed to volatile organic substances in indoor air. Risks to soil invertebrates, plants and small wildlife that were likely to be present on Site, based on the results of a habitat assessment, were also evaluated. (2015 – 2016).

Preliminary Quantitative Risk Assessment, Healing Village
Harrison Mills, BC

Senior discipline lead for a preliminary quantitative risk assessment (PQRA) associated with expansion of a First Nations healing village. The PQRA was used to determine whether additional soil impacted by a former fuel storage tank needed to be removed prior to expansion of the facility. Volatile petroleum hydrocarbons were the contaminants of concern and vapour intrusion into indoor air was the primary exposure pathway. (2011 – 2012).

Preliminary Quantitative Risk Assessment, Former Bank
Atlin, BC

Senior discipline lead for a preliminary quantitative risk assessment (PQRA) for an empty lot formerly occupied by a bank. The site had been impacted historic fill material from a local mine. The Site ownership was shared between the provincial and federal governments. The PQRA was used to target remedial activities. (2009 – 2011; 2016).

Preliminary and Detailed Quantitative Risk Assessments, Maa-nulth First Nations
Vancouver Island, BC

Senior discipline lead for several preliminary quantitative risk assessments (PQRAs) and detailed quantitative risk assessments (DQRA) for the Maa-nulth First Nations (Mission Island Indian Reserve #2, Houpsitas, Clakamucus, Houpsitas, Aktis, Macoah and Upsowsis) related to historic fuel spills and placement of poor quality fill material. The PQRA and DQRAs were used to determine whether there were any potential health risks to people or wildlife as the result of the leaving the soils in place or whether remediation was necessary. (2005 – 2011).

Human Health Risk Assessment – Shopping Mall
Surrey, BC

Principal Human Health Risk Assessor responsible for risk assessment of a shopping mall impacted by a fire at a former drycleaner site. A plume of chlorinated solvents (tetrachloroethene and trichloroethene) is present beneath a portion of the shopping mall. The risk assessment involves evaluation of soil, groundwater, soil vapour and indoor air data to determine risks to building occupants and customers. The assessment also included a critical evaluation of the available toxicity reference values for trichloroethene. (2010 – 2013).

Site-Specific Human Health and Ecological Risk Assessments Former Power Stations
Niagara Falls, ON

Principal Risk Assessor responsible for conducting a site-specific human health and ecological risk assessment of a two former historic hydroelectric power stations that will potentially be redeveloped as museums or for other public use. The primary contaminants of concern were metals, petroleum, and PAHs in soils. Risks were assessed for future residential users as well as maintenance and construction workers. (2005 – 2007).

Site-Specific Human Health and Ecological Risk Assessment Former Landfill
Ottawa, ON

Principal Human Health Risk Assessor responsible for conducting a site-specific human health and ecological risk assessment of a former landfill and salt storage site that is being redeveloped for residential and parkland use. The primary contaminants of concern were metals and PAHs in soil. Site-specific metal bioaccessibility in soil was used in the risk calculations. Risks were assessed for future residential users as well as maintenance and construction workers. (2005 – 2007).

Human Health Risk Assessment and Soil Vapour Intrusion Modelling, Brochet School
Brochet, Manitoba

Principal Human Health Risk Assessor and project manager responsible for conducting a soil vapour investigation at Brochet School, in northern Manitoba, to evaluate whether Health Canada guidance's default assumptions provided reasonable risk estimates in subarctic and arctic climates. A historic fuel spill had occurred beneath the school. The purpose of the investigation was two-fold and included an improved knowledge of subsurface chemical fate and transport in northern climates (including biodegradation processes) as well as an assessment of the impact of petroleum hydrocarbons under the school and any potential risks that might still exist for students and teachers. (2009).

Finalization of Clean-up Criteria
Port Hope, ON

Scientist responsible for the critical assessment of exposure models used in Ontario and other jurisdictions to derive risk-based clean-up criteria and assessment of the suitability for use in this community which had historically been impacted by uranium processing. A site-specific multimedia approach was recommended for several contaminants of concern. (2001).

Ontario Ministry of the Environment Course on the Contaminated Sites Guidelines
Ontario

Key Speaker at the Ontario Ministry of the Environment's course on Contaminated Sites Guidelines for environmental consultants and municipal planners held in several locations throughout Ontario. Discussed how to conduct the human health component of a site-specific risk assessment, including best practices and technical review considerations. (2001).

Screening Human Health and Ecological Risk Assessment
Fort McMurrary, AB

Principal Risk Assessor responsible for screening level human health and ecological risk assessment of a historic Oil Sands Extraction site from the 1950s. The primary contaminants of concern included petroleum hydrocarbons, PAHs and novel alkylated PAHs. The risk assessment exposure pathways included direct soil contact and vapour intrusion into indoor and outdoor air for human receptors as well as terrestrial and aquatic components for ecological receptors which included wildlife food chain modelling. The results were used to prioritize the need for further risk assessment or risk management measures for the various areas of concern at the Site. The risk assessment approach included modifying guidelines as per the Alberta Environment Tier II approach. (2010).

Preliminary Quantitative Risk Assessment CFB Shilo
Manitoba

Senior risk assessor and project manager responsible for conducting a preliminary quantitative human health and ecological risk assessments of a former shooting and rifle ranges at Canadian Forces Base (CFB) Shilo located in Shilo, Manitoba for Defence Construction Canada. The risk assessments were conducted to determine risks to ecological receptors as well as human residential, recreational users and construction workers resulting from elevated concentrations of metals and polycyclic aromatic hydrocarbons in soil and groundwater. (2008 – 2009).

Preliminary Quantitative Risk Assessment FOX-3 DEW Line Site Nunavut	Senior human health risk assessor and project manager responsible for conducting a preliminary quantitative human health risk assessment of a former FOX-3 distant early warning (DEW) line site located in Dewar Lakes, Nunavut for Defence Construction Canada. The risk assessment was conducted to determine risks to recreational users and construction workers resulting from elevated concentrations of metals and polycyclic aromatic hydrocarbons in soil and surface water. (2007).
Screening-Level Risk Assessment, Commercial Office Tower Vancouver, BC	Human health risk assessor responsible for conducting a human health risk assessment of a commercial office tower constructed on the site of a former drycleaner operation. The risk assessment was conducted to determine potential risks to building users and off-site receptors resulting from elevated concentrations of tetrachloroethene present in site groundwater. (2002 – 2003).
Screening–Level Risk Assessment, Active Drydock Vancouver, BC	Senior risk assessor responsible for conducting a human health risk assessment of an active drydock and associated property for purposes of a land transaction. The risk assessment was conducted to determine potential health risks to drydock and construction workers as well as site trespassers to elevated concentrations of petroleum hydrocarbons and metals in site soils and groundwater. (2005 – 2008).
Preliminary Quantitative Risk Assessment Bedford, NS	Senior Human Health Risk Assessor responsible for conducting a preliminary quantitative human health risk assessment of a former landfill at a former dredgeate disposal facility at the Canadian Forces facility. The risk assessment was conducted to determine risks to commercial and construction workers resulting from elevated concentrations of metals and polycyclic aromatic hydrocarbons in soil and sediment. (2005 – 2006).
Screening-Level Risk Assessment, Application of Coal Tar Enamel to Large-Diameter Pipes Vancouver, BC	Senior Risk Assessor responsible for conducting a human health risk assessment related to inhalation of PAHs, particulates, and VOCs as the result of application of coal tar enamel to large-diameter water pipes that are being placed through a series of residential neighbourhoods. The risk assessment was conducted to determine potential health risks to construction workers and nearby residents. (2008).
Site-Specific Risk Assessment of a Former Iron Pigments Manufacturing Facility Etobicoke, ON	Senior toxicologist responsible for conducting a site-specific risk assessment to determine the potential for adverse health impact to site users exposed to elevated metals concentrations in soil. A site-specific soil remedial criterion was developed for iron. The project also involved significant interaction with legal counsel for the former facility. (2001).
Screening-Level Risk Assessment, Public Storage Facility Vancouver, BC	Human health risk assessor responsible for conducting a human health risk assessment of a public storage facility constructed on a former commercial/industrial site. The risk assessment was conducted to determine potential risks to building users and off-site receptors resulting from elevated concentrations of concentrations of petroleum hydrocarbons in groundwater and lead in soil. (2004 – 2006).

Screening-Level Risk Assessment of a Manufacturing Facility
Confidential

Human Health Risk Assessor responsible for conducting a human health risk assessment of a manufacturing facility that was potentially impacted by a historic spill of chlorinated solvents. The risk assessment was conducted to determine potential risks to building users and construction workers associated with inhalation of indoor and outdoor air as the result of the subsurface vapour intrusion resulting from elevated concentrations of chlorinated solvents in site soils and groundwater. (2006 – 2009).

Screening-Level Risk Assessment, Church and Underground Parking Garage
Vancouver, BC

Human health risk assessor responsible for conducting a human health risk assessment of a church and underground parking garage in adjacent commercial building impacted by a historic fuel oil spill. The risk assessment was conducted to determine potential risks to building users and off-site receptors resulting from elevated concentrations of petroleum hydrocarbons and PAHs present in site soil. (2004 – 2006).

Screening-Level Risk Assessment Former Corrections Camp
Alouette Lake, BC

Senior risk assessor responsible for conducting a human health risk assessment of a former corrections camp on the shore of Alouette Lake which had been the site of fuel storage leak. The future site use is a proposed recreational camp for children. The risk assessment was conducted to determine potential risks to building users resulting from elevated concentrations of residual petroleum hydrocarbons present below several residential buildings on-site. (2004 – 2006).

Screening-Level Risk Assessment Public Works Yard
Nelson, BC

Senior risk assessor responsible for conducting a human health risk assessment of a public works yard. The risk assessment was conducted to determine potential risks to building users and off-site receptors resulting from elevated concentrations of concentrations of petroleum hydrocarbons in groundwater and lead in soil. (2005).

PROJECT EXPERIENCE – HUMAN HEALTH TOXICOLOGY

Technical Advisor, Human Health Risk Assessment
Wawa, ON

Senior Regulatory Toxicologist representing the Ontario Ministry of the Environment on the Wawa Technical Steering Committee. Responsibilities included providing expert advice, guiding and critically reviewing the human health risk assessments, human health toxicological data, and biological monitoring studies of a population living adjacent to soil containing elevated levels of arsenic. Regular meetings with the local medical officer of health, industrial stakeholders, local government, and their technical consultants were also required. (1999 – 2001).

Technical Advisor, Community-Based Risk Assessment
Pt. Colborne, ON

Senior Regulatory Toxicologist representing the Ontario Ministry of the Environment in the multi-stakeholder development of a community-based risk assessment approach for use in Pt. Colborne. Pt. Colborne has elevated metals concentrations in the soils in the area resulting from historical metal refining activities. Responsibilities included providing expert human health toxicological advice, critically reviewing the proposed community-based approach including the framework for the human health and ecological risk assessments, potential risk management measures, and implementation of these risk management measures. Risk communication at public forums and frequent interaction with the local medical officer of health, industrial stakeholders, local government, and their technical consultants was required. (1999 – 2001).

Provision of Expert Toxicological Advice to Ontario Medical Officers of Health
Ontario

Senior Regulatory Toxicologist responsible for providing expert toxicological advice to Ontario Medical Officers of Health on an "as-needed" basis. Various projects included the initiation of two blood lead screening programs for children and pregnant women exposed to lead (1) in mine tailings used for garden landscaping and paving, (2) from aerial deposition in gardens in a smelting town; and assessment of off-site odour/health issues related to remediation activities, and (3) odour and potential health issues associated with unknown noxious substances in soil. (1999 – 2001).

Development of a Provincial Uranium Air Standard
Ontario

Co-author of the provincial uranium air standard for the Ontario Ministry of the Environment based on the chemical toxicity specific to exposures by human and ecological receptors in a community adjacent to a uranium refinery. The uranium air standard was set to ensure that unacceptable levels of uranium did not accumulate in soil as the result of aerial deposition and utilized a multimedia approach. The development of the standard included a critical review of uranium human health toxicological data to determine an appropriate toxicity reference value. The development of the uranium standard involved extensive communication and consultation with the local medical officer of health, industrial stakeholders, local government, and public interest groups. (1999 – 2001).

Development of a Provincial Acetonitrile Air Standard
Ontario

Senior Toxicologist responsible for developing a provincial acetonitrile air standard for the Ontario Ministry of the Environment, based on protection of human health and the environment. The development of the standard included critically assessing the current literature related to the human health toxicology of acetonitrile. (1999 – 2001).

Market Analysis – Sepsis and Septic Shock
Boston, MA

Scientist responsible for a market analysis of the disease state, sepsis and septic shock for use by pharmaceutical and biotechnology companies. The market analysis included (1) a summary of most recent understanding of cause and mode of action of disease state, (2) summary of current treatment regimens (pharmaceutical and clinical) and efficacy of these treatments, (3) summary of new pharmaceuticals in the pipeline for the treatment of sepsis, including mode of action and expected efficacy, (4) analysis of sales of major pharmaceutical products used for treatment in various markets (Europe, Asia, and North America), and (5) interviews with leading medical experts specializing in the treatment of sepsis to determine what tools would be most useful to them in the treatment of disease. (1998).

PROJECT EXPERIENCE – GUIDANCE DOCUMENTS, CLASSIFICATION SYSTEMS AND CHEMICAL ASSESSMENTS

Development of Soil Quality Guidelines for PFOS and PFOA, Canada

Senior toxicologist and reviewer responsible for an update of the Canadian Council of Ministers of the Environment (CCME) Soil Quality Guidelines, Soil Screening Values and the Federal Contaminated Sites Action Plan (FCSAP) Factsheets for perfluorooctoane sulphonate (PFOS) and perfluorooctanoic acid (PFOA). The guidelines were updated to be consistent with Health Canada's Drinking Water Quality Guideline (DWQG) technical documents and based on the most up-to-date science. A peer review of and update of the draft Scientific Supporting Documents created by Health Canada for PFOS and PFOA was conducted, the soil quality guidelines updated and the results were then summarized in the FCSAP factsheet documents. (2006 – 2007).

Update of the National Contaminated Sites (NCS) Classification System

Project Manager and Principle Scientist involved in updating the existing NCS classification system which is used to rank federal sites. The NCS is used to determine priority of federal sites for further investigation and standardize prioritization for funding. The system is based on (1) the assessment of environmental fate and transport of chemicals, (2) hazard ranking of the chemicals, and (3) assessment of site characteristics that would increase risk of chemical to the environment or human health. Primary changes to the NCS included the reduction of ambiguity to assist in the standardization of responses, improved clarity, and incorporation of additional technical scoring such as northern specific issues. The updated NCS underwent trial testing using several case studies with a variety of datasets before use for prioritization of federal sites nationally. (2004 – 2007).

Update of Environmental, Health and Safety Guidelines for Base Metals Smelting and Refining Washington, DC

Project Manager involved in updating the International Finance Corporations (IFC) Environmental Health and Safety Standards (EHS) for Base Metals Smelting and Refining (e.g., aluminum, copper, lead, nickel, and zinc). The EHS guidelines are used internationally by project managers and financiers to minimize and/or control EHS impacts during construction, operation, and decommissioning of base metals smelters and refineries. The role involved project management, liaising with IFC, providing direction to and coordinating inputs from several industry experts, data analysis, and writing the guidance document. (2010).

Risk Management of Coarse Particulate Matter in Canada Canada

Project Manager and senior risk assessor responsible for risk management assessment for coarse particulate matter (PM2.5-10) in Canada completed for Health Canada. The project included the (1) review and compilation of information related to primary emission sources of coarse particulate matter in Canada focussing on industrial/urban and rural environments, (2) identification and compilation of risk management measures for coarse particulate matter from or proposed in other regulatory jurisdictions including interviews of regulators and other experts specializing in risk management of coarse PM, (3) identification of the major sources of coarse particulate matter in Canada and possible risk management measures that would address these major sources, and (4) prioritization of the risk management measures by identifying positive and negative effects associated with these measures. (2010 – 2011).

Development of Soil and Soil Vapour Standards for High Density Residential Land Use
BC

Project Manager for the development of soil and soil vapour standards for high density residential land use for BC Ministry of Environment and the Science Advisory Board for Contaminated Sites in BC (SAB). Responsibilities included managing and coordinating input from members of the SAB to derive soil and soil vapour standards, including organizing a workshop for peer review of the derived standards. (2010 – 2011).

Soil Vapour Intrusion Model and Updated Soil Vapour Characterization Guidance – British Columbia
BC

Project Manager for the development of a soil vapour intrusion model which provides chemical-specific attenuation factors and also updated guidance on soil vapour intrusion for the Science Advisory Board for Contaminated Sites in BC. A chemical-specific vapour intrusion model was developed which included the adaptation of an existing spreadsheet model, which implements partitioning calculations from soil and groundwater to soil vapour and models vapour intrusion according to the Johnson and Ettinger algorithm. The Johnson and Ettinger defaults are adapted from those adopted by Health Canada for their vapour intrusion guidance and incorporated in the BC MOE Technical Guidance for attenuation factors. In addition to the model development, the project included the update of a 2006 soil vapour characterization guidance document previously prepared by Golder for the SAB and the incorporation of field research on soil properties and moisture content in vapour attenuation modelling. (2009 – 2011).

PSL II – Evaluation of the Environmental Toxicology of Inorganic Chloramines
Vancouver, BC

Scientist responsible for evaluating the environmental toxicology of the drinking water disinfectant, chloramine, in accordance with the Environment Canada Priority Substances II List protocol. Technical tasks included collecting chloramine-related toxicological data, evaluating the data and data quality, determining that a new analytical method would need to be developed for the assessment, and selecting appropriate assessment endpoints for additional toxicity testing. A meta-analysis was conducted with the resulting toxicological data. Another key area of the project involved setting up an Environmental Resource Group consisting of chloramine experts from various academic, industrial, and government sources to provide ongoing feedback on the technical decisions made during the evaluation. Formal oral presentations were made to the Environmental Resource Group in Ottawa and Vancouver. (1995 – 1997).

Environmental Toxicity of Avermectins
Vancouver, BC

Scientist responsible for evaluating the environmental toxicology of the avermectins (a pesticide) for Environment Canada. Technical tasks included a conducting a literature survey of avermectin environmental toxicological data, evaluating the data and data quality, determining the key toxicological effects of avermectins, and the concentrations in the environment at which one would expect to find environmental effects on non-target species. (1996).

A Survey of Particulate Emission Control Devices Used with Wood-Fuelled Power Boilers in North America
Vancouver, BC

Scientist responsible for conducting a survey of particulate emission control devices used on wood-fuelled power boilers in North America. Dioxins and furans can be formed by the incomplete combustion of wood products and the objective of the survey was to determine (1) the type of particulate emission control device used most frequently with wood-fuelled power boilers, and (2) the resulting dioxin/furan emissions associated with each control technology. The results were used to determine what type of control technology would be most effective in reducing environmental emissions of dioxins and furans from wood-fuelled power boilers at sawmills and pulp mills in BC. (1996).

Assessment of Environmental Impacts of Pesticide Applications
Vancouver, BC

Scientist responsible for determining potential environmental effects associated with proposed pesticide applications. Pesticide permit applications were reviewed to determine compliance with federal environmental regulations, specifically protection of fish and migratory birds, and input was provided to a federal-provincial committee as to whether the application should be granted. Audits of pesticide applications were also conducted. In addition to the review of pesticide applications, activities also included response to public concerns related to pesticides and education related to pesticide use in urban and residential environments. (1994 – 1996).

Environment Canada Polycyclic Aromatic
Vancouver, BC

Scientist responsible for organizing a workshop to discuss risk management options for a community and surrounding environment in Northern British Columbia impacted by industrial emissions of polycyclic aromatic hydrocarbons. Other responsibilities included facilitating summary discussions and documenting workshop proceedings. Workshop participants included industrial stakeholders and their technical consultants, government scientists and officials, and First Nations elders from the impacted community. (1995).

PROJECT EXPERIENCE – THIRD-PARTY PEER REVIEW

Expert Opinion, Health Effects of Pesticides
Ontario

Senior health risk assessor responsible for conducting a review of historic documents and provided a preliminary expert opinion related to potential human health effects associated with DDT, DDE and PAH impacted soils. This work is related to an arbitration involving a pipeline company, the National Energy Board of Canada, and a private land owner using their property for agricultural purposes. (2016).

Expert Opinion Provided on Evacuation of Building Occupants as the Result of Potential Exposure to Trichloroethene,
Vancouver, BC

An expert opinion was provided based on a review of recent toxicological data on trichloroethene as to whether or not building occupants needed to be evacuated from a commercial building impacted by a historic trichloroethene plume in the floor slab. The review of the trichloroethene toxicological data focused on acute and sub-chronic exposure to pregnant women. A mobile field laboratory from the Vancouver Fire Department was used to analyze the trichloroethene concentrations measured directly above the cracked floor slab and at several locations at breathing height within the building. Parallel analyses were submitted to a local analytical laboratory. Field measurements indicated highly elevated concentrations of trichloroethene. Based on a review of current trichloroethene toxicological data, a recommendation was made to evacuate the employees from the building while engineers installed a vapour mitigation system and indoor concentrations of trichloroethene returned to acceptable levels. (2015).

Peer Review, Human Health Risk Assessment, Expansion of a Coal Terminal
Vancouver, BC

Third party peer review of a human health risk assessment to support an application for an air quality permit related to the expansion of a coal terminal. The third party peer review was conducted for a law firm and identified areas for discussion or those that were not compatible with provincial or federal requirements. Role also included provision of strategic technical advice to the legal team. (2014).

Peer Review, Human Health Risk Assessment, Fraser Surrey Docks
Surrey, BC

Senior human health risk assessor responsible for a third party peer review of a human health risk assessment related to a proposed direct transfer coal facility from an expanded facility at Fraser Surrey Docks. The third party peer review was conducted for the Vancouver Fraser Port Authority. The review was conducted twice; once for the initial project design and submission and a second time for a modified project design. (2013 – 2015).

Peer Review of US EPA Toxicity Reference Values for Tetrachloroethene
Sweden

Senior Toxicologist responsible for the peer review of the US EPA toxicity reference values for tetrachloroethene on behalf of the Swedish EPA to determine whether they should adopt the US EPA toxicity reference values or continue to utilize the World Health Organization toxicity reference values. The project involved a detailed comparison of the toxicological basis of both the US EPA and WHO toxicity reference values, a literature review of the basis of toxicity reference values used by other jurisdictions including Health Canada and contacting several of these jurisdictions to determine whether they are planning to review their toxicity reference values for tetrachloroethene. A key part of the toxicological review was an assessment of the genotoxicity and mutagenicity data for tetrachloroethene. (2012).

Peer Review of Air Quality Standards for Benzene
Alberta

Senior Toxicologist responsible for peer review of the toxicological basis of the air quality standards developed for benzene by the Ontario Ministry of Environment and the Texas Environmental Quality Commission. The peer review was conducted on behalf of the Canadian Association of Petroleum Producers and the purpose of the review was to provide a recommendation as to which of the air quality criteria were most suited to use in Alberta based on the toxicological assumptions used to derive the air quality criteria. (2012).

Peer Review of Toxicity Reference Values for Petroleum Hydrocarbons
Canada

Senior Toxicologist responsible for peer review of proposed toxicological reference values for Canada Wide Standard Petroleum Hydrocarbon Fraction F1 on behalf of Health Canada. The toxicity reference values had been derived by another consultant to Health Canada and the project consisted of a literature review to confirm whether the data used in the derivation were current and an assessment of the toxicological basis of the toxicity reference values and the subsequent derivation of a soil quality guideline. (2011).

Peer Review of Environmental Soil Quality Guideline for Zinc
Canada

Senior Toxicologist responsible for peer review of the proposed human health component of the environmental soil quality guideline for zinc as developed by Health Canada. The project involved a literature review to determine whether the information used in the soil quality derivation was current and critical assessment of the toxicological basis of and subsequent derivation of the environmental soil quality guideline. (2010 – 2011).

Peer Review of Human Health Risk Assessment for a Natural Gas Pipeline
BC

Senior Toxicologist responsible for the peer review of a human health risk assessment conducted to support an environmental impact assessment for a natural gas pipeline in BC and Alberta. Acted as an expert witness on behalf of a First Nations group and provided advice at a National Energy Board Hearing. The primary contaminant of concern was hydrogen sulphide which had the potential to impact health of trappers and residents living in the vicinity of the pipeline in the case of a pipeline rupture. The peer review was conducted in accordance with the protocol provided by the Alberta Energy Board. (2008).

Review of Site-Specific Risk Assessments
Ontario

Senior Regulatory Toxicologist responsible for reviewing site-specific risk assessments and remediation criteria to ensure compliance with the Guideline for Use at Contaminated Sites for the Ontario Ministry of the Environment. Excellent knowledge of Ontario Contaminated Sites Guidelines and the Ministry's site-specific risk assessment approval process. (1999 – 2001).

Peer Review of a Toxicity Reference Value for Salt
BC

Senior Toxicologist responsible for the peer review of a toxicity reference value derivation for salt and provided advice to the British Columbia Science Advisory Board. The toxicity reference value had been derived for Health Canada and would potentially be used to derive soil and groundwater standards for use at Contaminated Sites in British Columbia. The review included assessing the technical validity of the approach utilized and examining the selection of the key toxicological studies as well as providing a comparison/contrast with the proposed method of addressing salt by the BC MOE and practical considerations with regards to implementation of standards derived using the proposed toxicity reference value. (2008).

Peer Review of BC Human Health Soil Quality Matrix Guidelines
BC

Senior Toxicologist responsible for the peer review of a proposed update to the BC Contaminated Sites Task Group for the derivation of human health soil quality matrix standards for contaminated sites. The peer review was conducted on behalf of the BC Science Advisory Board. The peer review included a technical assessment of the approach and exposure parameters utilized. (2008).

Peer Review of Vapour Risk Assessment
BC

Senior Toxicologist responsible for a third-party peer review of human health and ecological risk assessment on behalf of a property developer in order to assist them with providing advice as to whether the site is suitable for a residential development. Several data gaps in the site characterization were identified and recommendations included some additional site investigation work and updating the risk assessment with the measurement of soil vapours after pursuing additional source removal. (2008).

Peer Review of Four Site-Specific Risk Assessments for Off-Site Impacts
Ontario

Senior Toxicologist responsible for the peer review of four site-specific risk assessments that had been conducted to determine the potential human and ecological risks originating from an industrial facility. Soil and groundwater remedial criteria were also reviewed. The primary contaminants of concern were elevated levels of chlorinated solvents such (such as trichloroethene, vinyl chloride and cis-1,2-dichloroethene) which have migrated in groundwater to a residential neighbourhood. The peer review was conducted in accordance with the protocol outline in the "Guidance on Site-Specific Risk Assessment for Use at Contaminated Sites in Ontario". (2001).

PROJECT EXPERIENCE – ECOLOGICAL RISK ASSESSMENT

Terrestrial and Groundwater Ecological Risk Assessments – South East False Creek
Vancouver, BC

Project manager for terrestrial and groundwater ecological risk assessments of a former industrial site scheduled for redevelopment for the 2010 Winter Olympic Athletes Village and later for use as a mixed residential and urban park property. Contaminants of potential concern included elevated concentrations of metals and PAHs in soil and groundwater. Responsibilities included providing direction and design of assessments, overseeing data analysis and food chain modelling and overall responsibility for report writing. (2003 - 2006).

Ecological Risk Assessment of a Former Sawmill Site
Vancouver, BC

Project manager for terrestrial and aquatic groundwater ecological risk assessments of metals and chlorophenols at a former sawmill site adjacent to the Fraser River. Responsibilities included providing direction and design of assessments, overseeing data analysis and food chain modelling and overall responsibility for report writing. (2005).

Ecological Risk Assessment for Pt. Atkinson Lightstation and Lighthouse Park
West Vancouver, BC

Project manager for terrestrial and aquatic ecological risk assessments of elevated metals in soils adjacent to the lightstation and in several areas of the park. Responsibilities included providing direction and design of assessments and problem formulation workshop, overseeing data analysis and food chain modelling and overall responsibility for report writing. (2002 – 2004).

Ecological Risk Assessment Tofino Airport
Tofino, BC

Project manager and senior risk assessor for terrestrial and aquatic ecological risk assessment for three former landfill sites associated with the Tofino airport. Contaminants of concern included elevated metals and petroleum hydrocarbons in site soils, groundwater, surface water and sediments. The problem formulation was presented to stakeholders for input and will be used to obtain funding under the Federal Contaminated Sites Action Plan for further work. Responsibilities included providing direction and design of assessments, overseeing data analysis, toxicity testing and food chain modelling and overall responsibility for report writing. (2005 – 2007).

Ecological Risk Assessment First Nations Reserves
BC

Project manager and senior risk assessor for terrestrial and aquatic ecological risk assessment for two First Nations reserves in remove locations on the West Coast of BC. Contaminants of concern included elevated metals, petroleum hydrocarbons and phenols in site soils, groundwater, surface water and sediments. The risk assessment will be used to obtain funding under the Federal Contaminated Sites Action Plan for further work. Responsibilities included providing direction and design of assessments, overseeing data analysis, toxicity testing and food chain modelling and overall responsibility for report writing. (2005 – 2011).

Ecological Risk Assessment Grain Terminal
Vancouver, BC

Project manager and senior risk assessor for aquatic ecological risk assessment for a grain terminal adjacent to an aquatic environment. Contaminants of concern included elevated metals, petroleum hydrocarbons and tannins/lignins associated with wood waste in soils and groundwater. Responsibilities included providing direction and design of assessments, overseeing data analysis, toxicity testing and overall responsibility for report writing. (2005 - 2006).

TRAINING

Mid-America Toxicology Course
Kansas City, Missouri, April 2012

Probabilistic Risk Assessment
Harvard School of Public Health, Cambridge, Massachusetts, 2000

Expert Witness Training
Ontario Ministry of the Environment, Toronto, Ontario, 2000

Fourth International Conference on Arsenic Exposure and Health Effects
The Society of Environmental Geochemistry & Health, San Diego, California, 2000

Crystal Ball – Probabilistic Risk Assessment Software Training
Toronto, Ontario, 1999

Human Health and Ecological Risk Assessment
SENES Consultants and Oak Ridge National Laboratories, Vancouver, British Columbia, 1994

PROFESSIONAL AFFILIATIONS

Society of Toxicology

American Chemical Society

PUBLICATIONS

Other

"New Environmental Health and Safety Guidelines for Smelting and Refining". Audrey Wagenaar and Rick Hilton. Environmental Mining Journal. October 2008.

"Novel Mono-and bis-Metallated Complexes of Dialkyldiaziridines; X-ray Diffraction Structures of Three Platinum Complexes". Adeyemi Adedapo, Anthony G. Avent, Duncan Carmichael, Penny A. Chaloner, Peter B. Hitchcock and Audrey Wagenaar. J. Chem. Soc., Chem. Commun., 1993, 186.

"Novel Diaziridine Complexes of Platinum and Palladium". P. Chaloner, A. Adepo, P. Hitchcock, and A. Wagenaar, Abstracts of the Papers of the American Chemical Society, April 1992.

Golder Associates Inc. – Portland

Education

BS, Chemical Engineering, Oregon State University, Corvallis, Oregon, 1999

Certifications

Registered Professional Engineer, #61441PE, Oregon, 2010, February 25, 2010

Professional Synopsis

Geoff Scott is a senior air resources engineer with 18 years of experience in air quality compliance consulting, including design of industrial ventilation systems, air pollution control equipment assessments (which have also included highly detailed and complex Best Available Control Technology [BACT] assessments), air dispersion modelling studies, human health risk assessments, complex emissions inventories, and visibility analyses. Geoff has completed many projects in the forest products, iron and steel, aggregate mining, and oil and gas sectors in locations throughout the United States and internationally including Russia, Greenland, South Africa, Peru, Canada, Fiji, and China. Geoff has prepared local, state, and federal construction and operating permit applications for many industrial facilities throughout the United States.

PROJECT EXPERIENCE – ENGINEERING PROJECTS

Above Ground Processing Facilities for Gold Mine
Russia

Led a multinational audit team for an audit of over 400 industrial ventilation systems located at the above ground processing facilities for a gold mine in central Russia. Each ventilation system was visually inspected and photographed. System condition and performance was assessed. Each system was scored using a system developed specifically for this site in order to determine the systems that need immediate redesign or refurbishment. The audit constituted Phase 1 of the overall project, with Phase 2 including the conceptual design and basic engineering services.

Industrial Ventilation System Optimization; Titanium Foundry
Oregon

Completed a detailed engineering analysis of a kiln off-gas ventilation system. The off-gas ventilation system included high temperature cyclones, a quencher, variable through venturi scrubber, cyclonic separator, demisters, two high pressure fans in a parallel configuration, a caustic scrubber, a wet electrostatic precipitator, and two system fans in a parallel configuration. System monitoring data were reviewed and analyzed for trends and system response relationships. These data were also combined with stream characterization measurements at various locations along the system to construct a computation model. The computational model was used to assess the suitability of the four fans to handle the desired airflow through the kiln, as well as assess various “what if” scenarios. Several system improvements were identified and simulated in the computational model to determine the additional airflow that could be realized for each suggested system improvement.

Odor Mitigation Analysis; Solid Waste Biorefinery
Mississippi

Conducted an analysis of odor mitigation technologies for a solid waste biorefinery. Various technologies, including biofilteration, thermal destruction and scrubbing with a chemical neutralizer, were assessed for suitability at the site. Budgetary quotes from several odor mitigation equipment vendors were solicited, analyzed, and adjusted for means of comparative analysis. Total capital costs and operating and maintenance costs were calculated and presented in a comparative format for the client.

Air Pollution Control Device Costing Analysis; Various Steel Foundries
South Africa

Prepared engineering costs for air pollution control devices for multiple sources/processes at four steel foundries in South Africa. The engineering costs were developed based on source type, level of existing air pollution control, required air flow volumes, and pollutant type and quantity. Air pollution control devices were selected and sized based on engineering design algorithms. Costs were then estimated, including capital costs, annual operating costs, and maintenance costs.

Solvent Recovery System Analysis; Chemical Company
New Hampshire

Conducted a detailed engineering review of a proposed expansion of a dichloromethane vapour capture and recovery unit that used activated carbon. The review was focused on determining if the proposed carbon charge to the vessels was adequate, if the proposed fan would be adequate for a higher volumetric flow through the system, and if the proposed steaming rates in the carbon vessel would be adequate for the regeneration of the activated carbon.

Indoor Air Quality Analysis; Hazardous Waste Processing Facility
Oregon

Performed an engineering analysis to determine the evaporation rate of solvents contained in concrete floors and walls of a room. The study included diffusion calculations to approximate the migration of the solvents out of the concrete, through an epoxy coating, and into the ambient air inside the room. The study also focused on the natural infiltration and exfiltration of the room and the resulting air changes per day. A steady state concentration was calculated and compared to pertinent Oregon exposure levels.

PROJECT EXPERIENCE – BEST AVAILABLE CONTROL TECHNOLOGY (BACT) AND SIMILAR STUDIES

Algorithm Development for Air Pollution Control Device Design and Costing; Wood Products Manufacturing Sector
Ontario, Canada

Conducted a detailed and comprehensive study for the Ontario Ministry of Environment. The study focused on emissions of Particulate Matter (PM) and Volatile Organic Compounds (VOC) from the wood products manufacturing sector in Ontario. Developed a suite of algorithms to estimated equipment sizing, capital costs, and annual operating costs of PM and VOC air pollution control technologies appropriate for the wood products industry.

Odor Control Analysis; Foundry
Oregon

Assisted with the control technology analysis. The analysis was concerned with the control of odor from the foundry process. A unique method for accounting for odor reduction was created in order to compare effectiveness of the different technologies. Technologies that were considered included RTOs, biofiltration units, carbon injection, and carbon adsorption.

PROJECT EXPERIENCE – AIR DISPERSION MODELING, ENVIRONMENTAL IMPACT REVIEWS, ENVIRONMENTAL IMPACT STATEMENTS, AND ENVIRONMENTAL ASSESSMENTS (EIR/EIS/EA)

Air Quality Impact Study for International EIA; Gold Mine Peru, South America	Conducted an air quality assessment to estimate the ambient air concentrations of criteria air compounds resulting from the operation of the Alto Chicama Gold Project in Peru. Responsibilities included coordinating the modeling component, including emissions of PM2.5 and PM10 particle pollution; total suspended particles (TSP); and process and combustion emissions including sulphur dioxide (SO2), nitrogen oxide (NOx), and particulates, as well as trace metals.
Air Dispersion Modeling; Malting Facility Alberta, Canada	Performed an air dispersion modeling assessment of a malting facility in Alberta, Canada. The assessment included estimating emissions of nitrogen oxide (NOx), carbon monoxide (CO), and particulates; processing meteorological data using AERMET; conducting the air dispersion modeling using AERMOD; and generating a report.
Combined Modeling and Monitoring Study; Metals Smelter Ontario, Canada	Conducted a Combined Modeling and Monitoring study for a large metals smelter in Ontario, Canada. Project responsibilities included designing the study, preparing project specific meteorological data, conducting a statistical analysis of monitored data, modeling air dispersion, and conducting a statistical analysis of the results. AERMOD was used to model ambient air concentrations from the sources that were the focus of the study. Two different operating scenarios were modeled and compared to the monitored results. The project required a thorough understanding of AERMOD as well as AERMET, the meteorological preprocessor for AERMOD. Statistical comparisons were made to show that the AERMOD model was conservative and was appropriate for compliance modeling going forward.
Compliance Tool Development; Wood Products Facilities Various Locations	Developed Excel spreadsheet that performed the look-up table determination of “Low Risk” categorization for the Plywood and Composite Wood Products (PCWP) Maximum Achievable Control Technology (MACT), Subpart DDDD. The spreadsheet allowed for entry of emission rates, distance to property lines, and stack heights; and performed the necessary calculations to determine whether or not the Low Risk designation applied to the facility.
Odor Impact Study; Steel Foundry Oregon	Assisted with an odor impact study for emissions. Using available olfactometry data, the ISCST3 dispersion model was used to predict maximum odor impacts surrounding the facility. Maximum impacts were compared to regulatory thresholds from several different states. Responsible for receptor grid generation, plant digitization, writing of the input files, and conducting the model runs. Also generated all the odor isopleths for interpretation of results that were used to determine the areal extent of the impacts.
Air Dispersion Modeling; Wood Products Facility Oregon	Assisted with the dispersion modeling using ISCST3 to determine maximum ground-level ambient concentrations for emissions carbon monoxide (CO), nitrogen oxide (NOx), PM10 particle pollution, resulting from various firing regimes of the current boiler configuration. Maximum ambient concentrations were compared to Oregon ambient air quality standards and increments.

Air Dispersion Modeling; Pulp and Paper Company
Oregon

Assisted with Prevention of Significant Deterioration (PSD) permitting services, which included modeling for carbon monoxide (CO) and Total Reduced Sulfur (TRS). Generated all impact isopleths for interpretation of results, which were used to determine the areal extent of the impacts.

PROJECT EXPERIENCE – PERMITTING, REGULATORY COMPLIANCE, AND EMISSION INVENTORIES

Emissions Inventory Development; Particleboard Facility
Montanna

Compiled several complex emissions inventories to determine Prevention of Significant Deterioration (PSD) applicability for several operating scenarios at a particle board facility in Montana. This assessment was particularly difficult given that the scenarios being assessed were for design purposes and would occur at distant points in the future. The emission inventories tracked all criteria pollutants for comparison to significant emission rates.

Emissions Inventory Development; Two Wood Product Facilites
Washington

Assisted in compiling multiple emission inventories for Prevention of Significant Deterioration (PSD) permitting purposes. This involved researching company records and constructing a timeline that included all modifications to the facilities back to the 1980s. The inventory included complicated material handling recycle loops, varying product processing (resulted in large variation in emissions), and relocation of manufacturing equipment responsive to the type of product being processed. A model was developed that balanced the input and output of materials through the facility to determine the magnitude of waste streams to various cyclones and baghouses.

PROFESSIONAL AFFILIATIONS

National Council for Air and Stream Improvement (NCASI)

Air & Waste Management Association (AWMA)

Golder Associates Inc. – Portland

Education

BS, Environmental Science, Oregon State University, Corvallis, Oregon, 2005

Environmental Scientist

Brian Eagle is a senior project air quality specialist with eight years of experience in air quality and consulting services. His primary expertise includes air quality permitting, and industrial ventilation design. Brian is specialized in many aspects of air quality permitting, including development of complex emissions inventories, air dispersion modeling assessments, and regulatory applicability determinations. In addition, Brian assists facilities with data management for recordkeeping and compliance assistance, and source test coordination and oversight on an ongoing basis. For industrial ventilation design, Brian performs troubleshooting of existing systems, design of new systems, field balancing of installed systems, and provides assistance with the selection of necessary air pollution control devices.

PROJECT EXPERIENCE

Gold Processing Ventilation System Audit; Polyus
Severo Yeniseysk, Russia

Performed a visual inspection and audit of industrial ventilation systems contained within four separate gold processing facilities. Over 100 ventilation systems were audited to generate a prioritized list of systems in need of most immediate redesign or repair in order to improve indoor air quality. Systems were reviewed from collection point to exhaust stack, including assessments of control device performance, fan performance, and materials of construction. A reporting format was developed to allow a numerical categorization of systems based on the significance of the performance issues observed.

Ventilation System Design; Thermite Process - Confidential Client
Oregon

Completed a conceptual and final design for a ventilation system mitigating combustible dusts generated by a thermite process. The system was designed to mitigate potential deflagrations and fires consistent with design recommendations from the National Fire Protection Agency (NFPA 654). Processes controlled by the ventilation system included a large ventilated bay designed to accommodate multiple operations, a slag crusher, and a vibrating screen. The system design included specification of inlet conditions to an air pollution control device, and was optimized to use the existing fan with a variable frequency drive.

Ventilation System Design; Chlorination Process - Confidential Client
Oregon

Completed a troubleshooting and improvement project on an industrial ventilation system designed to mitigate acid gas and particulate from a chlorination process. The ventilation system performance was determined by the process being ventilated, which required Golder to independently research the process engineering involved. The capacity of the scrubber system was analysed to determine whether the system was able to ventilate additional sources. This assessment led to the conclusion that the venturi scrubber was inadequately designed, and needed to be replaced. The system analysis also included a determination of the specific ventilation requirements of each branch of the ventilation system, which allowed Golder to produce a table predicting the system performance for a variety of operating scenarios.

Odor Management Technology Assessment; Enerkem

Evaluated odor management systems designed to contain odors from a solid waste recovery facility. Obtained vendor quotes for potential odor control technologies based on facility configuration and airflow demands. Vendor quotes were used to develop detailed control cost estimates for the facility following procedures outlined in the Environmental Protection Agency (EPA) Air Pollution Control Cost Manual. Control technologies included biofiltration, thermal oxidation, and wet scrubbing.

BACT Analysis and Emissions Inventory; Longview Fibre
Washington

Assisted in developing a detailed Best Available Control Technology (BACT) assessment for nitrogen oxide (NOx), carbon monoxide (CO), sulphur dioxide (SO2), and mercury. Performed a detailed cost analysis of each technology. Cost effectiveness was calculated for wet scrubbing, spray dryer, dry sorbent injection, activated carbon injection, selective non-catalytic reduction (SNCR), regenerative selective catalytic reduction (RSCR), SNCR RSCR hybrid, and CO RSCR. Developed detailed emissions inventory for the proposed emissions increases.

Lumber Facility Expansion; Oroville Reman & Reload
Washington

Prepared a detailed emissions inventory for the expansion of a lumber drying facility. Developed unique emission factors to represent emissions from kilns drying lumber of varied species and moisture contents. Estimated emissions for nearby facilities to be included as competing sources in the dispersion modeling assessments. Conducted dispersion modeling to demonstrate compliance with National Ambient Air Quality Standards, and Washington Ambient Significant Impact Levels. Prepared a detailed air permit application, including dispersion modeling report, for submittal to the Department of Ecology. Reviewed and commented on draft permit before receiving final permit for facility.

Biomethane Production Facility; Novus Biogas
Oregon

Developed a detailed permit application for a biomethane production facility. The facility would process onion waste, potato waste, and dairy manure in anaerobic digestion cells to produce biogas, primarily methane, for injection into a natural gas pipeline. Golder worked with the facility to develop the sulfur scrubbing system as part of the required emissions mitigation system. The primary concern of the facility was odor due to the feedstocks, and the by-products of anaerobic digestion. Golder developed detailed emissions calculations as part of the application process.

TRI Reporting Tool; Wood Products Facility
Multiple Locations

Assisted in the development of a complex Toxics Release Inventory (TRI) reporting spreadsheet tailored to each facility. User is able to input production and product throughput; and all calculations are performed automatically, resulting in a pre-populated summary table outlining all chemicals to be reported. Calculations are based on emissions inventory format, and include emissions due to boiler combustion, veneer processing, plywood processing, and lumber production.

Emissions Inventory; Canadian Iron and Steel Sector
Various Locations, Canada

Assisted with the compilation of emissions inventories for three iron and steel facilities located in Canada. The emissions inventories were designed with the goal of inputting the results into the CALPUFF dispersion model, including all pollutants known to be emitted by the facilities.