Our Proposal

PHASE 2

Human Health Risk Assessment of Northeastern British Columbia Oil and Gas Activity

REFERENCE: RFP HL173

SUBMITTED TO:

BC Ministry of Health

SUBMITTED BY:

Fraser Basin Council
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Proposal Summary

In late 2011 the Government of British Columbia, led by the Ministry of Health, launched a three-phase project to focus on the human health risks of oil and gas activity in British Columbia. This initiative was in response to a number of concerns raised by members of the public, the Northern Health Authority, medical health officers, First Nations, local government and non-government organizations.

Phase 1 of the project has been completed and a report prepared that sets out issues of concern associated with possible human health risks, including concerns that relate to changes to land, air, water and food quality. This information will be instrumental in informing and helping shape the next phases of the human health risk assessment.

Phase 2 will assess the human health risks of oil and gas activity identified in Phase 1 and will focus on the following categories of issues:

- environmental pathways of exposure (air quality, water quality and quantity, land and food quality)
- hazards posed through environmental issues and events such as incidents, fluid releases and increased traffic emanating from oil and gas activity associated with possible impacts on health via the identified pathways, and
- the Province's institutional framework with respect to oil and gas operational issues.

This proposal of the Fraser Basin Council ("FBC" or "the Council") lays out a solution and approach that will be carried out by a team of highly accomplished experts who have the relevant background and expertise and a balance of oil and gas industry, public health and private and public consulting experience. The proposal includes an eight-activity work plan, a communications plan that describes the extent and nature of stakeholder engagement, a project risk management strategy and a cost estimate.

The Council proposes a comprehensive human health risk assessment that will evaluate potential impacts on human health from oil and gas activities, including from incidents, chronic spills, fluid and gas releases, and increased road traffic. The project will also review and validate the environmental pathways of exposure that were identified in the Phase 1 Report. The framework (methodology and procedures) used for the human health risk assessment will draw on international best practices to assess human health risks and impacts on health via identified pathways, including those used by Health Canada, the World Health Organization and the US Environmental Protection Agency. The standard four-step process of hazard identification; dose-response assessment; exposure assessment; and risk characterization will be adapted for the unique circumstances of oil and gas development in northeastern BC.

Concurrent with this step will be a jurisdictional scan that will include the collection and review of past and current studies related to human health risk associated with oil and gas activity, with a specific focus on chemicals of concern, sources and pathways in health areas 81, 60 and 59. The scan will focus on jurisdictions in Canada — both federal and provincial — and the United States.

Exposure models for air, water, food and soil ingestion for general and sensitive populations (for example, infants/toddlers, women of childbearing age and Aboriginal peoples in northeastern BC) will

be developed. Exposure to chemicals of concern as a result of current and projected oil and gas development will also be estimated.

A feature of the Fraser Basin Council proposal is a review of the BC statutory, regulatory and policy framework aimed at protecting the health of the population in northeastern British Columbia. It will include recommendations on the adequacy of current statutes, regulations and policies and will propose changes to these, if required, to improve long-term health outcomes in northeastern BC. Recommendations will also be made on any spatial data needed to better monitor and manage the health of the population in northeastern BC.

The FBC proposal includes a stakeholder engagement process to enable relevant interests in northeastern BC to provide input and feedback on various scientific analyses and syntheses, as these are conducted. Section 7 of the Work Plan and a complementary Communications Plan lay out how the stakeholder engagement process will be established, how relevant interests will be informed of the progress of Phase 2, and how to participate.

For 20 years the Fraser Basin Council and its predecessor organization have been involved in complex inter-jurisdictional resource management issues across British Columbia and beyond. Since its inception in 1997, the Council has established itself as an effective, credible and impartial not-for-profit organization that specializes in developing constructive recommendations and practical solutions through multi-disciplinary processes, and convening "safe tables" for disparate groups to engage in effective dialogue to address tough issues. These issues have included flood hazard management, abandoned mine reclamation, gravel extraction, wetlands rehabilitation, climate change adaptation strategies, watershed management, drinking water legislation reform and many others. In most cases, the Council works in collaboration with public and private sector organizations, universities, First Nations and non-government organizations. To supplement its own expertise and ensure its work is done in a comprehensive manner, the Council often subcontracts with scientists and technical experts. The Council will follow this same approach in conducting Phase 2 of the Human Health Risk Assessment.

The Fraser Basin Council believes it is well positioned to continue the work it began in Phase 1 of the Human Health Risk Assessment. FBC is familiar with the key issues of concern associated with possible human health risks from oil and gas activity in northeastern BC, the environmental pathways identified in Phase 1 and the relevant interests in the Northern Rockies and Peace Regions. The Council's understanding and experience are reflected in this proposal and provide assurance that it will deliver Phase 2 effectively, on time and within budget.

Led by David Marshall, the Fraser Basin Council's Executive Director who would serve as the Project Manager, FBC has assembled a strong multi-disciplinary team with diverse backgrounds and relevant experience. The FBC team offers knowledge and experience with respect to the oil and gas sector, human health risk issues, Aboriginal/non-Aboriginal relations, stakeholder engagement processes, multi-interest process design and facilitation, information management, project management, communications, contract management and the regional, provincial and national context of the oil and gas industry in northeastern British Columbia. Mr. Marshall, a professional engineer, has been managing and conducting comprehensive and complex resource management projects that have included teams with diverse technical and scientific expertise within British Columbia, in northern Canada and internationally for over 30 years on a variety of topics. Some of this work stems from oil and gas reviews that have included assessments of human health risks.

"As Provincial Minister of Water, Land and Air Protection in 2002, I greatly appreciated the outstanding work of David Marshall and his FBC team in the work they did in the review of the proposed Drinking Water Protection Act. As a result of Mr. Marshall and the scientific panel's work, BC implemented the Drinking Water Protection Act and an innovative Drinking Water Action Plan for the province."

— Joyce Murray, Member of Parliament, Vancouver Quadra

"Thanks to the Fraser Basin Council for administering Natural Resources Canada's Regional Adaptation Collaborative (RAC) program in British Columbia, which ran from November 2009 to March 2012. The Council's expertise in bringing together multiple partners and stakeholders, and its experience in managing complex, multi-disciplinary initiatives was invaluable and assured the success of this initiative. RAC involved a collaboration of 23 organizations, including provincial government agencies, non-government organizations, universities, local governments and First Nations, working on complex issues including Water Allocation and Use, Forest and Watershed Management, Flood Protection and Floodplain Management and Community Adaptation. "

— Thomas White, A/ Executive Director, Climate Change Policy, Climate Action Secretariat

Solution and Approach

Given British Columbia's policy actions in the 1990s to stimulate the natural gas sector with the creation of the Oil and Gas Commission, investments in road infrastructure and reviews of royalty and tax regimes, it is timely to conduct a human health risk assessment of oil and gas activity in northeastern British Columbia. The Fraser Basin Council has an extensive track record of success in managing multi-disciplinary scientific and technical teams to address complex resource management projects and activities. It therefore has the experience and qualifications to carry out this project. The Council, a not-for-profit society incorporated in 1997, helps public, private and civil society interests work collaboratively to find solutions to complex sustainability issues throughout the Fraser River Basin, British Columbia and beyond. The Council welcomes this opportunity to submit its proposal in response to RFP No. HL173.

Following the 2002 BC Energy Plan, the Province of British Columbia introduced the Oil and Gas Development Strategy, a comprehensive program that included:

- royalty programs targeting specific resource opportunities (e.g., deep gas, marginal producing wells)
- significant investments in public roads supporting development and cost-sharing Petroleum Development Roads
- streamlined and harmonized regulations and
- actions to support and enhance the competitiveness of the local service sector to create economic and employment opportunities for British Columbians.

British Columbia has continued to augment its Oil and Gas Development Strategy with additional policies and programs announced through the 2007 BC Energy Plan. These enhance British Columbia's competitiveness for natural gas development. In addition to new royalty and infrastructure programs, the Province has put emphasis on enhancing relationships with local communities and First Nations, reducing greenhouse gas emissions and enhancing environmental protection.

The British Columbia Energy Plan specifically identifies recovery of unconventional resources, including shale gas, as being a provincial priority. The Province has recently undertaken a number of shale geological surveys. These studies were a key driver of recent subsurface rights sales activity – that is, oil and gas company geologists were able to review high quality geoscience that ultimately supported strategic corporate decisions to pursue shale gas in British Columbia.

Human health hazards could potentially emanate from oil and gas development, extraction and production methods, emergency events such as well blowouts and pipeline breaks, chemicals used in drilling and well simulation techniques, contaminants in drilling waste, air quality issues and offsite waste management, transportation and disposal activities, and land reclamation activities. The Council has the experience and the networks to identify and review the major areas of concern for impacts on human health.

This FBC proposal lays out an assessment approach that will be carried out by an outstanding team of highly accomplished experts who have the relevant background and expertise and a balance of oil and gas industry, public health and private and public consulting experience. The proposal includes an eight-activity work plan, a communications plan describing the extent and nature of targeted stakeholder engagement, a

project risk management strategy and a cost estimate.

The Council proposes a comprehensive human health risk assessment that will evaluate potential impacts on human health from oil and gas activities. It will cover incidents such as chronic spills, fluid and gas releases from flaring operations used in the clean-up and testing phase to get fracking liquids and sand out of a well, and increased road traffic. The methodology used for the human health risk assessment will be based on international best practices to assess human health risks and impacts on health via identified pathways, including frameworks used by Health Canada, the World Health Organization and the US Environmental Protection Agency and adapted for the unique circumstances of oil and gas development in northeastern BC.

Concurrent with this step will be a jurisdictional scan that will include the collection and review of past and current studies related to human health risk associated with oil and gas activity. Initially, information from jurisdictions in the United States, such as the federal government and relevant states, will be collected and reviewed, as well as from British Columbia, Alberta and the Government of Canada.

Exposure models for air, water, food and soil ingestion for general and sensitive populations (for example, infants/toddlers, women of childbearing age and Aboriginal peoples in northeastern BC) will be developed. Exposure to chemicals of concern as a result of current and projected oil and gas development will also be estimated.

A feature of the Fraser Basin Council proposal is a review of the BC statutory, regulatory and policy framework aimed at protecting the health of the population in northeastern British Columbia. It will include recommendations on the adequacy of current statutes, regulations and policies and will propose changes to these, if required, to improve long-term health outcomes in northeastern BC. This is important because there may be key policy or program changes that could significantly reduce human health risks, if present, and improve the overall health of the population. Recommendations will also be made on spatial data needed to better monitor local effects or health risks and help manage the health of the population in northeastern BC.

The FBC proposal also includes a stakeholder engagement process to enable relevant interests in northeastern BC to provide input and feedback on various scientific analyses and syntheses as they are prepared. Opportunities will be given to those interests to express their perspectives on specific human health risks related to oil and gas development in an open and transparent manner.

FBC's core competencies include effective project management of complex resource management issues. The Council has been conducting these types of activities since its inception in 1997. It has been involved in many contentious complex issues, such as Nechako Watershed enhancement in the aftermath of the cancelled Kemano Completion project, the rehabilitation of the former copper mine at Britannia Beach in Howe Sound, gravel management in the Lower Fraser River, collaborative approaches to controlling invasive plants, and many others.

The Fraser Basin Council does not advocate on behalf of any single organization, sector or stakeholder. Rather, the FBC's primary role is to be an impartial facilitator of collaboration among all interests. This attribute is best illustrated by the fact that, since 1997, the FBC's Board of Directors – which includes a broad diversity of government, private sector and civil society interests – makes all of its decisions by consensus, guided by an impartial Chair. Given the FBC's role and track record at fostering multi-interest collaboration, it can be trusted to manage multi-disciplinary reviews in a fair and impartial manner.

In addition to the Council's experience and networks, it has the capacity, infrastructure and track record to

prepare all deliverables required for Phase 2 on time and within budget. It is prepared to complete the project between October 1, 2012 and March 31, 2014.

In summary, because of the Council's unique collaborative governance structure, this proposal has a number of strengths. These include:

- an impartial approach to solving complex resource management issues and developing constructive solutions
- extensive links and associations with public and private sectors, universities and First Nations and,
- well-established experience in multi-disciplinary risk assessments.

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"As Chief of Soowahlie First Nation, I see the Fraser Basin Council providing a valuable role in the multi-stakeholder process to take care of our traditional watershed and Cultus Lake. The extensive efforts of the Council bring balance and consideration to a water problem that others thought was too complex or too expensive to address. The Council has brought forward the science, the critical information and built the community to help decision-makers join in a collaborative effort for a better future."

— Chief Otis Jasper, Soowahlie Indian Band

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"The Fraser Basin Council has successfully facilitated a constructive and respectful dialogue of over 25 community, government and private sector organizations, many with diverse views on the Nechako River Watershed. This dialogue allowed the diversity of interests to be heard, understood and explored in a respectful, calm and safe forum. This forum fostered a better understanding of the challenges that exist in this watershed and developed a consensus on the best way to take these interests into account in the management of the Watershed. From our perspective this reflects the role and success of the Fraser Basin Council in regard to the watershed."

— Richard Prokopanko, Rio Tinto Alcan – BC

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Project Management

The Council's Executive Director, David Marshall, will serve as Project Manager. He will be the primary point of contact and responsible for the successful delivery of services. He will participate in bi-weekly meetings via teleconference or in person at 1515 Blanshard Street in Victoria with Ministry of Health officials and their colleagues. Regular input to, and feedback from, the Ministry of Health is considered an important component of this assessment. Prior to each meeting, Mr. Marshall will provide bi-weekly progress reports two days prior to these meetings on progress of the project, timelines, issues, concerns, risks and on other matters related to the project.

Adriana Ruso, the Fraser Basin Council's Chief Financial Officer and a Certified General Accountant will serve as the financial and contract manager for the project. In this capacity, she will manage the project's budget, prepare regular financial reports, manage the contracts of outside consultants and prepare the financial section of the final report.

"We were very pleased to have David Marshall and the Fraser Basin Council assist us with the facilitation and preparation of a Discussion Paper on a proposed Northern Rockies Partnership consisting of the Northern Rockies Regional Municipality, Fort Nelson, First Nation communities, the oil and gas sector and the provincial government.

The assistance and guidance provided throughout the project by David and the Fraser Basin Council led to a very positive agreement between the Fort Nelson First Nation and the Northern Rockies Regional Municipality to work together for the long-term sustainable betterment of all people living and working within our region."

— Randy McLean, City Manager, Northern Rockies Regional Municipality

Project Team

Here is FBC's project team to carry out Phase 2 of the Human Health Risk Assessment.

A profile and business history of the Fraser Basin Council is set out in **Appendix A**.
Resumes and CVs of project team members are set out separately as **Appendix B**.

David Marshall
Project Manager

A professional engineer, David Marshall was appointed Executive Director of the Fraser Basin Council in May 1997, after serving in the same capacity since 1993 with the Council's predecessor organization, the Fraser Basin Management Board. In May 1998 he received the National River Conservation Award Of Merit for his outstanding contribution to river conservation in Canada by the Canadian Heritage Rivers System. In 2001-2002, Mr. Marshall chaired the Drinking Water Review Panel that included the review of over 250 submissions during a multi-stakeholder engagement process.

From 1980 until 1990, he was the Regional Director, Pacific, Western and Northern Region, of the Federal Environmental Assessment Review Office (FEARO), the predecessor organization to the Canadian Environmental Assessment Agency (CEAA) located in Vancouver, Canada. Mr. Marshall's main responsibility was the administration of the Canadian Environmental Assessment and Review Process (EARP) in British Columbia, Alberta, Yukon and the Northwest Territories. Included in these responsibilities was the management of the Beaufort Sea Oil and Gas Production Project, the most comprehensive public inquiry of offshore oil and gas development ever to take place in North America. In this capacity, he managed 30 scientific and technical experts contracted to provide specific expertise in all facets of oil and gas development and transportation. He also served as Project Co-Director for the West Coast Offshore Drilling Environmental Assessment in the 1980s where he was responsible for the management of the multi-disciplinary scientific experts that reviewed Chevron's environmental impact assessment. During this period, he conducted many environmental assessment and risk assessment processes of oil and gas development proposals in the Arctic, Alberta and British Columbia for which he received two separate merit awards for his exceptional and distinguished contribution to the effectiveness and efficiency of the Canadian Public Service.

From January through March of 2012, Mr. Marshall oversaw Phase 1 of the Human Health Risk Assessment on behalf of the Fraser Basin Council.

Dr. David Bowering
Area of Focus: Human Health Risk

Dr. David Bowering has had a distinguished medical service career in many parts of British Columbia, including northeastern BC, the North Okanagan and currently northwestern BC. His understanding of and familiarity with human health risk issues in northern BC and in rural areas of BC make him an extremely valuable member of the FBC team.

Dr. Laurie Chan
Area of Focus: Toxicology and Human Health Risk Assessment

Dr. Laurie Chan is a Professor and Canada Research Chair in Toxicology and Environmental Health at the University of Ottawa, and he brings extensive toxicology and human health risk assessment experience and expertise to the project. He is also the Director of the Center for Advanced Research in Environmental Genomics (CAREG). He was formerly the holder of Dr. Donald Rix B.C. Leadership Chair in Aboriginal Environmental Health and Professor at the School of Health Sciences at the University of Northern British Columbia from 2006 to 2011 and held one of the six NSERC Northern Research Chairs between 2002 and 2006 at McGill University. Prof. Chan's research in environmental and nutritional toxicology spans from the lab, developing new techniques for contaminant analysis, to participatory research in the community on the risk and benefits of traditional foods and impact of environmental change on food security. His research is supported by NSERC, CIHR, and various government departments. Prof. Chan was involved in the drafting of the 2nd edition of Tri-Council Human Research Ethics Guideline as well as the CIHR Guidelines for Health Research involving Aboriginal People. He is the Principal Investigator of two national projects on First Nations and Inuit food safety and environmental health. Prof. Chan has also served as an advisor for international and national governments and organizations and numerous Aboriginal communities on environmental health issues. Prof. Chan was selected as a Fellow by the Leopold Leadership Program of Stanford University in 2008 and served on a World Health Organization expert panel in 2010 on the benefits and risks of fish consumption. Prof. Chan has published over 140 scientific papers and supervised over 40 graduate students.

Rainer Hofmeister
Area of Focus: Oil and Gas Development

Rainer Hofmeister has more than 29 years in the oil and gas industry, providing operational, construction and health, safety, environment with risk management services for various Canadian oil and gas companies. His experience ranges from seismic, drilling, pipelines, facilities, and well-site construction in various projects throughout Canada, Europe, the Middle East and Africa. In 2001 Rainer formed HI Energy Consultants which provides Health Safety & Environmental consulting services nationally and internationally to the oil and gas industry. Rainer provided expertise to the BC Oil and Gas Commission, as a consultant, in the early development of the British Columbia Pipeline and Pipeline Facility Integrity management program that included the:

- consequences of oil and gas development and its direct relationship to human health risks, and
- health, environment and socio-economic impacts of oil and gas activity on humans, wildlife and effected geography.

He has resided in Victoria, Nanaimo and Fort St. John where he worked for the Ministry of Energy and Mines as a Transport Inspecting Engineer. In this capacity, his duties included the review and approval of applications for the design, construction, operation, maintenance and abandonment of wells, pipelines and pipeline facilities and the inspection of oil and gas activities to ensure compliance and providing enforcement. His duties also included the approval of oil and gas companies' emergency response and management programs; the assessment of risk management; and the inspection and approval of response and remediation following a spill of oil, gas or water into the environment.

Dr. Peter Jackson
Area of Focus: Air Quality Monitoring

Dr. Peter Jackson is a Professor at the University of Northern British Columbia in the department of environmental science and engineering. Dr. Jackson specializes in exposure to, and dispersion of, particulate matter pollution in the central interior of BC, including personal exposure of school children to PM 2.5 in Prince George, and on spatial distribution of wood smoke. His role on the scientific and traditional knowledge advisory panel of this project will be to focus on the identification of issues related to monitoring air quality pollutants in the atmosphere resulting from oil and gas development.

Steve Lonergan
Area of Focus: Risk Assessment Synthesis and Project Management

Dr. Steve Lonergan is a Professor Emeritus in the Department of Geography, University of Victoria, Victoria, BC, Canada. He holds a BSc from Duke University in Zoology and an MA and PhD from the University of Pennsylvania in Regional Science. From 2003-2005, he was Director of the Division of Early Warning and Assessment (DEWA) at the United Nations Environment Programme in Nairobi, Kenya. Dr. Lonergan's research focuses on water resources, environment and security, impact assessment, energy and economic development and economic/ecological modelling. He is the author of four books (two edited volumes) and has published widely on energy development, risk assessment and water resource issues. Dr. Lonergan has been a consultant to the Ontario Nuclear Safety Review, Esso Resources Canada, Shell Canada, Energy Mines and Resources Canada, the Ministry of Environment (Canada) and the Ontario Ministry of Energy and has served as associate director for the McMaster Institute for Energy Studies. He was also a member of the Editorial Board of the journal *Environment and Health* and the *Energy Studies Review*.

Dr. Asit Mazumder
Area of Focus: Water Quality

Dr. Asit Mazumder is a Professor and NSERC Senior Research Chair on Water at the University of Victoria. He is considered a world leader for his pioneering research integrating physical, chemical and biological processes determining the structure, function, and quality of aquatic ecosystems and the services they provide. He is best recognized for his research in quantifying and modelling how nutrients and food webs interact in determining responses of freshwater and marine ecosystems in terms of water quality, nutrient dynamics, food web structure, contaminant transport to fish, plant biodiversity and salmon productivity. He has published over 100 peer-reviewed papers in international journals, including some of the top journals in the field, such as *Science*, *Ecology, Limnology and Oceanography, Canadian Journal of Fisheries and Aquatic Sciences, Environmental Science* and *Technology and Environmental Health Perspectives*. He had been awarded the Chandler-Misener Award by the International Association for Great Lakes Research for the best scientific paper on the Great Lakes, and the Miller Institute Professorship for Basic Science at the University of California Berkeley. As a recognition of his research, he has been invited to serve in several important internationally recognized positions: editorial board member for three international journals, the director of the Laurentian Biological Station for ecological and environmental research, Secretary and Chair of meetings committees for the American Society of Limnology and Oceanography (ASLO), and members of grant selection committees for NSERC, NSF, FCAR and SCBC, and as member of the Research Management Committee for the Canadian Network of Centres of Excellence on Water.

Since 1999, Dr. Mazumder has been holding NSERC Senior Research Chair award on Environmental Management of Drinking Water, a collaborative and partnership research program integrating inter-disciplinary sciences and technologies for sustainable clean and healthy water and public health. As a part of this Research Chair program, he has been conducting research on how land use and climate variability affect chemical and microbial quality of water, and has developed several new technologies to track sources of chemical and microbial contaminants in surface and groundwater of both non-Aboriginal and Aboriginal communities in BC, several other provinces in Canada and several other countries.

Peter Ostergaard
Area of Focus: Energy

Peter Ostergaard will be the project's institutional advisor on BC's oil and gas regulations. Through most of the 1990s, he was the Assistant Deputy Minister responsible for British Columbia's oil and gas policies, resource management, rights dispositions and activity regulation, including drilling, production, intra-provincial pipelines and processing. He helped lay the groundwork for the creation of the Oil and Gas Commission, and the transition of the upstream activity regulatory framework from the Energy and Minerals Division to the Commission. In addition to his provincial government experience, his knowledge of northeastern BC oil and gas matters has been augmented by private sector consulting engagements, including environmental and social-economic assessments of major pipeline proposals and as a land use planning consultant to local governments in northeastern BC.

Mapmonsters GIS Inc.
Area of Focus: Geographic Information Systems

Mapmonsters GIS Inc. is a Victoria-based company started in October 2011 with the primary goal of delivering GIS support to natural resources professionals throughout British Columbia. Mapmonsters is a company of two GIS experts with 18 years of combined GIS experience. Its professional experience is entirely consulting driven. Modelling using GIS is the core of the Mapmonsters' business.

The company processes and analyzes GIS data to produce resultants and models that help its clients answer questions about their resources. Its Senior GIS Analyst is Brian J. Calder BSc., MGIS, RPBio. He holds a Bachelor of Science in Conservation Biology from the University of British Columbia, an ArcInfo Certificate from Okanagan University College, and a Masters Degree in GIS from the University of Calgary. Brian is also a Professional Biologist registered with the Association of Professional Biology.

Dr. Margot Parkes
Area of Focus: Health, Ecosystems and Society

Margot Parkes is a Canada Research Chair in Health, Ecosystems and Society at the University of Northern British Columbia (UNBC), with a cross-appointment in the School of Health Sciences, and the Northern Medical Program. Dr. Parkes' research focuses on impacts of ecosystem change on social determinants of health, and the design of research, education and governance options that address converging objectives at the interface of health, ecosystems and society. Her research on the combined health impacts of social and environmental change has developed from experience in a variety of contexts, including international work in New Zealand, Hawaii, Ecuador prior to coming to Canada. Since moving to northern BC in 2009, Dr. Parkes' research has engaged a range of groups interested in the

converging goals of healthy people, living in healthy communities and healthy environments, including watershed groups, First Nations, local and provincial government agencies, and interdisciplinary research colleagues at UNBC and beyond.

Dr. Parkes maintains an ongoing research focus on integrated watershed governance as a means to improve social and environmental determinants of health, developed through national and regional initiatives. These projects seek to better integrate an understanding of health impacts of social and environmental change by identifying, developing and refining tools and processes that facilitate inter-sectoral, cross-disciplinary and multi-stakeholder collaboration and learning. The projects have included workshops on "integrating spatially-referenced information" to meet social, environmental and health outcomes, as well as national and regional initiatives focused on governance options that foster synergies between watershed management and public health objectives. Dr. Parkes is co-lead of a pan-Canadian collaboration focused on education and policy efforts that link public health, ecosystem sustainability and social equity through ecosystem approaches to health (www.copeh-canada.org) and since 2010 has been President of the International Association for Ecology & Health (www.ecohealth.net).

Dr. Shaun Peck
Area of Focus: Human Health Statutes, Regulations and Policies

Dr. Peck served as BC's Deputy Health Officer from 1995-2004. In this capacity, he provided support to and acted on behalf of the Provincial Health Officer, which included advising the Minister of Health in an independent manner on health issues in BC and the need for legislation, policies and practices respecting these issues. He also established professional standards for Medical Health Officers and assisted these officers with the interpretation of public health legislation.

He was influential in the development of the *Drinking Water Protection Act* and Regulations in 2002 and the new BC *Public Health Act*. He taught a course on risk assessment and risk communication as part of the University of Victoria's Continuing Education Program.

His knowledge of current public health legislation will be a strong asset in the jurisdictional scan, and his extensive experience with human heath risk assessment will ensure a thorough human health risk assessment of oil and gas activity in northeastern BC.

John Talbot
Area of Focus: Multi-Stakeholder Engagement

As principal of John Talbot & Associates Inc., John Talbot has acted as a project co-coordinator for hundreds of projects in British Columbia and has steered many community planning and stakeholder processes through controversial issues of growth and change, linking social, environmental and economic factors en route to organizational and community consensus. Mr. Talbot has also assisted a large number of community, governmental and non-profit organizations, as well as private companies, to overcome obstacles to effective functioning. He has facilitated hundreds of seminars and workshops on a range of subjects, including teamwork, communication, leadership development, organizational growth and change, problem-solving and decision-making, opportunity analysis and planning.

Carmine Vertone
Area of Focus: Oil and Gas Regulatory Review

A graduate with honour from the University of Tulsa in Chemical Engineering, Carmine Vertone has over 35 years of experience working for the BC government and industry as an engineer involved in all aspects of development of oil and gas resources in BC, from subsurface to market. Mr. Vertone's knowledge in petroleum/chemical engineering, economics models, risk analysis, regulatory and environmental issues resulted in the development of fiscal regimes and policies that has made BC one of the most competitive jurisdictions in development of gas and oil resources with consideration of environmental and regulatory factors. His knowledge of emission sources in BC has made him a valuable resource to the Province of BC and the Pacific Carbon Trust. He was involved in such projects as: the national inventory to set an emission baseline, the potential for and economics of carbon sequestering in BC, carbon tax, utilization of existing databases to quantify greenhouse gas at a facility and equipment level, facilities and equipment cost, acid gas injection development, policies for setbacks and emergency response plans (plume models). In addition, Mr. Vertone has knowledge of the regulations in Alberta, Saskatchewan, Quebec, the Atlantic provinces and the USA. He has worked on unconventional and conventional resources as a reservoir engineer for industry. He has helped develop some of the fiscal regimes and policy for the Government of Quebec for the Utica shale gas and conventional resources.

Gilles Wendling
Area of Focus: Hydrology

Gilles Wendling, a professional engineer, has over 25 years' experience in hydrogeology and water management. Through his studies, research and years in consulting, he has gained a thorough understanding of the multiple aspects of water source assessment, protection and water management.

Mr. Wendling has completed his research on the development of water wells and is very knowledgeable about well design and construction, and well and aquifer interactions. He is focusing his work on aquifers at the watershed scale, with a particular focus on groundwater and surface water interaction.

He is now involved (2012-2013) with two projects in northeastern BC, focusing on the interaction between the deep bedrock aquifers used by the oil and gas industry and the shallow aquifers used as sources of potable water which are also closely connected to surface water features (streams, lakes and wetlands). The first project (with the City of Dawson Creek) consists of characterizing how the oil and gas activities in the Kiskatinaw River watershed may modify the groundwater regime and, as a result, may affect both the quantity and quality of the City of Dawson Creek drinking water source. The second project is taking place in the Fort St. John and Hudson's Hope area and consists of assessing the potential effects of both hydraulic fracturing and the deep injection of industry wastewater on shallow aquifers used for agricultural activities and for potable water sources.

Mr. Wendling is also working in collaboration with the University of Quebec in Chicoutimi (UQAC) developing numerical models to simulate the long-term modification of the groundwater flow between shallow and deep aquifers due to drilling (with the creation of pathways due to poorly constructed or aging oil and gas wells) and the cumulative effect resulting from the large number of drilled wells.

He has completed the Regional District of Nanaimo (RDN) Electoral Area A Groundwater Assessment and Vulnerability Study (2009) in partnership with Vancouver Island University (VIU). He was part of the

team leading the consultation effort, which resulted in the Action for Water, the RDN's proposed 10-year plan for protecting regional water resources and improving understanding of RDN's watersheds. Dr. Wendling is a member of the RDN Drinking Water and Watershed Protection Advisory Committee.

He is working (2009-present) with the Mid Vancouver Island Habitat Enhancement Society (MVIHES) to define the interconnection between both the overburden (e.g., sand and gravel) and the bedrock aquifers and the Englishman River, near Parksville, on Vancouver Island. Aquifer monitoring is ongoing. The work has been presented in a series of presentations (now posted online via YouTube).

He is a contributing author to *Groundwater Resources in Canada* (in the section dealing with groundwater sustainability), a technical book on groundwater in Canada to be published by NRCan in 2012.

Mr. Wendling has worked in France, Sweden, Switzerland, Libya, Mauritania, Mali, Indonesia, and Canada. He has volunteered in Tanzania. He has also started a foundation (Global Aquifer Development Foundation) to establish partnerships with developing countries and to provide them with training, capacity and systems to characterize, understand and manage their groundwater resources in a sustainable way.

Brian Wilkes
Areas of Focus: Scientific Analysis and Project Management

Brian Wilkes is an experienced project manager with over 35 years of successful project work in both the public and private sectors. He has a Master in Environmental Studies degree from York University and is a Professional Biologist registered with the College of Applied Biology of BC. Mr. Wilkes brings several skills to the project team. He has a deep technical background in water quality and aquatic sciences. As a former Director at the Canadian Council of Ministers of the Environment, he participated in numerous issue and policy scanning projects aimed at understanding and analyzing the policy environment around specific sets of issues. He has led or participated in several significant program and policy reviews, including developing an adaptive service delivery strategy for the BC Ministry of Environment, and assessing the effectiveness of intergovernmental cooperation agreements in various national councils. He is a specialist in reviewing regulatory and policy frameworks and developing new policy alternatives. He is very experienced in working in and leading teams of specialists, and coordinating their inputs. His consulting practice has public and private sector clients, including major private land developers and the BC Ministry of Environment. His latest work with the Fraser Basin Council was coordinating an initiative on collaborative watershed governance from 2008-2010. His role in the project will be to act as a team leader for work plan components 3, 5 and 6 and team member for the others.

Jessica Hawkins
Area of Focus: Research

With 10 years of experience as a project manager, planner and community coordinator, Jessica Hawkins is proficient at organizing, designing and implementing planning processes for rural and First Nation communities. She is an excellent researcher and effective writer of proposals, reports, feasibility studies and business plans. Ms. Hawkins has served as Co-Manager of the Fraser Salmon and Watersheds Program for the Fraser Basin Council. She also worked as a researcher and writer for Phase 1 of the Human Health Risk Assessment.

Bob Purdy
Area of Focus: Stakeholder Engagement

Bob Purdy is FBC's Director of External Relations and Corporate Development. He brings to this project an academic background in life sciences, extensive experience in public/stakeholder engagement process design and facilitation, and over 15 years' experience in business as a senior executive in the high technology industry. Prior to joining FBC, Mr. Purdy was Vice President, Sales and Marketing, ESSA Technologies Ltd, a Vancouver-based environmental consulting firm and provider of GIS-enabled expert systems for environmental impact assessment.

Since joining the FBC in 1999, Mr. Purdy has designed, convened and facilitated a broad variety of stakeholder engagement and conflict resolution processes, including: engagement of BC's mining sector to advance progress on sector-led climate risk assessment and management efforts; ensuring the continued operation of the Fraser River debris trap through multi-stakeholder engagement, business case development and the securing of over $600K per year in operational funding; facilitation of sustainable economic development strategies and inter-jurisdictional collaboration for First Nations; enhancing multi-interest collaboration on independent power project planning and development; bringing multiple stakeholders together to advance sustainable community planning in Metro Vancouver; development of a concept plan for oceanfront lands in Squamish through broad community engagement and intensive design charettes; and facilitation of public consultation on a proposed solution to metals contamination at the site of the former Britannia Mine.

Adriana Ruso
Area of Focus: Project Financial Management

Adriana Ruso, B.Sc., CGA, MBA is the Chief Financial Officer at Fraser Basin Council where she oversees finance and administration. Previously, Ms. Ruso held various finance and executive roles at Ecotrust Canada (an NGO), Simon Fraser University and Telus Communications Inc. Throughout her career, she has had the opportunity to lead or participate in strategic initiatives that have benefitted from her exceptional analytical and problem-solving abilities, negotiations techniques and leadership skills. Adriana applies her engineering and accounting/financial backgrounds to bring rigour and professionalism to her work.

Denise Palmer Hoskins
Area of Focus: Communications

Ms. Hoskins is Communications Manager for the Fraser Basin Council, responsible for planning and delivering communications programs for multiple audiences. She offers advice and support on initiatives ranging from climate change mitigation and adaptation to sustainable purchasing, and she is experienced in producing web and electronic communications, presentations, internal and external briefings, publications, speeches, media materials and events. After completing the Programme d'études françaises et québecoises (Université Lavel) and the Paralegal Studies program (Capilano University), Ms. Hoskins worked for several years as a legal and policy researcher and writer. Before joining the Fraser Basin Council, she served for over 10 years as the Law Society of BC's Member Communications Manager, responsible for communications with over 10,000 BC lawyers and articled students and others in the legal community. She believes in respectful, inclusive two-way communications with all people, the need to creatively tailor communications to connect with different

interests, and the importance of earning public trust. Ms. Hoskins was Communications Manager for Phase 1 of the Human Health Risk Assessment.

Jennifer Nichols
Area of Focus: Communications

Jennifer Nichols develops the Fraser Basin Council's Smart Planning for Communities' (SPC) education, outreach and communication initiatives including e-learning production, webinar support and crafting SPCs Stories in the Field. Jennifer provides graphic recording support at events and facilitates collaborative tools for FBC staff and partners. She manages content about municipal climate action for the BC Climate Action Toolkit: toolkit.bc.ca. In past roles, Jennifer has worked with the City of Vancouver Sustainability Group, a zero waste project in northern BC and several publishing houses in Canada and the UK. Jennifer has completed degrees in Communication Design and Strategic Leadership towards Sustainability.

Yvonne Nichols
Area of Focus: Administration

Yvonne Nichols organizes the day-to-day operations of the Fraser Basin Council head office while supporting the finance, governance and executive team, as well as the Board of Directors. With over 10 years of office administration and five years of office management experience, she has successfully developed and maintained detailed administrative and procedural processes to achieve organizational goals within time and budget requirements.

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"As Vice President of Sustainability for the Vancouver Organizing Committee for the 2010 Olympic Games I worked closely with David Marshall in his capacity as Chair of the VANOC Board Advisory Committee on Sustainability Performance (2007 – 2010). This independent multi-stakeholder advisory committee was made up representatives from sectors with an interest in the sustainability aspect of the Games, including business, government, First Nations, labour, local communities and environmental and social non-government organizations (NGOs). The perspectives were diverse, the issues complex and frequently controversial. David did an excellent job of facilitating understanding, discussion and problem-solving between the Organizing Committee and its key stakeholders in ways that ultimately strengthened the sustainability outcomes and legacies from the Vancouver Games."

— Linda Coady, Former Vice President of Sustainability, VANOC

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Work Plan

The following work plan consists of eight key activities with specific tasks identified to complete each activity, the team member(s) responsible for completing each activity, and the time expected to complete it. The general approach will be to work in teams on the eight key activity areas, with a view to producing the specific deliverables identified in the RFP. The approach and method will consist of groups of experts forming teams for each activity, each with an identified team leader. As team members will be located in different geographic locations, electronic communications tools and web-based approaches will be used to collaborate and assemble research, data, draft reports and review comments. Overall coordination will be by the Project Manager and a few key team leaders. The Ministry of Health will be kept informed at each stage in the project.

For the purposes of work planning, the 18 months of the project have been divided into six three-month quarters. These are: Q1: October-December 2012; Q2: January-March 2013; Q3: April-June 2012; Q4: July-September 2013; Q5: October-December 2013; Q6: January-March 2014. It is intended that Q6 will be dedicated to preparation, review and editing of the final report, leaving five quarters available for developing and completing the other deliverables identified in the RFP.

Work Plan Activities

1.0 Project Launch and Communications

This first set of activities is focused on getting the project going and running smoothly. It is extremely important to get started on the right track. The proposal involves a large team of experts, each with focused tasks. Effective coordination of team members will be key. Activities related to this main task include:

1.1 Arrange a start-up meeting with the Ministry of Health to review the Work Plan, Budget and Communications Plan, confirm the work schedule, and address administrative matters. Q1: DM – 4, AR - 2

1.2 Initiate meetings with key team members to ensure that their specific tasks and the timing of these tasks are clear. Q1: DM - 6

1.3 Activate and implement the Communications Plan. Estimated timeframe: Q1-Q6. DM – 10, BP – 4, JT – 2, DH – 73, JN – 5

Team Leader: David Marshall (DM). **Team Members:** Adriana Ruso (AR), Denise Hoskins (DH), John Talbot (JT), Jen Nichols (JN), Bob Purdy (BP).

2.0 Human Health Risk Assessment Framework

In concert with the identification of environmental pathways of exposure and the jurisdictional scan, this activity will develop and describe, with supporting rationale, the human health risk assessment framework, including the methodology and procedures for carrying out the human health risk assessment. The development of the framework will draw on international best practices to assess human health risks and impacts on health via identified pathways, including relevant work done by agencies and organizations that have had success with specific methodologies, such as Health Canada, the BC Ministry of Health, the US Environmental Protection Agency and the World Health Organization. This component will include the following tasks:

2.1 Review successful human health risk assessment methodologies. Estimated timeframe: Q1. SL – 3, LC – 4, DB – 2, JH - 10

2.2 Develop the draft human health risk assessment methodology and framework. Estimated timeframe: Q2. SL – 3, LC – 6, DB – 2, MP – 4, Mapmonsters – 2, JH – 6

2.3 Send draft to the Ministry of Health for comment, and discuss with local stakeholders, First Nations and local governments the adequacy of the approach and related issues. Estimated timeframe: Q2-3. See Task 7.4

2.4 Obtain approval from the Ministry of Health on the draft framework, then finalize and prepare to implement the risk assessment methodology. Estimated timeframe: Q2-3. SL – 2, DM – 2

2.5 Prepare a report on the development of the human health risk assessment methodology and framework. Estimated timeframe: Q3. SL – 4, LC – 6, DB – 1, DH – 4, JH – 6

Team Leader: Steve Lonergan (SL). **Team Members:** David Marshall (DM), Laurie Chan (LC), David Bowering (DB), Margot Parkes (MP), Mapmonsters, Denise Hoskins (DH), Jessica Hawkins (JH), Margot Parkes (MP).

3.0 Jurisdictional Scan of Human Health Risk from Oil and Gas Activity

This activity will include a collection and review of past and current studies related to human health risk associated with oil and gas activity. The purpose of a scan is to try to understand the breadth of information available. Initially, information from jurisdictions in the United States, such as the federal government and relevant states, will be collected and reviewed, as well as from British Columbia, Alberta and Government of Canada. For example, the BC Ministry of Energy and Mines, Ministry of Environment and Oil and Gas Commission have maps and data that provide gas analysis and production for each well, facility type and location, along with throughput and releases, incident reports, considerable data on flaring and other data to identify areas of greater hazard and risk. This data can be used, for example, to show the amount of nitric oxide emissions from compressors as the location hours of run time and horsepower are provided.

This review will lead to other information sources, which will be examined if they appear to be relevant. The review will draw out the common elements and features, as well as the key differences among jurisdictions, and the reasons for those differences. Finally, the scan will compare the common elements and gaps in the BC approach when comparisons can be made. It will result in a report that will also help inform the assessment of human health risk and impacts on health via identified pathways of Phase 2. It will include the following tasks:

3.1 Develop terms of reference for the jurisdictional scan. Estimated timeframe: Q1. DM – 1, BW – 2, SP – 1, CV – 1, PO – 1

3.2 Research available literature. Estimated timeframe: Q1. BW -3, SP-1, JH – 10

3.3 Review reports from federal, provincial and other agencies. Estimated timeframe: Q2. BW – 4, CV – 2, SP – 2, JH – 10

3.4 Conduct meetings or telephone interviews with federal and provincial (BC and Alberta) officials to review their respective jurisdictional circumstances. Estimated timeframe: Q2. BW – 4, CV – 2, PO – 2, JH – 4

3.5 Prepare the jurisdictional scan report and bibliography. Estimated timeframe: Q2-Q3. BW – 4, DM – 2, SP – 2, PO – 2, CV – 2, DH – 4, JH – 6

Team Leader: Brian Wilkes (BW). **Team Members:** Peter Osterguaard (PO), Shaun Peck (SP), Denise Hoskins (DH), Jessica Hawkins (JH) and Carmine Vertone (CV).

4.0 Human Health Risk Assessment

Human health risk assessment is a process used to estimate the nature and probability of adverse health effects in humans who may be exposed to chemicals and other deleterious substances in contaminated environmental media.

This Human Health Risk Assessment project focuses on health effects arising from oil and gas activities in northeastern BC, now and in the future. Work plan Activity 4 will implement the framework developed in Activity 2: to identify the environmental pathways of exposure (air quality, water quality and quantity, land and food quality) to chemicals of concern; impacts on health via identified pathways, including from incidents, fluid releases, increased traffic and other factors stemming from oil and gas development in northeastern BC. The focus will be on local health areas 59, 60 and 81. This component will incorporate all the information from Work Plan Activities 2-3 into the human health risk assessment and will include the following tasks and activities. This component will include specific reports and will inform the human health risk assessment. It will include the following tasks:

4.1 Identify environmental pathways of exposure to chemicals of concern from the HHRA Phase 1 report, identify potential impacts on human health via identified pathways, and gather evidence from available literature and from relevant provincial and federal government reports. Estimated timeframe: Q1. DM – 2, BW – 2, SL – 2, JH – 10, Mapmonsters – 4

4.2 Research available literature and information from government and the oil and gas sector for information on impacts on health via identified pathways, including from incidents, fluid releases and increased traffic. Estimated timeframe: Q1. SL – 4, RH – 6, JH - 10

4.3 Scan and assess the institutional framework in British Columbia and Alberta with respect to oil and gas activities, and conduct a scan on all proposed oil and gas projects planned for the area. Estimated timeframe: Q1. BW – 3, SL – 2, CV – 3, JH – 6

4.4 Conduct and document a scientific analysis of each pathway of exposure. Estimated timeframe: Q1 – Q3. BW – 2, PJ- 8, AM – 8, LC – 8, GW – 8, DB – 4, DH – 8, JH – 16

4.5 Estimate the exposure to chemicals of concern and other deleterious substances via each pathway of exposure (i.e., air quality, water quality, water quantity, land and food quality) for the current and projected oil and gas developments in the area. Estimated timeframe: Q2. BW – 4, PJ- 2, AM – 2, LC – 2, GW – 2

4.6 Develop exposure models for air, water, food, soil ingestion for general and sensitive populations (for example, infants, toddlers, women of childbearing age, and Aboriginal peoples) in the local health areas. Estimated timeframe: Q3-4. LC – 7, PJ – 7, AM – 7, Mapmonsters – 4

4.7 Assess and document the extent and nature of potential impacts on health via identified pathways, including from incidents, fluid releases and increased traffic on human health. Estimated timeframe: Q1- Q3. SL – 8, MP – 6, DH – 4, JH – 10

4.8 Prepare a report on the application of the human health risk assessment methodology and framework. Q5. SL – 10, BW – 4, LC – 5, DH – 4, JH – 10

Team Leader: Steve Lonergan (SL). **Team Members:** David Marshall (DM), Brian Wilkes (BW), Laurie Chan (LC), David Bowering (DB), Peter Jackson PJ), Rainer Hofmeister (RH), Asit Mazumder (AM), Denise Hoskins (DH), Margot Parkes (MP), Shaun Peck (SP), Jessica Hawkins (JH), Mapmonsters, Gilles Wendling (GW).

5.0 BC Statutory, Regulatory and Policy Frameworks

The purpose of this work plan activity is to review the statutory, regulatory and policy frameworks aimed at protecting the health of the population in northeastern British Columbia and, where appropriate, develop recommendations that will improve long-term health outcomes in that region. Initially, this will include a review of legislation and policy as it relates to the key findings of the Human Health Risk Assessment – Phase 1 report, except for those elements from Phase 1 that are out of scope for Phase 2. As information is obtained in the risk assessment, additional review will be conducted. It will include the following tasks:

5.1 Identify the statutory, regulatory and policy and program initiatives. Estimated timeframe: Q1-Q4. DM – 4, BW – 4, CV – 3, RH – 2, PO – 2, JH – 10

5.2 Review the statutory, regulatory and policy frameworks and make recommendations on:

- adequacy of current statutes, regulations and policies
- gap analysis and
- proposed changes to current statutes, regulations and policies that will improve long-term health outcomes in northeastern BC. Estimated timeframe: Q2-Q4. DM – 4, BW – 6, SP – 10, CV – 8, RH – 8, PO – 3, DB – 4, JH - 10

Team Leader: David Marshall (DM). **Team Members:** Brian Wilkes (BW), Shaun Peck (SP), David Bowering (DB), Carmine Vertone (CV), Rainer Hofmeister (RH), Peter Ostergaard (PO), Jessica Hawkins (JH).

6.0 Spatial Data and Mapping Tools

This activity will focus on the development of recommendations on relevant spatial data and mapping tools to improve current efforts to monitor and manage the health of the population in northeastern BC, including identification of vulnerable and potentially affected populations within the Northern Rockies and Peace Regions. It will include the following tasks:

6.1 Review relevant existing Geographic Information System (GIS) datasets for northeastern BC and elsewhere respecting oil and gas development to determine what types of GIS data (spatial data) could be collected and what additional data needs to be collected. Estimated timeframe: Q3-Q-4. BW – 4, Mapmonsters – 6

6.2 Review current efforts to monitor, map and manage population health in northeastern BC. Estimated timeframe: Q3-Q-4. BW – 4, LC – 6, SP – 3, AM – 3, PJ – 3, DB – 3, MP – 2, JH – 3

6.3 Prepare a report that includes recommendations on spatial data and mapping approaches required to improve monitoring and health management. Estimated timeframe: Q5. BW – 4, Mapmonsters – 8, DH – 4, JH – 3

Team Leader: Brian Wilkes (BW). **Team Members:** Laurie Chan (LC), Peter Jackson (PJ), Asit Mazumder (AM), David Bowering (DB), Shaun Peck (SP), Margot Parkes (MP), Denise Hoskins (DH), Mapmonsters, Jessica Hawkins.

7.0 Key Stakeholders Engagement

This activity will include the tasks associated with informing and interacting with relevant stakeholders in northeastern BC who have expressed a strong interest in Phase 2 throughout Phase 1. It is proposed that a Community Advisory Group (CAG) will be established to provide feedback and input at critical stages of the human health risk assessment. This will include opportunities to review various reports: such as on the jurisdictional scan, the environmental pathways of exposure, the nature of potential impacts on human health and the human health risk assessment framework and methodology. Terms of reference for the CAG will be developed early in the project and reviewed with the Ministry of Health. They will include a section that describes the role and work of the CAG. It is expected that the CAG will be representative of the various relevant government, private sector, non-government and First Nations interests in northeastern BC.

This activity will include a report at project completion summarizing the extent and nature of the stakeholder engagement. It will include the following tasks.

7.1 Review the list of people and organizations, including First Nations communities, that participated in HHRA Phase 1. (Appendix 8.3 of the HHRA Phase 1 Report). Estimated timeframe: Q1. DM – 2, BP – 2

7.2 Develop terms of reference and establish a Community Advisory Group to enable ongoing stakeholder engagement and feedback throughout Phase 2. Estimated timeframe: Q1. DM – 4, JT – 2, BP – 2

7.3 Review final Work Plan and Communications Plan with the CAG. Estimated timeframe: Q1 DM – 3, JT – 3, BP – 2, DH – 3

7.4 Seek input from the CAG and other specific stakeholders or interests on the human health risk

assessment framework and methodology. Estimated timeframe: Q2. DM – 6, SL – 2, JT – 2

7.5 Seek input from the CAG and other specific stakeholders or interests on environmental pathways of exposure and on the extent and nature of potential impacts on health via identified pathways such as from incidents, fluid releases and increased traffic on human health. Estimated timeframe: Q2. DM – 6, SL – 3, MP – 4, RH – 4, JT - 2

7.6 Seek input from the CAG and other specific stakeholders or interests on the scientific analysis of each environmental pathway of exposure. Estimated timeframe: Q3-Q4. DM – 6, BW – 6, JT – 1

7.7 Seek input from the CAG and other specific stakeholders or interests on the assessment of the potential impacts on human health, such as from incidents, fluid releases and increased traffic. Estimated timeframe: Q3-Q4. DM – 6, MP – 4, SL – 3, RH – 6, JT - 1

7.8 Seek input from the CAG on the human health risk assessment. Estimated timeframe: Q4-Q5. DM – 6, SL – 4, LC – 6, JT – 2

7.9 Document the extent and nature of the multi-stakeholder engagement process. Estimated timeframe: Q6. DM – 4, BP – 2, DH - 6

Team Leader: David Marshall. **Team Members:** Brian Wilkes (BW), Steve Lonergan (SL), Laurie Chan (LC), Rainer Hofmeister (RH), John Talbot (JT), Bob Purdy (RP), Denise Hoskins (DH), Margot Parkes (MP).

8.0 Project Management and Administration

This activity will include the overall management and administration of the project as well as the development and completion of the final report for the Ministry of Health.

8.1 Oversee implementation of the project. Estimated timeframe: Q1-Q6. DM – 26, AR – 34, YN - 30

8.2 Complete final report and submit it to the Ministry of Health. Estimated timeframe: Q6. DM – 6, BP – 8, AR – 4, YN - 6

Team Leader: David Marshall (DM). Team Members: Adriana Ruso (AR), Bob Purdy (BP), Yvonne Nichols (YN).

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"As Chair of the provincial Living Rivers Trust Fund, I'm pleased by the progress made by the Fraser Basin Council and Pacific Salmon Foundation in co-managing the Fraser Salmon and Watersheds Program (FSWP) these past six years. Between 2006 and 2012, the program invested $13.6 million in over 300 projects across the Fraser Basin – with a focus on watershed planning and governance, habitat restoration and stewardship, sustainable fisheries management, and education and engagement. It's gratifying to see the science advance, partnerships grow stronger, and commitments deepen on issues so critical to the future of BC's watersheds and water resources."

— John Woodward, Chair, Living Rivers Trust Fund

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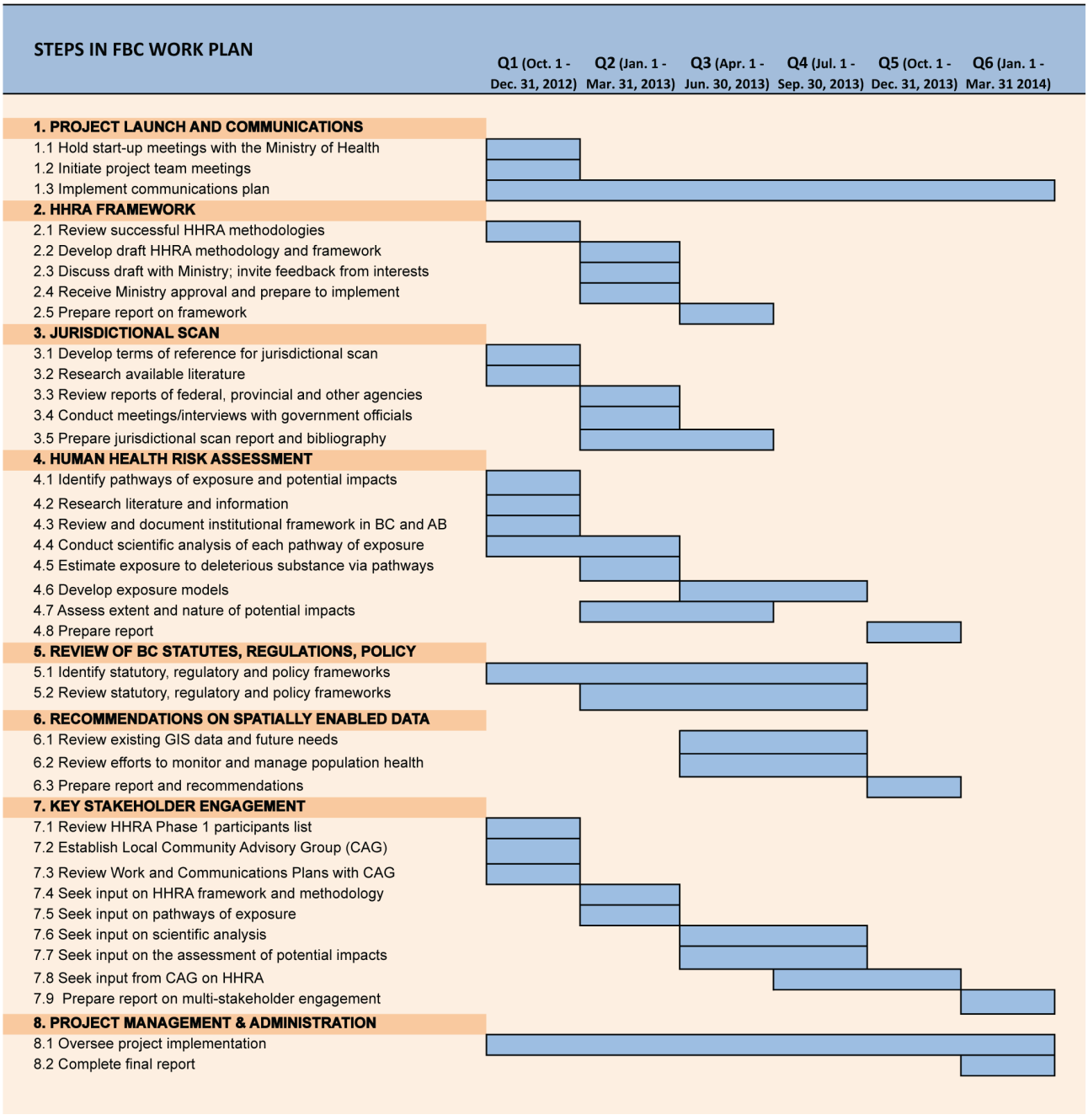
Work Plan Timeline and Milestones

Below is a chart summarizing the major work plan components and timeline for completion.



Communications Plan

Introduction

This communications plan describes a framework for outreach to key audiences in Phase 2 of Human Health Risk Assessment (HHRA) of Northeastern British Columbia Oil and Gas Activity. The aim is to create awareness and understanding of Phase 2 among these audiences by raising the profile of the project, offering key progress reports, and opportunities for engagement.

This is a preliminary communications plan that will be finalized alongside the work plan, in coordination with the Ministry of Health and the Human Health Risk Assessment project team of the Fraser Basin Council (FBC), and with feedback from a Community Advisory Group (CAG).

The timeline for the communications plan is that of the Phase 1 work plan, running October 2012 to March 2014 and broken into six time periods:

- Q1 (October-December, 2012)
- Q2 (January-March, 2013)
- Q3 (April-June, 2013)
- Q4 (July-September, 2013)
- Q5 (October-December, 2013)
- Q6 (January-March, 2014).

Communications Goals

The goals of this communications plan are to:

- Build awareness and understanding among key audiences for the Human Health Risk Assessment (HHRA) project — and particularly the work in Phase 2
- Support the HHRA project team in reaching audiences critical to the work of Phase 2
- Support good communications practices with all audiences and within the project team itself.

Key Audiences

External Audiences

For the purposes of carrying out the project, the following may be considered priority or key audiences:

- Individuals and organizations across northeastern BC and beyond (including those people who participated in Phase 1) who have a particular interest in the issues explored in the Human Health Risk Assessment or wish to track its progress.

(Phase 1 participants includes representatives of all orders of government (federal, provincial, local and First Nations), citizens groups, oil and gas industry, health care professions, educational institutions, environmental groups, labour, and other organizations.)

- Scientists, researchers, regulators and subject matter experts who can offer the project team information, expertise and assistance relevant to the health risk assessment framework
- Individuals and organizations that have specific information, experiences or contacts relevant to the assessment
- A new Community Advisory Group (CAG) that can offer feedback to the project team on process and specific issues defined in the work plan
- Media of communication that serve as a conduit and information source to one or more of these audiences.

Internal Audiences

The Ministry of Health is the primary point of contact for the project team, and a schedule of meetings is referenced in the work plan to ensure all aspects of the project proceed as expected. Audio-conference meetings with the Ministry may be enhanced by a web conferencing option when on-screen visuals are helpful to the discussions. As well, the project manager and other team members will be available to the Ministry by email and telephone for updates, briefings and consultations between meetings as needed.

Members of the project team form a separate internal audience with specific needs for regular internal communication. The project manager and other senior members of the team will organize regular meetings by audio-conference or web-conference, as needed, and will regularly make use of online collaboration tools: see section 2.4 of this Communications Plan, which follows.

Overall Approach

To support increased awareness and understanding of Phase 2 among key audiences, all project communications should reflect the following:

- Clarity, transparency and accuracy about the Human Health Risk Assessment, including its scope, processes, issues, methodology, milestones and outcomes
- Updates that are timely, accessible, respectful and relevant to multiple audiences
- Protection of confidentiality and privacy of personal information received during the process.

Communications Activities

1.0 Finalize the Communications Plan

1.1 Review this draft communications plan (including list of audiences, communications activities and timeline) with the project team and the Ministry of Health, and make adjustments as needed to support the final work plan. (Q1)

1.2 Seek feedback on the communications plan from the Community Advisory Group. (Q1)

1.3 Finalize the communications plan in coordination with Ministry of Health, and subject to modifications that may be needed later in the project. (Q1)

1.4 Submit a wrap-up communications report to the project team and Ministry of Health at the end of the project. (on completion of Q6).

2.0 Create Communications Support Tools

2.1 Create an HHRA – Phase 2 briefing paper (2-4 pages) for use in electronic and print form to describe the project, project team, work plan, timeline, milestones, outputs and opportunities for engagement. This piece will highlight the project website. It will be suitable for multiple audiences and will support the project team in external communications. (Q1)

2.2 Create guidelines for visual consistency in all external communications about the Human Health Risk Assessment, Phase 2. It is recommended that these be similar to those used in Phase 1, for cost-efficiency and recognition. (Q1)

2.3 Prepare a report template to assist project team with preparation of reports for external publication. (Q2)

2.4 Canvass and recommend online tools (such as Blackboard Collaborate and Base Camp) to support the project team, including options for: online project management, document management and sharing, group calendars, and audio and videoconferencing. Tools will be evaluated and chosen on the basis of ease of use, work efficiency, cost efficiency and security of team communications. (Q1)

2.5 Create an HHRA 1-800 telephone message, documenting information on the process and the opportunity to leave comments for the project team. This line will be managed by administrative support for the team.

3.0 Define Opportunities for Engagement

Experts on Issues under Review

3.1 Project team members will make direct contact with other scientists, researchers, experts and other individuals and organizations relevant to their work in Phase 2 in the course of the jurisdictional scan, assessment framework and assessment process.

These communications will be further described and budgeted in the final work plan and assessment framework. (Q1-Q6)

Community Advisory Group

3.2 As referenced in the work plan, a Community Advisory Group will be invited to offer feedback to the project team, which may include in-person or online meetings, on:

- The Work Plan and Communications Plan (Q1)
- Issues or documents offered for comment by the project team. (Q1-Q6)

Other Audiences

3.3 The Fraser Basin Council will invite key audiences to:

- Learn about the project by visiting the project website and/or subscribing to updates (Q1-Q2)
- Engage further by providing: (Q1-Q4)
  - suggestions on expert contacts, research data or resources relevant to the assessment
  - comments on the draft assessment framework and methodology and other documents available for comment
  - experiences or feedback relevant to the issues in the assessment.

These opportunities will be refined in consultation with the project team and the Ministry of Health. Invitations will be made via the communications vehicles outlined in this plan.

The FBC project team will invite comments by email, web form and toll-free message line and will make opportunities for one-on-one telephone or in-person meetings as needed.

4.0 Launch Project Website

4.1 Create an interactive website to inform and engage key audiences on the Human Health Risk Assessment. (Q1)

4.2 Create web content that covers: (Q1-Q3)

- Background on the HHRA
- Synopsis of issues under review
- Timelines and outcomes
- Project team members and key contacts
- Project reports for public release

- Opportunities for engagement.

4.3 Post web updates as needed (estimated 20-30) on news, events, activities, newly published documents, and progress on assessment (Q2-Q6)

4.4 Offer a web form for online submission of comments. (See section 3.0 above: Opportunities for Engagement).(Q2)

5.0 Finalize and Publish Project Reports

5.1 In consultation with the Ministry of Health, publish on the HHRA website the project team reports and other key documents as these are ready and approved for publication (Q1-Q6). There will be reports on the following:

- Identification/validation of environmental pathways of exposure relating to oil and gas activity (Q1)
- Terms of reference for specific scientific analysis of pathways of exposure (Q1-Q3)
- Reports on analysis of each pathway: 1) Air quality, 2) Water quality and quantity and 3) Land and Food (3 reports)
- Human health impact assessment relating to fluid releases, incidents and increased traffic (Q1-Q3)
- A review of the regulatory framework for oil and gas activity in BC and Alberta (Q1)
- Scan of multiple jurisdictions for studies related to human health risk assessment associated with oil and gas activity (Q1-Q3)
- A Human Health Risk Assessment Framework:
  - Draft for comment (Q2)
  - Final version: (Q3)
- Human Health Risk Assessment report and supplementary or incorporated reports:
  - A review of BC statutory, regulatory and policy framework (Q4)
  - A report on spatially enabled data for improved monitoring and health management. (Q4-Q5)

5.2 Invite feedback on some reports, or specific issues, as directed by the project team.

5.3 Finalize and deliver the final Human Health Risk Assessment report (in electronic form, limited print copies) to the Ministry of Health and subsequent online publication. (Q6)

6.0 Support Media Coverage

Three to four BC-wide media releases are proposed over the course of the project, with emphasis on reaching media contacts in northeastern BC and any media within the scientific, health and industry media as identified by the project team. It is anticipated that the Fraser Basin Council will issue two of the four releases, and assist on the other two. Primary media monitoring is expected within Ministry of Health, supplemented by FBC.

The Project Manager will serve as spokesperson for the team and will be available for interviews throughout the project and following release of the final report. This approach demonstrates transparency and will help build an accurate understanding of the issues among key audiences. The key points of outreach are described below.

6.1 Media Release/Backgrounder #1: Announcement of Project Start-up (Prior to Q1)

The Ministry of Health is expected to issue this initial media release and backgrounder. FBC will support this release by providing any necessary background information and by making the Project Manager available to media for comment**.**

6.2 Media Release #2: Rollout of Work Plan (Q1)
– by Fraser Basin Council

It is expected that FBC will announce details of the steps it will take over the 18 months of the project, including key milestones and reports, and will introduce the Community Advisory Committee.

6.3 Media Release #3: Rollout of Draft Assessment Framework for Comment
– by Fraser Basin Council (Q3)

It is expected that FBC will announce the draft Health Risk Assessment Framework and provide an opportunity for public comment.

6.4 Media Release/Backgrounder #4: Release of Final Report (To follow Q6)

The Ministry of Health is expected to prepare and issue this media release and post the final report(s), which can also be available on the HHRA website. The FBC project manager, and possibly other members of the team, will be available for a media event, community briefing and interviews.

7.0 Connect Through Social Media

7.1 Establish a presence on Facebook for the Human Health Risk Assessment, or leverage the Fraser Basin Council Facebook page to do so. Highlight the project and its importance, offer key updates and opportunities for engagement. (Q1)

7.2 Offer 10 to 20 Facebook updates, in conjunction with web postings and broadcasts. (Q1-Q6)

8.0 Deliver Email Broadcasts to Update Multiple Audiences

8.1 Prepare and deliver 10-15 broadcast emails to update key audiences on work of the project team, focusing on key developments and reports. (Q1-Q6)

8.2 Update the broadcast list to include new subscribers and expert contacts identified by the project team (Q2-Q4)

9.0 Update Residents of Northeastern BC

During Phase 1 there was strong media coverage of the Human Health Risk Assessment in many communities of northeastern BC, but less so in others. To reliably reach individuals and organizations across the region, additional steps are desirable.

A way to cover rural and urban communities is through a householder flyer delivered by Canada Post. This was successful step during Phase 1 of the project, and is recommended for Phase 2, subject to consultations and budget. It is possible to use this piece to 1) publicize the project overall or 2) solicit specific feedback. (In the latter case, additional communications support may be required).

9.1 Seek advice from the Community Advisory Group and project team on the value of extending outreach on Phase 2 via a household flyer and to determine the preferred timeline and focus of the message. (Q2)

9.2 If approved, deliver an HHRA Phase 2 flyer to all rural and urban households in northeastern BC. (Q2-Q4)

Project Risk Management Strategy

The Fraser Basin Council foresees some potential risk factors that may arise during Phase 2. Risk mitigation measures have been incorporated into the project design to address these. Because of the relatively large number and diverse geographic locations of the proponent team members, and the related potential for project inefficiencies, the Project Manager will need to establish a firm project management discipline. Specific time allocations for each proponent team member will be monitored and reported on a monthly basis to ensure that work is done on time and on budget. Required adjustments to these time allocations will be done taking into account the entire project budget. Internal communication devices and practices will be established at the outset of the project and maintained throughout the project to ensure that all team members are fully informed with respect to the progress of the project. This procedure will also ensure timely and effective input from each of the team members.

There may be occasions during the 18-month project period when key team members may not be available to provide important information related to the Human Health Risk Assessment. Every attempt will be made to avoid these situations through detailed project planning and providing the team members with as much advance notice as possible regarding their assignments.

Given the significant interest in this Human Health Risk Assessment that was evident during Phase 1, some of the stakeholders and interests may express concern that certain issues (examples: cumulative effects and indirect health issues, such as mental stress) are not part of Phase 2. These out-of-scope considerations that are explicitly described in the RFP will be explained to relevant interests at the outset of Phase 2 and strictly adhered to so as to avoid misunderstandings or “scope creep.”

There also may be issues related the adequacy or inadequacy of available information with which to conduct defensible human health risk assessments. Measures will be developed at the outset of the project by the Project Manager to access all available data sources and provide explanations in situations where important data is either inaccessible of not available. Such data limitations will be addressed in the final Human Health Risk Assessment and appropriate recommendations developed to address these data inefficiencies.

Many First Nations organizations and communities have made it clear that they not be deemed “stakeholders” but rather acknowledged as an order of government. The stakeholder engagement process will ensure that First Nations are positioned as separate and distinct.

In addition to risk mitigation factors within the project design, the Fraser Basin Council has a number of advantages in mitigating risk during the proposed project. This project relates directly to FBC’s five-year Strategic Plan approved in April, 2011, and is therefore perfectly aligned with the organization’s expertise, goals and objectives. The Council employs a staff of experienced professionals who could be assigned to this project if required. As well, if the proposed project generates interest in the news media, FBC has a history of successfully communicating complex issues in a manner that maintains the impartiality and the integrity of the process, which is consistent with the principles in the Fraser Basin Council’s Charter for Sustainability. As it did throughout Phase 1, the Council will work in close cooperation with the Ministry of Health’s management and communications staff to monitor and respond to all media activities and stakeholder inquiries.

Ministry of Health Requirements

It is expected that the Ministry of Health will designate a project liaison person as the main Ministry contact for the duration of the project who will be available to respond to questions and requests for provincial government information as needed. It is also understood that other relevant provincial government ministries will each designate a project liaison person for the project.

It is also anticipated that the Ministry of Health will update the Project Manager on any relevant provincial government information related to oil and gas development that may surface during the project. It is expected that provincial government officials will cover their own costs related to the project, including meeting expenses, travel and administration.

Conflict of Interest

The following proponent team members are directly or indirectly affiliated with an organization involved in oil and gas exploration, extraction, processing, advocacy or support:

- Rainer Hofmeister – currently provides consulting services to companies in Alberta with no involvement in northeastern BC.
- Carmine Vertone - currently provides consulting services to companies in Alberta with no involvement in northeastern BC
- The Fraser Basin Council is in the process of entering into a relationship with Spectra Energy with respect to strengthening watershed management in the Fraser River Basin.
- Dr. David Bowering is presently working half time with the Northern Health Authority in northwestern BC. Although, he has no responsibilities in northeastern BC, it is important to disclose this possible perceived conflict of interest due to the Northern Health Authority's significant interest in this project.
- Dr. Margot Parkes is currently Co-Chair with Dr. Ronald Chapman (Chief Medical Officer of Health, Northern BC) in a "Knowledge to Action" research project funded by the Canadian Institutes of Health Research and entitled: "Improving social and environmental determinants of health through integrated water governance." It seems relevant to disclose this possible perceived conflict of interest due to the Northern Health Authority's significant interest in this project.

The Council will take steps to avoid activities that may bring it into conflict with its obligations under this project, and will disclose all direct and indirect affiliations with the oil and gas sector that may arise during Phase 2.

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Appendix A: FBC Profile and Business History

Established in 1997, the Fraser Basin Council is a charitable, not-for-profit organization dedicated to advancing sustainability in the Fraser River Basin and beyond. The Council was founded on the belief that sustainability – defined broadly in the Council's vision statement as "social well-being supported by a vibrant economy and sustained by a healthy environment" – is best achieved through informed collaboration among multiple interests representing business, governments and civil society.

To deliver on its broad mandate, the Council has a unique and internationally acclaimed collaborative governance structure, led by 38 directors from the four orders of government – Federal, Provincial, Local and First Nations – and from the private sector and civil society. Directors include senior government elected officials and staff, leaders in the not-for-profit and academic sectors, businesspeople and citizens from all walks of life and regions. In all of its activities, the Council strives to ensure that all interests in an issue are afforded opportunities to become informed and to be heard in an environment of mutual respect. Through this approach, the Council helps people and organizations find practical solutions to sustainability challenges – solutions that are "owned" by participants working together towards shared goals.

At the core of what the Council is and does is its model of collaborative leadership, whereby diverse interests coalesce around core values, and cooperation and joint action are chosen over confrontation and inaction. The Council's typical roles include being a catalyst for collaborative action, serving as an impartial, trusted facilitator, helping multiple jurisdictions pursue goals in common, and acting as a conflict resolution agent when required.

Well into its second decade of service, the Council has developed a positive reputation as an effective and independent catalyst for collaborative action towards sustainability. The Council's professional staff have skills and experience in multi-interest process design and facilitation, conflict resolution, sustainability planning, natural resources management, sustainability education and program administration. The Council's thirty-one staff operate from regional offices in Vancouver, Mission, Kamloops, Williams Lake, Prince George and Victoria. In addition to having a presence in these communities, the Council maintains an extensive and diverse network of public and private sector leaders and decision-influencers throughout BC.

The overall framework for the Fraser Basin Council's work is its Charter for Sustainability. The Charter is good-faith agreement, signed in 1997, by representatives from multiple sectors across the Fraser Basin who believed in the critical need for collaborative action for a more sustainable future.

In addition to offering a vision, directions and goals, the Charter includes 12 principles that guide the Council's work:

- **Mutual Dependence**: Land, water, air and all living organisms, including humans, are integral parts of the ecosystem. Biodiversity must be conserved.
- **Accountability:** Each of us is responsible for the social, economic and environmental consequences of our decisions and accountable for our actions.
- **Equity:** All communities and regions must have equal opportunities to provide for the social, economic and environmental needs of residents.
- **Integration:** Consideration of social, economic and environmental costs and benefits must be an

integral part of all decision-making.

- **Adaptive Approaches:** Plans and activities must be adaptable and able to respond to external pressures and changing social values.
- **Coordinated and Cooperative Efforts:** Coordinated and cooperative efforts are needed among all government and non-government interests.
- **Open and Informed Decision-Making:** Open decision-making depends on the best available information.
- **Exercising Caution:** Caution must be exercised when shaping decisions to avoid making irreversible mistakes.
- **Managing Uncertainty:** A lack of certainty should not prevent decisive actions for sustainability.
- **Recognition:** There must be recognition of existing rights, agreements and obligations in all decision-making.
- **Aboriginal Rights and Title:** We recognize that Aboriginal nations within the Fraser Basin assert Aboriginal rights and title. These rights and title now being defined must be acknowledged and reconciled in a just and fair manner.
- **Transition Takes Time:** Sustainability is a journey that requires constant feedback, learning and adjustment. In the short-term, the elements of sustainability may not always be in balance.

A complete copy of the Charter is available on the FBC website at **www.fraserbasin.bc.ca**.

Unique Attributes of the Council

As noted, the Council has established strong networks and a local presence in several regions of BC. With these assets, the Council is in a position to play a credible role in convening, facilitating and reporting on a wide range of multi-interest engagements on behalf of corporate, government, academic and other partners.

Positive Relationships and Regional Presence

The Council's existing regional, Basin- and province-wide relationships with First Nations, Local Governments, Federal, Provincial governments, community and private sector interests can help secure a range of perspectives at various stages of project development and implementation. Regional Committees are already in place in the Council's Thompson, Cariboo-Chilcotin, Upper Fraser, Fraser Valley and Greater Vancouver – Sea to Sky regions. These Committees can be harnessed as broad-based "safe tables" for the provision of input and advice.

Process Design and Facilitation

Mistrust of multi-interest processes and of the organizations convening them can be a barrier to engagement. The Council has earned a reputation as a trusted, skilled and impartial "arm's length" convener

and facilitator of multi-interest dialogues on a broad range of topics. Stakeholders are more likely to trust and participate in processes that are transparent, inclusive, informed, and sensitive to regional and cultural engagement styles and preferences. The Council's focus is always on fostering engagement and dialogue in support of sustainability.

First Nations Understanding and Connections

The meaningful engagement of First Nations in proposed development projects is a particularly complex endeavour requiring special understanding, skills and relationships. The Council's experience starts with its Board, which includes eight First Nations Directors representing the eight Aboriginal language groups of the Fraser River Basin. These Directors include Tribal Council Chairs as well as hereditary and elected Chiefs who are in a position to provide advice and important connections to Aboriginal communities in both rural and urban regions. The Council has established a Board Committee dedicated to improving Aboriginal / non-Aboriginal relationships, and has a policy to ensure meaningful Aboriginal engagement in projects and programs.

Selected Projects

Northern Rockies Partnership

The Council was invited to work with the Northern Rockies Regional Municipality to establish a partnership with First Nations in the region, the oil and gas sector, and the provincial government. This initiative is intended to ensure that resource development in the region could be managed in a way that promotes a sustainable community infrastructure.

Aboriginal Economic Development

The Council has worked with several First Nations to help them collaborate on economic opportunities with adjoining jurisdictions. For example, assistance was provided to Sto:lo Tribal Council to work with local governments, the business community and academic institutions on local economic development opportunities, and a directory of First Nations natural resource expertise was created in the Cariboo.

Squamish Oceanfront Concept Plan Development

The Council, in partnership with the UBC Design Centre for Sustainability, designed and implemented a public consultation process and design charrette to develop a concept plan for the downtown waterfront in the District of Squamish. A tremendous level of public engagement was achieved, along with meaningful participation of the Squamish Nation and federal and provincial government agencies. The plan was focused on sustainability and was instrumental in attracting the interest of progressive land developers.

Britannia Mine Reclamation

The Council played an early and pivotal role as catalyst for the clean-up of Britannia Mine by bringing together government agencies, the landowner and members of the community of Britannia Beach to discuss a "solution to the pollution." The Council also designed, facilitated and reported on a comprehensive public

and agency consultation process with respect to a proposed solution.

Interface Fire Prevention

The Council helped two interior communities develop interface fire plans and is helping to implement the Williams Lake plan, where over 100 hectares of high-risk Crown land areas have had dense, dead understory trees removed. This work is thanks to multi-interest collaboration and consultation among governments, industry, environmental groups, private landowners and First Nations.

Tsilhqot'in Framework Agreement

The Council helped facilitate the Tsilhqot'in Framework Agreement, which provides for shared decision-making between the Tsilhqot'in First Nation and the provincial government with respect to land and resources. The Council is now supporting implementation of the agreement. This is one of just two Strategic Engagement Agreements in the Province of BC.

Range Management

The Council is managing a number of initiatives on range resources for livestock, wildlife and wild horses in the Chilcotin. In the Cariboo, the Council is helping deal with wildlife mitigation issues, as well as conflicts between ranchers and recreational users of rangeland.

Shuswap Lake Integrated Planning Process (SLIPP)

The Council is the secretariat for SLIPP, which has developed a strategic plan to encourage development in less sensitive areas of Shuswap and Mara Lakes, improve wastewater management and study recreational impacts. Priorities include protecting and restoring foreshore habitat, maintaining and improving water quality, informing and educating the public and industry groups, and initiating coordinated development and recreation plans.

Moving Forward

In February 2011, the Council's Board of Directors unanimously approved a five-year Strategic Plan for the organization. The plan recognizes the Council's key roles as catalyst, facilitator and conflict resolution agent in advancing social, economic and environmental sustainability. Consistent with its mandate, the Council is in a good position to encourage natural resource development that garners local and regional support, contributes to the long-term strength and resiliency of rural communities and BC's economy as a whole, and is carried out in an environmentally responsible manner.

Iona Campagnolo, the founding Chair of the Council and 27th Lieutenant Governor of British Columbia, characterized the Council's role as follows:

> *"It is not so much the technical challenges that stand in the way on our journey towards sustainability, nor is it even money - or lack thereof. The key to the success of this journey is the willingness and ability of people to work together towards common goals. This is the work of the Fraser Basin Council."*

Pages 41 through 211 redacted for the following reasons:
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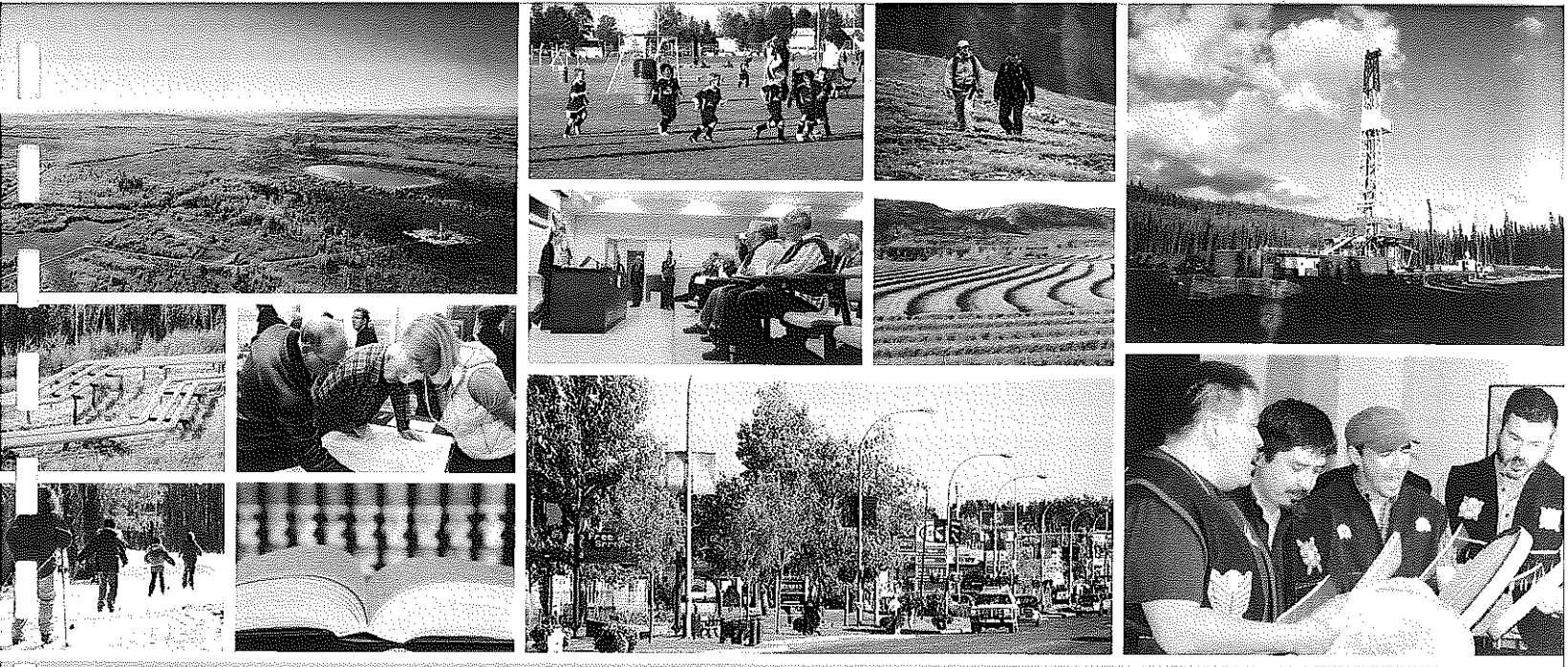


Cost Proposal For:

Original

Phase 2 - Human Health Risk Assessment of Northeastern British Columbia Oil and Gas Activity

Proposal Number : RFP HL173

Prepared For:

Ministry of Health

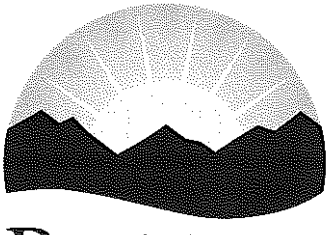
Prepared By:

SENES Consultants Limited

In Association With:

Morrison Hershfield Limited

August 2012



BRITISH COLUMBIA

SENES Consultants Limited

Specialists in Energy, Nuclear and Environmental Sciences

MORRISON HERSHFIELD

PRICING PROPOSAL
FOR

PHASE 2 – HUMAN HEALTH RISK ASSESSMENT OF NORTHEASTERN BRITISH COLUMBIA OIL AND GAS ACTIVITY (REQUEST FOR PROPOSAL: RFP HL173)

Prepared for:

Ministry of Health
Purchasing Services Branch
c/o 2nd Floor 563 Superior Street
Victoria, B.C. V8V 1T7

Prepared by:

SENES Consultants Limited
121 Granton Drive, Unit 12
Richmond Hill, Ontario
L4B 3N4

August 2012

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LIST OF TABLES

1.0 PRICING

SENES Consultants Limited is pleased to submit the following proposal in response the Ministry of Health's Request for Proposal (RFP HL173) *Phase 2 – Human Health Risk Assessment of Northeastern British Columbia Oil and Gas Activity.* Since its inception in 1980, SENES, an acronym for Specialists in Energy, Nuclear and Environmental Sciences, has grown to become one of Canada's premier environmental consulting firms.

It is understood that the contract will be fixed price and deliverable based, with key milestone payments based on receipt of deliverables over two fiscal years as key milestones are met (deliverables received). The schedule for the milestone payments will be determined by the Ministry.

A holdback equivalent to 10% of the Contract value will be applied to the Contract, with release of the holdback 30 days following the successful completion of all Contract deliverables.

Table 1.1 provides a breakdown of the proposed hourly rates for services to be completed between 1 October 2012 to 31 March 2014.

The proposed budget for this Project is $765,545.00:

- Proposed labour totals: $744,845.00
- Proposed expenses total: $20,700.00

Table 1.2 provides a breakdown of team member hours per task activity in relation to the project schedule. Table 1.3 provides further breakdown of the expenses proposed to be incurred throughout the course of the Project.

Table 1.1 Staff Rate Table

Staff Classification	2012 Rate (CDN$/hr)	2013 Rate (CDN$/hr)	2014 Rate (CDN$/hr)
Project Director Douglas Chambers			
Technical Director Tee Guidotti			
Health/Oil and Gas Professional Ian Arnold Derek Doyle			
Sr. Professional A Lesley Cabott Dan Hrebenyk Patrice LeBlanc Harriet Phillips Farhad Seif			
Sr. Professional B Fred Bernard Stacey Fernandes Mehran Monabbati			
		s.21	
Int. Professional A Jennifer Turner			
Int. Professional B Joe Liu Sveltanan Music			
Int. Professional C Andrea Bell Zahra Parhizgari Sean Shekarforoush			
Jr. Professional Kim Theobald Leah Windisch			
Graphics			
Word Processor			

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Table 1.3 Breakdown Of Expenses

Activity	Breakdown of Activity	Proposed Cost	Assumptions
Project Kick-off Workshop	Flights to Vancouver for 2 Staff	$ 2,000.00	Assuming $1000.00 / person
	Hotel for 2 Staff	$ 400.00	Assuming $200.00 / night
Human Health Risk Assessment 2 day Workshop	Flights to Vancouver for 3 Staff	$ 3,000.00	Assuming $1000.00 / person
	Hotel for 3 Staff	$ 600.00	Assuming $200.00 / night
Environmental / Public Health	Trip to Review Health Documents - Flights for 2	$ 2,000.00	Assuming $1000.00 / person
	Hotel for 2 staff	$ 800.00	Assuming $200.00 / night for 3 nights
	Vehicle Rental	$ 1,000.00	
	Incidentals, including meals	$ 1,200.00	
Stakeholder Consultation Workshop	Review results Phase 1 Report	$ 2,000.00	
	Workshop	$ 4,000.00	
	Workshop Follow-Up	$ 1,000.00	
	Engagement Report	$ 1,000.00	
Preparation of Reports	Gap Analysis	$ 200.00	
	Air Quality Assessment	$ 200.00	
	Noise Assessment	$ 200.00	
	Risk Perspective	$ 200.00	
	Regulatory Review	$ 200.00	
	Human Health Risk Assessment	$ 200.00	
Project Management	Incidentals - Courier, Printing of PM Documents	$ 500.00	
	TOTAL COST	$ 20,700.00	

BRITISH COLUMBIA
The Best Place on Earth

Request for Proposals
Phase 2 – Human Health Risk Assessment of Northeastern British Columbia Oil and Gas Activity

Ministry of Health Request for Proposals Number: RFP HL173

Issue date: June 28, 2012

Closing Time: Proposal must be received **before** 2:00 PM Pacific Time on: Friday August 10, 2012

GOVERNMENT CONTACT PERSON: All enquiries related to this Request for Proposals (RFP), including any requests for information and clarification, are to be directed, in writing, to the following person who will respond if time permits. Information obtained from any other source is not official and should not be relied upon. Enquiries and any responses will be recorded and may be distributed to all Proponents at the Province's option.

<<Norman Helewa, Project Manager e-mail: norman.helewa@gov.bc.ca>>

DELIVERY OF PROPOSALS:

Proposals must not be sent by mail, facsimile or e-mail. Proposals are to be submitted to the closing location as follows:

A. (8) complete hard-copies(and 1 copy on CD) must be delivered by hand or courier to:

Purchasing Services Branch
c/o 2nd Floor 563 Superior Street
Victoria, B.C. V8V 1T7
Attention: Norman Helewa

Proposal envelopes should be clearly marked with the name and address of the Proponent, the Request for Proposals number, and the project or program title.

PROPONENTS' MEETING:

☐ A Proponents' meeting **will** be held at:

Auditorium A &B - Basement
1515 Blanshard Street,
Victoria, BC
V8W 3C8
From 1:00 pm – 3:00 pm PST on Friday July 13, 2012.

Note: A summary of questions and responses will be posted on the BC Bid Website. Attendance is optional. Oral questions will be allowed at the Proponents' meeting. However, questions of a complex nature, or questions where the Proponent requires anonymity, should be forwarded in writing (via email), prior to Noon PST Wednesday, July 11th, 2012, to the Government Contact person designated above. Please note – There will be no video/teleconferencing for this meeting.

[redacted]

Legal Name of Proponent *(and Doing Business As Name, if applicable):* SENES CONSULTANTS LIMITED

Address of Proponent:
121 GRANTON DRIVE
UNIT 12
RICHMOND HILL, ON L4B 3N4

Authorized Representative phone, fax or email address (if available): 905.764.9380












Technical Proposal For:

Copy

Phase 2 - Human Health Risk Assessment of Northeastern British Columbia Oil and Gas Activity

Proposal Number : RFP HL173

Prepared For:

Ministry of Health

Prepared By:

SENES Consultants Limited

In Association With:

Morrison Hershfield Limited

August 2012

SENES Consultants Limited

Specialists in Energy, Nuclear and Environmental Sciences

MORRISON HERSHFIELD

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1980 - 2010 30 YEARS OF ENVIRONMENTAL EXCELLENCE WORLDWIDE SENES Consultants Limited

551505

08 August 2012

Norman Helewa
Project Manager
Ministry of Health
Purchasing Services Branch
c/o 2nd Floor 563 Superior Street
Victoria, B.C. V8V 1T7

RE: Phase 2 – Human Health Risk Assessment of Northeastern British Columbia Oil & Gas Activity (REQUEST FOR PROPOSAL: RFP HL173)

Dear Mr. Helewa,

SENES Consultants Limited in association with Morrison Hershfield is pleased to submit one (1) original copy ("Master") and eight (8) facsimile copies ("Copy") of our proposal to assist The B.C. Ministry of Health in completing the *Human Health Risk Assessment of Northeastern British Columbia Oil & Gas Activity*. A copy of the Financial Proposal is provided under separate cover.

SENES has assembled a team of medical doctors, scientists, engineers, regulatory and policy experts whose expertise addresses all requirements of the scope of work detailed in the Request for Proposal. The team includes individuals with extensive experience in human health risk assessments and community health.

We believe that our team will meet or exceed all expectations expressed in the Request for Proposal and look forward to hearing from you upon review of our proposal.

Sincerely,

SENES Consultants Limited

Harriet Phillips, Ph.D.
Senior Specialist, Risk Assessment/Toxicology

Encl: Proposal

TECHNICAL PROPOSAL
FOR

PHASE 2 – HUMAN HEALTH RISK ASSESSMENT OF NORTHEASTERN BRITISH COLUMBIA OIL AND GAS ACTIVITY (REQUEST FOR PROPOSAL: RFP HL173)

Prepared for:

Ministry of Health
Purchasing Services Branch
c/o 2nd Floor 563 Superior Street
Victoria, B.C. V8V 1T7

Prepared by:

SENES Consultants Limited
121 Granton Drive, Unit 12
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L4B 3N4

August 2012

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EXECUTIVE SUMMARY

Background and Introduction

Oil and gas activity in northeastern BC has resulted in a number of health concerns being raised by various stakeholders. . In response to these concerns B.C. Health commissioned a three phase human health risk assessment study. The first phase of the study involved public engagement to determine the scope of the study and identify the stakeholder concerns. The second phase of the study for which this proposal has been prepared involves a human health risk assessment as well as a jurisdictional and regulatory review and a public health component. The third phase of the study will involve reporting on the findings of this human health risk assessment to the stakeholders and public.

In response to the Request for Proposal, SENES Consultants Limited (SENES) is pleased to submit this proposal to undertake the human health risk assessment and related studies. Since its inception in 1980, SENES, an acronym for Specialists in Energy, Nuclear and Environmental Sciences, has grown to become one of Canada's premier environmental consulting firms. The company is a leader in the provision of specialized scientific environmental services and offers national and international experience in risk assessment. SENES staff have contributed to the advancement of science in the resource sector, have made significant contributions to policy development and capacity building in Canada and internationally, have significant recent and relevant experience in the north and working with First Nations, and are free of conflicts of interest for the task.

A Unique Team for a Unique Project

SENES is recognized worldwide as a leader in environmental consulting services

SENES is at the forefront of research and application of environmental sciences

Trusted advisors to the public, industry, government, First Nations, and international agencies

Our expertise and experience and those of our sub-contractors that are pertinent to the current project include:

- Extensive human health risk assessment experience;
- A track record of effective consultation, facilitation and communication initiatives; and
- A solid reputation with government, resource management boards, industry, the public and Aboriginal communities as an organization that provides high quality, impartial and defensible expertise on environmental management issues.

Why our Team is Best Qualified

- *Fresh Objective and Unbiased*
- *Unique Expertise*
- *Technical Resources*
- *Competent and Experienced Project Management*
- *Ability to Start Project Immediately*
- *Capacity and Capability*
- *Insight into Relevant Issues*

Project Team Qualifications

To carry out the assignment, SENES has assembled a project team that provides all the requisite risk assessment skills; oil and gas and regulatory expertise; experience in public health; and First Nations experience to carry out the defined scope of work. The proposed project management

team has more than 80 years combined experience and a successful record in managing large, multi-disciplinary projects in Canada and internationally.

SENES has extensive experience in the areas of risk assessment, including both human health and ecological risk assessments. This experience includes development of risk assessment frameworks, site specific risk assessments, facility risk assessments, transportation risk assessments and human health exposure and radiological assessments.

Key Team Qualifications

- *Strong Project Management*
- *Risk assessment expertise*
- *Proven Oil and Gas Experience*
- *Expertise in Environmental/Public Health*
- *Proven Northern and First Nations Experience*
- *Expertise in Communications and Facilitation*
- *Expertise in Community Consultation*
- *Environmental Assessment Expertise*
- *Regulatory/Policy Expertise*
- *Expertise in Cumulative Impact Assessment*

The project's need for an objective and balanced approach is well served by the proposed SENES Team as they have not been directly involved in oil and gas developments in British Columbia. SENES' reputation for excellence in environmental assessments and risk assessments is built on the depth of skill and expertise we bring to bear on issues associated with the environment. The team proposed for this project, are recognized experts in their fields. Members of the team have over 40 years experience in developing and implementing policies, legislation, regulations, guidelines, management practices and tools related to environmental assessment and management, occupational health, and environmental health. Therefore, their extensive experience will provide a knowledgeable an unbiased approach to this project.

Understanding of Needs & Approach

We understand that B.C. Health is soliciting a human health risk assessment with the goal of assessing the public health risks and where appropriate to provide recommendations to address potential public health risks. There are several other deliverables associated with this project including a jurisdictional review, a regulatory review, a public health component and a limited public engagement process. This Project is limited to the geographic area within the administrative boundaries of Local Health Areas 81, 60 and 59 of the Northeast Delivery Area of Northern Health Authority which are Fort Nelson and Peace River North and South.

Our approach to the project is that each task involves a separate team that is led by a senior level individual with extensive direct experience in similar projects and tasks which will allow our team to carry out this project in an efficient and cost effective manner. Both the jurisdictional and regulatory review will use the proven structured methodology that has been successfully used in many other jurisdictional and regulatory review projects For the tasks and activities with dependencies, the sequence of the execution of the activities is designed to ensure a smooth

transition from one activity to another. Independent tasks and activities were designed to be conducted in parallel to save time. Various tabular summary tools that have been successfully used on other jurisdictional and regulatory reviews will be used to provide easy to read reports.

Key Team Members

SENES has designated Dr. Douglas Chambers and Dr. Harriet Phillips, both senior staff at SENES, to act as Project Director and Project Manager respectively, for this assignment. Both have extensive risk assessment experience and both have had major roles in leading, managing and participating in complex inter-disciplinary environmental projects. In addition they have northern and First Nations experience. To supplement the team and because the human health risk assessment is a major component of the project, Dr. Tee Guidotti will be the Technical Director for the Human Health Risk Assessment. Dr. Guidotti is a medical doctor with practical experience in the oil and gas industry. He is known for his scientific achievements on questions directly related to oil and gas, to toxicology of relevant exposures, to community health assessment methodology, and to risk perception.

Project Management Team

- *Over 80 years of combined environmental experience*
- *Practical Experience in Oil and Gas Industry*
- *Direct Community Health Experience*
- *Deep experience with working with First Nations including health and related issues*
- *Risk Assessment Experience*

Dr. Ian Arnold, another medical doctor will be the Team Lead on Public Health and will work closely with Dr. Guidotti. Dr. Arnold also has experience in the oil and gas sector and has wide ranging experience in occupational health and environmental health. Other key members of the team include Mr. Patrice LeBlanc who will be the Team Lead for the regulatory review process. Mr. LeBlanc was a federal regulator and therefore has a deep understanding of the regulatory process and therefore is well suited to the role. He also has expertise in liaising with federal regulators and Provincial and Territorial agencies. He will be assisted by Mr. Derek Doyle who is the retired Commissioner of Oil and Gas for B.C.

Key Team Qualifications

- *Extensive Experience in Human Health Risk Assessment*
- *Specialization in Environmental / Public Health*
- *Direct Experience in Oil & Gas Industry*
- *Expertise in Stakeholder Consultation*
- *Regulatory / Policy Expertise*

Our Project Team also includes individuals with excellent human health risk assessment expertise, air quality and noise modelling skills, emergency preparedness, research skills, and public consultation experience. As well, SENES has a broad range of highly-qualified senior, intermediate and junior staff who will be available for support if necessary.

Closure

Based upon our experience in human health risk assessments in many jurisdictions, SENES recognises the importance of independence for carrying out this Project for B.C. Health. As such we have put together a team that fully adheres to the independence necessary for the contract.

1.0 INTRODUCTION & UNDERSTANDING OF ASSIGNMENT

SENES Consultants Limited (SENES) is pleased to submit the following proposal in response the Ministry of Health's Request for Proposal (RFP HL173) *Phase 2 – Human Health Risk Assessment of Northeastern British Columbia Oil and Gas Activity*. Since its inception in 1980, SENES, an acronym for **S**pecialists in **E**nergy, **N**uclear and **E**nvironmental **S**ciences, has grown to become one of Canada's premier environmental consulting firms. The company is a leader in the provision of specialized scientific environmental services and offers national and international experience in human health risk assessment. SENES staff as well as the study team have contributed to the advancement of science in the resource sector, have made significant contributions to policy development and capacity building in Canada and internationally, have significant and relevant experience in the north and working with First Nations, and are free of conflicts of interest for the task.

1.1 OVERVIEW

The goal of this Project is to assess the public health risks and where appropriate provide recommendations to address potential public health risks. Project objectives include:

- Review the significant concerns identified by stakeholders in Phase 1, and determine if they may be assessed using human health risk assessment methods;
- Through the development and application of a human health risk assessment and other research and analysis, including evaluation of existing institutional mitigation requirements, identify and validate areas of concern; and
- Improve public health outcomes through the development of key reports and deliverables and where appropriate recommendations to manage significant human health risks related to oil and gas activities.

In Phase 2 human health risks identified in Phase 1 will be evaluated and in combination with other evidence such as related reports from other jurisdictions (e.g., Alberta and the United States) will, where appropriate, make recommendations to address human health risks for oil and gas activity in northeastern BC. The reports for Phase 2 shall provide where appropriate recommendations for improvements related to environmental pathways of exposure and related environmental issues, and institutional framework issues (refer to section 3.3.1 for more detail). Limited stakeholder engagement will also take place during Phase 2 and will build on the Phase 1 stakeholder engagement.

The human health risk assessment will follow the traditional risk assessment framework as accepted by numerous regulatory agencies including Health Canada and the United States Environmental Protection Agency (EPA). This framework includes:

- Receptor Characterization: At this phase of the assessment, the potential receptors are identified and the pathways of exposure are defined.
- Exposure Assessment: The purpose of this stage is to quantify the contact between the receptor and the chemical of concern.
- Hazard/Toxicity Assessment: This phase of the risk assessment examines the potential effects of a chemical on a receptor.
- Risk Characterization: The risk characterization stage combines the information collected in the exposure assessment and the hazard assessment, and the potential for adverse effects is estimated.

Phase 2 of this Project is limited to the geographic area within the administrative boundaries of Local Health Areas 81, 60 and 59 of the Northeast Delivery Area of Northern Health Authority which are Fort Nelson and Peace River north and south.

1.2 TERMS AND CONDITIONS

1.2.1 Terms And Conditions

Our Team has read and understands the Terms and Conditions, as outlined in the RFP, and agree to abide by the outlined administrative requirements.

We will work off-site and be responsible for providing own facilities, equipment and necessary supplies to perform contracted services.

1.2.2 Mandatory Requirements

As per Section 5.1 Mandatory Criteria of the RFP, our team declares that we will use the General Service Agreement (GSA) with no modification, as referred to in Appendix I of the RFP.

Table 1.1 provides a summary of where pertinent information can be located within this proposal related to the requirements outlined in Section 4 of the RFP.

Table 1.1 Requirements Location within the Proposal

REQUIREMENTS		LOCATION IN PROPOSAL
	Proponent must declare in writing that they will use the General Service Agreement (GSA) with no modification	Section 1.2.2
a.	Clear understanding of required activities to be undertaken in Phase 2	Section 1.3 Chapter 2.0
b.	Detailed proponent response that meets project goal and objectives of Phase 2	Chapter 2.0
c.	Detailed description of each deliverable listed in Section 3.2.1.	Chapter 2.0
d.	Proponent response may include the following:	
e.	Team members balance of public sector and private sector client consulting work, current work and professional affiliations	Section 4.6
f.	Team members declaration of actual or perceived conflicts of interest	Section 4.6
g.	Proposed team for Project	Section 2.2 Figure 2.1
h.	Team members required experience related to risk, and associated scientific expertise and experience	Section 4.6 Table 4.1
i.	Team members required experience to carry out proposal	Section 4.6 Table 4.1
j.	Work off-site and be responsible for providing own facilities, equipment and necessary supplies to perform contracted services	Section 1.2.1
k.	Participate in bi-weekly meetings	Section 2.5.2.1

REQUIREMENTS		LOCATION IN PROPOSAL
l.	Provide bi-weekly progress reports	Section 2.5.2.1
m.	Project manager acting as Single Point of Contact	Section 2.3 Section 2.5
n.	Meeting project timeframe and acting in self-directed manner	Section 2.5
o.	Detailed work plan and communication plan	Section 3.1 Section 3.2
p.	Team members signing confidentiality/non-disclosure agreements	Section 4.6
q.	References	Section 4.7

1.2.3 Sub-Contracting

SENES will act as the Prime Consultant for contracting purposes and project management, and will oversee all activities conducted by the following sub-contractors:

- Morrison Hershfield, Vancouver, British Columbia
- Mr. Derek Doyle, Independent Contractor, British Columbia
- Dr. Ian Arnold, Independent Contractor, Ottawa, Ontario
- Dr. Tee Guidotti, Independent Contractor, Washington D.C.
- Dr. Farhad Seif, Independent Contractor, Toronto, Ontario

1.2.4 Point Of Contact

The primary point of contact with SENES in respect to this proposal will be

Primary Contact	Alternate Contact
Dr. Harriet Phillips 12 – 121 Granton Drive Richmond Hill, ON L4B 3N4 Phone: 905.764.9380 Email: hphillips@senes.ca	Mr. Dan Hrebenyk 303 - 1338 West Broadway Vancouver, BC V6H 1H2 Phone: 604.685.1612 Email: dhrebenyk@senes.ca

1.2.5 Proposal Layout

This proposal has been presented with the following sections:

Section 1 – Introduction & Understanding of Assignment
Section 2 – Solutions and Approach
Section 3 – Work and Communications Plan
Section 4 – Qualifications and Experience
Appendix A – Corporate Profile
Appendix B – Curricula Vitae

1.3 THE OBJECTIVES

The objective of the study is to provide an assessment of the impact of various works and activities related to the oil and gas sector within on the human health of the member of the public residing in this area.

The study area is the administrative boundaries of Local Health Areas 81, 60 and 59 of the Northeast Delivery Area of Northern Health Authority of the province of British Columbia.

The assessment will include:

- review of previous similar or relevant studies in other jurisdictions;
- a frame work for human health risk assessment;
- an overview of the impact of oil and gas activities on public health;
- a human health risk assessment that identifies the potential adverse effects of oil and gas activities in the study area.

It also includes an assessment of the BC regulatory framework to govern the protection of the human health against and public consultation.

2.0 SOLUTION AND APPROACH

In section 1 of this proposal a clear understanding of the required activities to be undertaken in Phase 2 was provided. Based on our understanding, this proposal was prepared to meet the project goal and objectives. Our solution and approach includes two sections: 1 - our technical approach comprising a number of tasks to be undertaken for successful execution of the study and 2 – project team. Our solution and approach is described in the following section.

The following table provides the response to the requirements outlined in Section 6 of the RFP "Solution and Approach".

Table 2.1 Requirements for Solutions and Approach

Requirement	Response
How solution and approach and resulting outcomes support the project goal and objectives, and completion of deliverables	Several tasks were designed to be completed for successful execution of the assignment. The tasks are aligned with the project description provided in Section 3.2.1 of the RFP and project objectives provided in Section 1.2 of this proposal. Jurisdictional review → Experience from similar studies Regulatory review → Adequacy of BC regulatory framework to protect human health against oil and gas activities. Public Health analysis → Overview of the impact of oil and gas industry. Developing HHRA framework → A credible, internationally recognized framework for HHRA support by air dispersion modelling (and other environmental modelling) accepted for regulatory use. Conducting HHRA → Using the approved framework and Also supported by peer reviewed factors and parameters frequently used in similar studies in other jurisdiction. Public Consultation → Ensure the credibility and acceptable of the assignment findings by the members of the public. Each task involves a separate team that is led by a senior level individual with extensive direct experience in similar projects and tasks as supported by their profile and CVs provided elsewhere in this proposal. Upon completion of each task, a number of deliverables will be prepared. The deliverables and their time line are summarized in Table 2.2. Each deliverable will be reviewed by BC health and comments will be considered and incorporated in the final deliverables.

Table 2.1 Requirements for Solutions and Approach (Cont`d)

Requirement	Response
	Public Consultation → Ensure the credibility and acceptable of the assignment findings by the members of the public. Each task involves a separate team that is led by a senior level individual with extensive direct experience in similar projects and tasks as supported by their profile and CVs provided elsewhere in this proposal. Upon completion of each task, a number of deliverables will be prepared. The deliverables and their time line are summarized in Table 2.2. Each deliverable will be reviewed by BC health and comments will be considered and incorporated in the final deliverables.
Why solution and approach is the best (advantages) for supporting Phase 2 of the project	Both the jurisdictional and regulatory review will use the proven structured methodology that was successfully used in many other jurisdictional and regulatory review projects. The review methodology is supported by a full time in-house librarian who makes the literature and catalogue search very efficient. The structured methodology records the outcome of the review for each document or regulation as the review progresses. The recordings are in the following categories such as the objectives, the outcomes, the conclusions, recommendations, etc. The HHRA framework will be based on the internationally recognized mythologies and the HHRA will be conducted by the experts with extensive experience in the conduct of HHRA and impact assessment of the normal operation and the accidents across wide range of industries including upstream oil and gas sector. The public consultation team is very familiar with consultation with First Nations, the public and are familiar with the study area.
Why activities in solution and approach add value while minimizing risk to the project outcome	Each task or activity of our solution and approach are designed to provide the information needed to complete the project deliverables. Each task is assigned with a budget and a timeline which will be monitored closely by the project manager. For the tasks and activities with dependencies, the sequence of the execution of the activities is designed to ensure a smooth transition from one activity to another. Independent tasks and activities were designed to be conducted in parallel to save time. A large project team was assigned to the study to ensure that the tasks are provided with adequate resources. The information required for each task are already available, or will be provided by BC health, or collected in a timely manner. The project risk management will ensure that the risk of delay in each activity to the overall project is minimal.

Table 2.1 Requirements for Solutions and Approach (Cont`d)

Requirement	Response
Activities identified to be removed from list (section 4 (d) of RFP) and why	None
Alternate / additional activities identified and supporting rationale	It has been proposed that Emergency Response Planning be an additional component of the HHRA and regulatory review. It is significant that both the private sector (the operators of the oil and gas facilities) and the government sectors (in both provincial and minicab levels) be prepared to deal with the emergency situations arising from industrial accidents and the integration of the natural events and the oil and gas activities.
Project / Contract Manager responsible for successful delivery of services	Please see Section 2.3
Project Risk Management Strategy	Please Section 2.5
Time commitment, resources and requirements needed from Ministries / Agencies to make solution and approach successful	Please see Section 2.5.5

2.1 THE APPROACH

2.1.1 Project Tasks

In this section technical approach comprising a number of tasks to be undertaken for successful execution of the study is described. The tasks to be undertaken are:

- Jurisdictional review to identify other HHRA or studies related to HHRA for the upstream activities of the oil and gas sector.
- Assessment of the BC regulatory framework to govern the protection of the human health against.
- Providing an overview of the impact of upstream oil and gas activities on public health.
- Establish a framework for HHRA which is credible and accepted internationally.

- Conducting a HHRA for of upstream oil and gas activities which includes air quality. odour and noise assessment.
- Assessment of air quality, odour and noise.
- Public Consultation.

In the following sections each task is described in detail in tabular format.

2.1.1.1 Jurisdictional Review (Scan Report)

The study should benefit from the experience and lesson learned from similar studies conducted in other jurisdictions. The methodology used, stakeholder involved, public and regulator's reaction to the outcome of similar studies in other jurisdictions provides invaluable input to the overall quality of this assignment. The following table provides the description of the jurisdictional review proposed for this study.

Task Description:	**Jurisdictional Review**
Objectives and Rationale:	Prepare Jurisdictional Scan Report of past and current studies related to human health risk in relation to Oil and Gas Activities
Key Activities:	
Conduct Literature Search	A literature search will be carried out to obtain studies from various jurisdictions such as Canada (Alberta in particular), U.S.A, Europe (Norway and UK in particular), the EU and Australia to name a few. Key search terms such as oil and gas, health, respiratory, cancer, nitrogen oxide, sulphur dioxide, fine particulate matter, hydrogen sulphide, sour gas, fracking, exploration, to name a few.
Develop Framework for Summarizing Studies	A framework will be developed to provide a consistent methodology for assessing the various literature sources and reports. An example of a framework is attached to this scope of work. The framework will be tweaked after review of different papers to ensure that the framework captures the information from the various sources on the health effects associated with oil and gas activities.
Conduct the Review	The various literature sources will be reviewed by one individual and another will provide a QA/QC function to ensure that all the important components of the papers have been captured. An overall summary of the reviews will be provided which will indicate some recommendations that should be carried forth to inform the human health risk assessment. It should be noted that there may be insufficient studies that directly link health effects to oil and gas activities; however, there are other studies associated with contaminants that are the same as those associated with oil and gas and these will be extrapolated in the review.
Prepare Report	Preparation of a draft Jurisdictional Scan Report for Client Review. We anticipate comments which will be dispositioned in tabular form followed preparation of the Final Report.

Task Description:	Jurisdictional Review
	The report includes the summary review which include • The scope and objectives of the HHRA reviewed • The authors or responsible authority • The findings and conclusions of the study • The target audience of the study • The public/government/industry response to the study • Any outcome or follow-up to the study
Deliverables:	Framework for Summarizing Studies Summary of the Jurisdictional Review in Tabular form Draft Report for Client Review Disposition of Comments Final Report
Assumptions and Exceptions/Caveats:	1 set of review comments per deliverable which will be dispositioned in tabular form in a disposition sheet (see attached)
Efficiencies:	This review will most likely also highlight some regulations that would be applicable to the Regulatory review.

Example of Proposed Summary Table for Jurisdictional Review

Name of Study	Potential Exposure-Related Human Health Effects of Oil and Gas Development: A Literature Review (2003-2008)
Authors	R. Witter, K. Stinson, H. Sackett, S. Putter, G. Kinney, D. Teitelbaum, L. Newman
Country	U.S.A.
Classification	Literature Review
Year	2008
Governing Body/ Stakeholders	Not applicable
Website (if applicable)	http://www.ccag.org.au/images/stories/pdfs/literature%20review%20witter%20et%20al%202008.pdf
Key Objective(s)	• Review of contaminants associated with oil and gas exploration, drilling, extraction and production • Review of medical literature on health effects related to oil and gas production and extraction • Review of community and occupational injury rates associated with oil and gas extraction and production • Review of potential social and psychological risks of increased oil and gas drilling on a community
Key Findings	*VOCs* • Low airborne exposures to benzene should be investigated in people living close to oil and gas production as it is a human leukemogen • Limited evidence in literature that children are at increased risk of adverse outcomes or that there are fetal and neonatal impacts of VOCs

Name of Study	Potential Exposure-Related Human Health Effects of Oil and Gas Development: A Literature Review (2003-2008)
	Diesel Exhaust • No published studies on health impacts of diesel exhaust – major data gap *Criteria Pollutants* • No published studies on health impacts of criteria pollutants on populations in the vicinity of oil and gas exploration activities – major data gap; however extrapolation can be made based on other studies such as traffic related data and health effects *PAHs* • Little available data on effects of PAHs on populations near oil and gas facilities – data gap *Metals* • No published studies on metals and health effects in populations in vicinity of oil and gas *Hydrogen Sulphide* • Dangers associated with high level H2S exposures are well documented • Small amount of information on adverse effects of chronic low level exposure
Limitations	• No formal criteria established to assess papers considered for strength of evidence and study design • Reliance on known exposures; possibility of missing other not as well-known exposures • Complex mixtures not considered
Conclusion	Limited information published between 2003 and 2008 on the effect of contaminants from oil and gas activities on human health. However, there is other information available that can be used to extrapolate potential effects.

2.1.1.2 Regulatory Review

The other task involves the review of the regulatory framework in BC that governs the oil and gas sector and HHRA. The risk assessment outcome will identify the significant factors that should be considered when conducting the regulatory review. Therefore, the review will be completed when there is a significant progress in HHRA task is achieved. The review will identify if current regulatory framework is adequate to protect the human health against the oils and gas activities. The areas of weakness will be identified as gaps.

The following table describes how the regulatory review will be conducted in this study.

Task Description:	Regulatory Review
Objectives and Rationale:	Protection of the health of the population from the effects of oil and gas activities must be based on a scientifically sound legal and policy framework that will effectively manage risks to human health. Identify the changes to existing statutes, regulations and policies required to improve their effectiveness and efficiency in managing human health risks associated with oil and gas activities.
Key Activities:	
Identify whether current statutes, regulations and policies are acceptable for managing human health risk	This task will involve a comprehensive review of the current statutes, regulations and policies administered by the various provincial agencies; and an assessment of their acceptability for managing human health risks associated with oil and gas activities. This will include a review of the draft chapter of the results of the regulatory acceptability assessment by the Client.
Identify gaps of Current Statutes, regulations and policies for managing health risks	This task will involve the identification of gaps in the acceptability of the current statutes, regulations and policies for managing human health risks associated with oil and gas activities. This will draw on the legal and policy frameworks used in other jurisdictions (United States, Australia, United Kingdom and European Union) as well as lessons learned from their application drawing on information obtained as part of the jurisdictional review. This task will also include a review of the draft chapter of the results of the regulatory gap analysis by the Client.
Identify benefits of current statutes, regulations and policies to enable improved management of human health risk	This will involve identifying where current statutes, regulations and policies would benefit from changes to enable improved management of human health risks associated with oil and gas activities. This will draw on the legal and policy frameworks used in other jurisdictions (United States, Australia, United Kingdom and European Union) as well as lessons learned from their application drawing on information obtained as part of the jurisdictional review. This task will also include a review of the draft chapter of the proposed regulatory changes by the Client.
Prepare Report	Preparation of a Draft Regulatory Review Report for Client Review. It is anticipated that comments which will be provided in tabular form and this will be followed by the preparation of the Final Report.
Deliverables:	Regulatory Acceptability Assessment Chapter Regulatory Gap Analysis Chapter Regulatory Changes Chapter Draft Regulatory Review Report for Client Review Disposition of Comments Final Regulatory Review Report
Assumptions and Exceptions/Caveats:	Assume that information on the legal and policy frameworks used in other jurisdictions (United States, Australia, United Kingdom and European Union) as well as lessons learned from their application will be available from the jurisdictional review One set of review comments per deliverable which will be dispositioned

Task Description:	Regulatory Review
	in tabular form in a disposition sheet (see attached) Teleconference meetings until submission of draft Regulatory Review Report Assume one face-to-face meeting for review of final report
Efficiencies:	Ability to draw on the legal and policy frameworks used in other jurisdictions (United States, Australia, United Kingdom and European Union) as well as lessons learned from their application obtained as part of the jurisdictional review One single Regulatory Review Report that integrates the three chapters noted above Teleconference calls and e-mails to gather information and inputs for chapters

2.1.1.3 Public Health

The protection of the health of individuals in the vicinity of Oil and Gas activities is an important part of the Project. Therefore the following table provides the approach to the determining the feasibility of spatially-based health data and public health.

Task Description:	Public Health Surveillance
Objectives and Rationale:	1) To determine the feasibility of a spatially-based health surveillance network to monitor the health of residents in the Northeast Delivery Area 2) To determine the feasibility of using this health surveillance network to monitor health impacts attributable to oil and gas development in northeastern BC 3) To identify a minimum and an optimum data set that would be required to achieve robust monitoring of health impacts attributable to oil and gas development in northeastern BC 4) To identify special populations impacted by health oil and gas development in northeastern BC, reasons for disparities in coverage for health surveillance, their special vulnerabilities, and relevant special data needs 5) To prepare a report assessing the above and recommending guidance for implementation
Key Activities:	1) It is anticipated that most of the necessary information related to: • Population health status (in the affected area and in reference communities) • Health care utilization (in the affected area and in reference communities) • Disease registries (in the affected area and in reference communities)

Task Description:	Public Health Surveillance
	• Ambient air quality and pathways of exposure • Source emissions to air and pathways of exposure • Surface water quality and pathways of exposure • Effluents released to surface water through operations and leaks in impoundments and pathways of exposure • Groundwater quality and pathways of exposure (including deep well intrusion) • Soil quality and pathways of exposure • Food (vegetables, berries, fish etc. and pathways of exposure through agriculture and harvesting of country foods are available from government departments and local health units. Nonetheless, a gap analysis will be carried out to ensure the adequacy of the data for use in the human health risk monitoring. 2) Spatial models in the form of GIS data bases are in common use. Inquiries will be made to identify systems in current use and any existing system that could provide the foundation or framework for a future system. 3) The limitations and functionality of public health surveillance systems have been extensively studied. "Lessons learned" and performance characteristics will be identified through literature review and incorporated into the guidance.
Define Activity	The essential task of this activity is to determine the feasibility of establishing a population health risk surveillance system based on spatial (and temporal) distribution of hazards, population characteristics (e.g. density and vulnerabilities), exposure potential, existing data on health status (time series), and local assets that may modify health outcomes (e.g. health care access, abatement programs).
Identify Existing Data Series	Data on health, hazard, and population characteristics are not usually combined into comprehensive datasets. To determine the feasibility of doing so, it is first necessary to determine what data are available from existing sources.
Identify Existing GIS-based Monitoring Systems	Spatially-enabled data sets may already exist. Several environmental health studies have been conducted in western Canada using GIS methodology but it is not clear whether population health monitoring routinely uses spatial mapping and whether the systems are compatible.
Gaps Analysis	Identify gaps between what is available and what is needed for a viable surveillance program.
Develop Model System	A population health risk surveillance system logically requires spatially-specific data on exposure (surrogate is potential exposure), receptor characteristics (density, demography with emphasis on children, unusual prevalence of certain chronic diseases especially asthma, social vulnerabilities), and existing health risk, both historical (time series) and in real time to identify trends. The required data are

Task Description:	Public Health Surveillance
	usually not collected in the same time frame, with the same level of spatial resolution, or with the same level of accuracy. Some method of routinely analyzing these data is required. Documentation of disparities arising from local risks, such as the oil and gas industry, depends on precise (meaning "reproducible" but not necessarily accurate, meaning "exact") ascertainment or measurement of data, and the "power" (a statistical term of art) of the method to identify differences in health status.
Prepare Report	The report will document the data sources available, identify gaps, identify the minimum and the optimum data sets that would be required to monitor the population of northeastern BC, and the magnitude of differences ("effect size") that would be required to identify health risks associated with oil and gas development in this population. Recommendations for consideration in contingent implementation will be outlined. The report will be prepared in preliminary form, then peer-reviewed and revised to completion.
Deliverables:	1) Inventory of data sets 2) Draft report on public health surveillance 3) Final report on public health surveillance (after review)
Assumptions and Exceptions/Caveats:	It is not a foregone conclusion that a system as described above will be feasible for the evaluation of health risks associated specifically with the oil and gas sector.
Efficiencies:	This activity will not require inventing a new approach to surveillance for the health risks associated with the oil and gas sector. The limitations and functionality of public health surveillance systems have been extensively studied in numerous contexts. The basic principles of any public health risk surveillance systems are well known and understood.

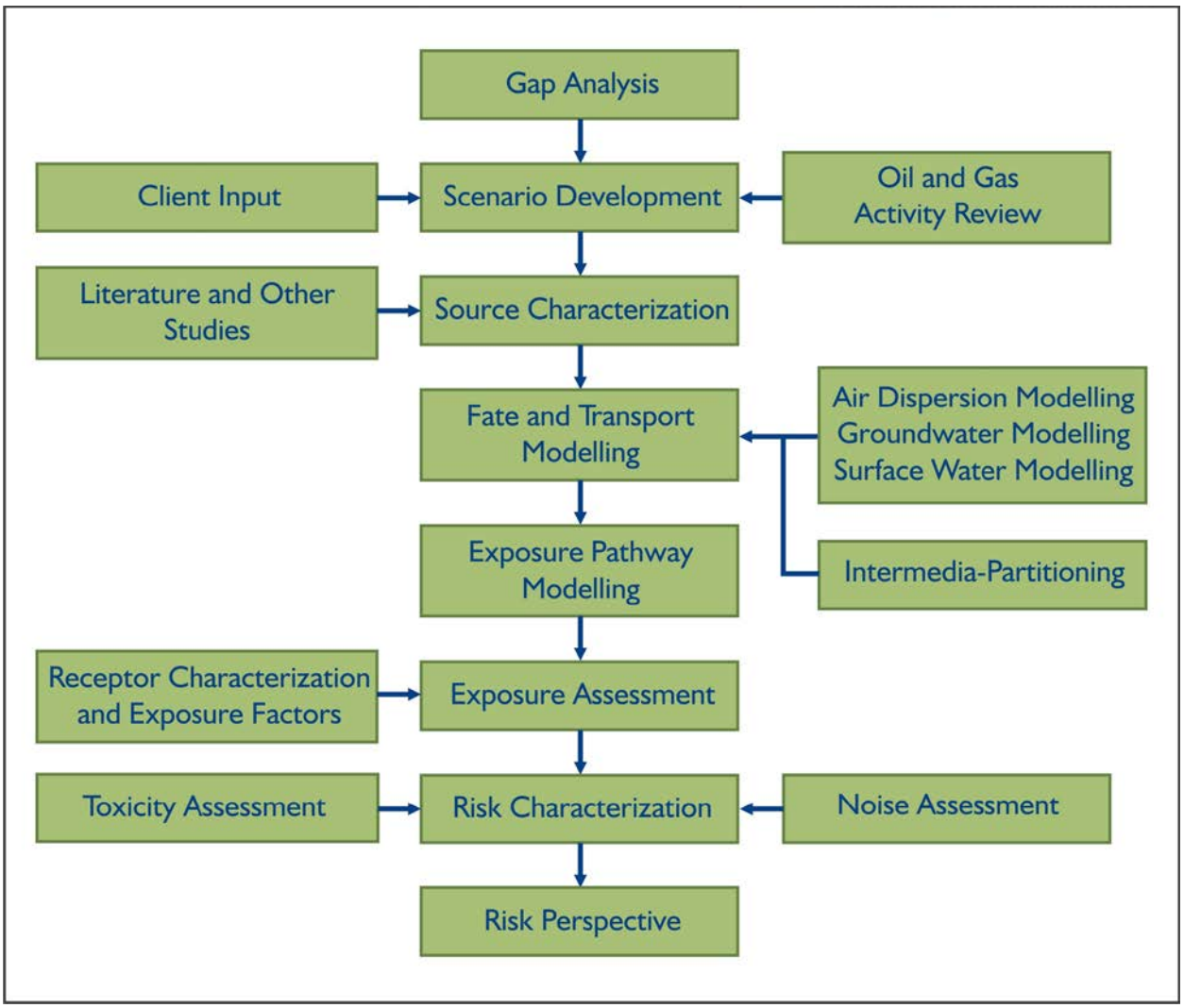
2.1.1.4 Human Health Risk Assessment Framework

The human health risk assessment framework used in this assignment follows internationally accepted mythologies used in various jurisdictions. The framework is very systematic and transparent easy to follow. However, it is supplied with credible and peer reviewed input parameters to ensure the quality of the HHRA outcomes. The HHRA scenarios will be prepared following a comprehensive review of the oil and gas activities within the following four major components for both normal operations and accidents:

- exploration;
- development and production;
- transmission;
- road transportation.

All scenarios will be developed in workshops attended by key technical leads with contribution from the client.

The following block diagram illustrates the framework for the HHRA.



The human health risk assessment will be completed using the framework provided above and the assessment will be supported by technical support documents for air quality and noise. A major aspect of the HHRA is to put the results into a health perspective that will be understood by the communities. The HHRA task is described below with the Air Quality and Noise assessments in the two following sections.

Task Description:	Human Health Risk Assessment
Objectives and Rationale:	1) Conduct a baseline characterization of effects and therefore risks, 2) Conduct a dynamic assessment predicting future risks, and 3) to support the various scenarios for future Oil and Gas Activities in Northern B.C. that will be applied in the AQ and other activities of this project.
Key Activities:	
Gap Analysis	It is anticipated that the majority of the necessary information related to: • Ambient Air Quality; • Source Emissions to Air; • Surface Water Quality; • Effluents released to Surface Water and Groundwater; • Groundwater Quality; • Soil Quality; and • Food (vegetables, berries, fish etc.) are available from participating organizations and government departments. Nonetheless, a gap analysis will be carried out to ensure the adequacy of the data for characterizing the baseline and for use in the human health risk assessment.
Scenario Development	This Task will be an integral part of the human health risk assessment and will be the foundation for evaluating human health risks, thus we are proposing to hold a 2 –day workshop at our offices to develop the HHRA scenarios. Members of our team such as Dr. Guidotti (Technical Director for HHRA), Dr. Arnold (Public Health), Mr. Patrice LeBlanc (Oil and Gas Regulatory Review), Ms. Fernandes (Human Health Assessment) Dr. Monabbatti (Accidents and Malfunctions), Dr. Harriet Phillips (Project Manager) and others would develop the scenarios that would be evaluated in the assessment. B.C. Ministry Health is welcome to participate in the workshop; however, these costs are not considered in the proposal. The scenarios reflect the various sources of emissions to various environmental media (air, surface water, groundwater, soil) and include both normal operations and accidents. For normal operation the following sources of emissions will be considered: • Condensate tanks • Construction activity • Dehydrators • Controlled released such as blowouts, flaring, and venting • Fugitive emissions from valves, pumps, and compressors • API separators and water treatment plants • Vehicles/Transportation • Ponds and impoundments

Task Description:	Human Health Risk Assessment
	• Engines • Combustion sources • Naturally occurring radioactive materials (NORM) The above sources are related to four main component of the process: • Exploration • Production • Transmission (pipelines) • Road transportation It should be noted that shale gas will also be part of the oil and gas activities and this will also be a consideration; however, the emissions are to water and not to air. The issues related to will be identified. For accidents the following sources will be considered when developing scenarios: • Uncontrolled emissions (spills) from pipelines and failed equipment. This includes releases from PSV and rupture disks as well. • Released following natural events (such as overflow and run off from impoundments) • Transportation accidents
Framework for Assessing Scenarios	A framework will be developed to provide a consistent methodology for assessing the various scenarios. The framework will, at minimum, include the following components: • Source characterization: For each scenario, the type of the release, the duration of the release, the amount of the material released, the material composition and phase, and the target environmental media will be identified. A part of source characterization is the identification of the contaminants of potential concern (COPC). This will include Criteria Air Contaminants (CACs), VOCs, H_2S, etc. The informational from various sources will be used for the emission calculations: These sources will include: o Canadian Association of Petroleum Producers (CAPP): A National Inventory of Greenhouse Gas (GHG), Criteria Air Contaminant (CAC) and Hydrogen Sulphide (H2S) Emissions by the Upstream Oil and Gas Industry: Volume 4 Methodology for CAC and H2S Emissions o A Recommended Approach to Completing the National Pollutant Release Inventory (NPRI) for the Upstream Oil and Gas Industry, March 2007

Task Description:	Human Health Risk Assessment
	o US EPA, AP 42 Emission Factors o API 4661: Exploration And Production Emission Calculator (epec) o Australian Government – NPI Emission Estimation Technique Manual for Oil &Gas Exploration and Production
Assessment of Effects	The assessment of the effects includes: • Fate and transport modeling: The fate and transport modeling will serve as the precursor for the exposure pathways assessment. This will use the identified source terms for each scenario and include air dispersion modeling, surface water modeling, groundwater modeling, intermediate partitioning and food chain assessment of the released chemicals. The air quality assessment is a separate scope of work below. A noise assessment will also form part of the assessment of effects and is detailed in a separate scope of work. • Exposure pathway modeling: The exposure pathways considered will include: air, drinking water, food, and direct skin contact. The duration of the exposure, food source and other factors will also be considered. The result of the fate and transport modeling along with the exposure factors will be used in the exposure assessment. • Exposure assessment: This will be based on the result of the fate and transport and exposure pathways modelling. The intake of released chemicals from various pathways for various age cohorts will be calculated. These calculation will be conducted for all HHRA scenarios. The results will be provided in tabular format in the report. . Toxicity assessment: This will include the identification of the toxicity reference values for various scenarios. The toxicity reference values will be identified for the following cases o Occupational exposure: using exposure limits such as STEL and TLV-TWA based on the exposure duration (NIOSH) o Reference doses for public exposure: acute or chronic based on the exposure duration from agencies such as the World Health Organization (for CAC), California EPA, U.S. EPA IRIS, to name a few o The Emergency Response Planning Guidelines (ERPG) produced by the American Industrial Hygiene Association (AIHA) for accident assessment

Task Description:	Human Health Risk Assessment
	• Risk Characterization: which compares the calculated dose to the appropriate toxicity reference value. The results are presented as the hazard quotient which is the ratio of the estimated intake to the toxicity reference value.
Health Risk Perspective	Once all the scenarios are evaluated, there will be a need to provide a meaningful perspective on what the results in terms of the potential health effects to the public. Information collected from the public health component of this study as well as the experience of the two health professionals on the team will inform this task. As part of this activity, based on the outcome of the risk assessment, recommendations for the emergency response will be provided.
Prepare Report	Preparation of a draft Human Health Risk Assessment for the Various Identified Scenarios for Client Review. We anticipate comments which will be dispositioned in tabular form followed preparation of the Final Report.
Deliverables:	Gap Analysis Report Scenario Development Report Framework for Assessing Human Health Risks Summary of Risk Perspective Draft Report for Client Review Disposition of Comments Final Report
Assumptions and Exceptions/Caveats:	Assume that all information of exposure pathways are readily available from B.C. Health and other governmental agencies. 1 set of review comments per deliverable which will be dispositioned in tabular form in a disposition sheet (see attached) - Assume 2-day workshop to develop Scenarios – Assume bi-weekly teleconference meetings until submission of draft HHRA - Assume preparation for and attendance at two face-to-face meetings The consultant is not responsible for any travel or costs incurred by B.C. Health for participation in the HHRA
Efficiencies:	One single HHRA report containing the various evaluated scenarios is proposed. Separate Technical Supporting Documents for the evaluation of Air Quality and Noise will be provided.

Air Quality Assessment

Task Description:	**Air Quality and Odour Impact Assessment**
Objectives and Rationale:	Prepare Air Quality Impact Assessment Document, including: 1) defining baseline air quality levels prior to development of oil and gas activity, 2) trend analysis for both emissions and ambient air quality monitoring data from existing data sources, 3) development of emission inventories and meteorological data to support air dispersion modeling for the highest priority scenarios identified in the workshop for Oil and Gas Activities in Northeastern B.C., and 4) dispersion modeling analyses of the highest priority scenarios in support of the HHRA.
Key Activities:	
Gap Analysis	Compile and review existing information on air quality in the northeastern sector of the province including: • Ambient air quality monitoring data to determine trends and current levels; • Air dispersion modelling analyses submitted in support of oil and gas facility permits; Sources of information to include air quality assessment reports in support of permit applications for oil and gas facilities in the region, ambient air quality monitoring data from Ministry of the Environment (MOE) network and from any industry operated sites, and emission inventories prepared by the MOE. Information will be used to summarize what is known and unknown about air quality in the region, and define the magnitude of predicted impacts from existing facilities associated with various aspects of oil and gas activities. Specifically, the gap analysis will focus on the key areas of concern raised in the Phase 1 report, namely: • Available information (frequency and magnitude) of air concentrations from routine flaring and fugitive emissions due to leaks from pipelines and other gas collection and processing equipment • Available information of air concentrations from non-routine emissions due to process upsets • Available information on fine particulate matter from combustion sources • Available information on transportation-related emissions, with particular emphasis on diesel particulate emissions • Adequacy of the existing air quality monitoring network • Information on historical trends and projections for overall future emissions in the region from all sources related to oil and gas industrial activities
Scenario Development and Source Terms	• Based on gap analysis and workshop discussion of issues in the early stages of the project, develop a series of air quality issues that could be addressed in the HHRA, ranked

Task Description:	Air Quality and Odour Impact Assessment
	according to priority • Identify a number of source and emission scenarios from among the highest priority issues to be addressed in the HHRA - total number of scenarios to be determined at the workshop • Develop emission inventories for the sources in each scenario at an appropriate detail to evaluate the highest priority issues • Obtain or develop meteorological data suitable for dispersion modeling in each scenario • Complete dispersion modelling for each scenario
Prepare Report	• Report will include: o a summary of the air quality information review and gap analysis o summary of any trends in ambient air quality levels and emissions o summary of each emission scenario considered, including source terms o modeling results in both graphical and tabular format o discussion of the results in terms of comparisons with established ambient air quality objectives, as well as comparison with anticipated new comprehensive air quality management system expected to be announced in 2012 or 2013 o identification of any data or modeling limitations and recommendations for further analysis in Phase 3, if required
Deliverables:	1. air quality assessment status report following the gap analysis and project workshop summarizing results of the review of existing information sources on emissions and ambient air quality levels in the region, and identifying the source/emission scenarios to be modeled for the HHRA and a description of the modeling approach to be used for each scenario 2. air quality assessment report summarizing the results of the dispersion modeling analyses for the selected source/emission scenarios
Assumptions and Exceptions/Caveats:	Number of source/emission scenarios to be modelled will depend on the timely availability of information to be provided for the gap analysis and the outcome of the workshop, as well as on the available budget for the air quality assessment. The scenarios to be modelled will be selected based on perceived priority as determined in the workshop.
Efficiencies:	Familiarity with emissions from parts of the oil and gas activities from previous reviews of sour gas well test air quality modeling reports for the OGC and a recent peer review of a gas plant in the Fort Nelson area.

Noise Assessment

Task Description:	Noise Assessment
Objectives and Rationale:	Prepare technical report outlining the potential noise impacts from to support the various scenarios developed for Oil and Gas Activities in Northern B.C. The assessment will be primarily qualitative in the absence of specific project details, but will provide guidance on good practice and mitigation measures.
Key Activities:	
Regulatory Review	This will entail a review of existing relevant regulations in: • British Columbia • Canada • Other jurisdictions, if necessary The intent is to review regulations pertaining to both construction and operating conditions. This process will assist in determining the most appropriate regulations/guidelines to be applied for assessing potential noise impacts on humans
Establish worst-case noise scenarios for construction and operating phase	Potential worst-case construction and operating noise scenarios will be established in conjunction with other disciplines. The objective is to determine which combination of activities, or operating equipment, is likely to generate the most noise.
Framework for Assessing Scenarios	A framework will be developed to provide a consistent methodology for assessing the various scenarios
Assessment of Effects	The noise effects of activities associated with each scenario will be assessed. This assessment will be primarily qualitative in the absence of specific project details.
Recommend mitigation based on best practice	Mitigation measures based on best practice will be recommended based on review of oil and gas sector-specific literature and professional experience.
Prepare relevant sections for inclusion in main project report	Preparation of a Draft Technical Noise Report. We anticipate comments which will be dispositioned in tabular form followed by preparation of revised text for the Final Report.
Deliverables:	Draft Technical Noise Report for Client Review Disposition of Comments Final Technical Noise Report
Assumptions and Exceptions/Caveats:	Assumes only one round of client review Assumes no direct involvement in public consultations
Efficiencies:	Our experience in dealing with equipment and regulators on the myriad of noise jobs will ensure that the work will be completed in a cost effective manner.

2.1.1.5 Stakeholder Consultation

There will be a limited public engagement process throughout this project as described in the table below.

Task Description:	Stakeholder Engagement
Objectives and Rationale:	• To engage with the key stakeholders from Phase 1 to confirm the Phase 2 approach and workplan. • To identify the gaps from Phase 1 that need to be included in Phase 2. • To continue the momentum and interest from Phase 1. • To ensure transparency in the process. • To receive input into the scenarios. • To ensure Phases 1, 2 and 3 are integrated.
Key Activities:	
Work with the Ministry to create a representative stakeholder committee	This task will involve working with the Ministry of Health to identify key stakeholders to sit on a Stakeholder Committee that would be engaged throughout Phase 2 to ensure transparency and stakeholder engagement and communication.
Review the Results from Phase 1 Report: Identifying Health Concerns; relating to oil and gas development in northeastern B.C., human health risk assessment, Fraser Basin Council.	This task will involve reviewing the results from the Phase 1 Report with the Stakeholder Committee (the committee) to confirm all concerns are addressed and gaps are identified. The Phase 2 process and approach will also be reviewed with the committee and amended to reflect their concerns prior to being shared with all stakeholders.
Prepare a Stakeholder' Communications Plan	In consultation with the client and the committee prepare a Communications Plan reflecting the various stakeholders' communications needs, the key messages as determined by the Ministry and the milestones and process for stakeholder education and engagement (limited in Phase 2). Methods will include print, media, web, email, and in person meetings with key stakeholders (municipalities, first nations, NGOs as determined by committee and Ministry).
Scenario Development Workshop	During this task the Ministry, the committee and the Ministries' representatives will participate in a workshop with the consultant team in Northeastern BC to develop the scenarios. During this workshop the consultant team will present the key findings from the Jurisdictional Review and a list of the proposed scenarios for discussion and input from the stakeholders.
Workshop Follow-up	The purpose of this task is to follow up with the committee and those that participated in the scenario development workshop the gaps in the regulations as they relate to the issues and risks that have been identified through the scenario work.

Task Description:	Stakeholder Engagement
Prepare Engagement Report	Preparation of a Draft Engagement Report for Client Review. This report will provide a record the process, the results and comments by the stakeholders, committee and ministry officials and recommendations for integration into Phase 3.
Deliverables:	Open and transparent process. Communication's Plan Phase 2 Engagement Report, summarizing the process and outcomes. Recommendations for Phase 3 process
Assumptions and Exceptions/Caveats:	The consultant is not responsible for any stakeholder travel or honorarium costs. The stakeholder contact information is available from Phase 1. The client reviews and approves all information, drafts, agendas etc. before being distributed to the stakeholders, committee, public, media and/or website.
Efficiencies:	The creation of the Stakeholder Committee, the continued use of a project website and regular project updates to the key stakeholders reflect the desires of stakeholders to stay involved. This proposed process highlights transparency and allows for a smooth transition to Phase 3.

2.1.2 Project Deliverables

Table 2.2 summarizes the deliverables for the Project and their timeline.

Table 2.2 Project Deliverables and Timelines

Task	Deliverables	Timeline
Jurisdictional Review	Framework for Summarizing Studies Summary of the Jurisdictional Review in Tabular form Draft Report for Client Review Disposition of Comments Final Report	15 October 2012 14 December 2012 31 January 2013 28 February 2013 29 March 2013
Regulatory Review	Regulatory Acceptability Assessment Chapter Regulatory Gap Analysis Chapter Regulatory Changes Chapter Draft Regulatory Review Report for Client Review Disposition of Comments Final Regulatory Review Report	31 October 2012 30 July 2013 30 July 2013 30 August 2013 24 September 2013 19 October 2013
Public Health	Inventory of data sets Draft report on public health surveillance Final report on public health surveillance (after review)	28 February 2013 30 September 2013 30 November 2013
Human Health Risk	Gap Analysis Report Scenario Development Report	28 February 2013 29 March 2013

Task	Deliverables	Timeline
Assessment	Framework for Assessing Human Health Risks Summary of Risk Perspective Draft Report for Client Review Disposition of Comments Final Report	29 March 2013 3 January 2014 30 January 2014 28 February 2014 31March 2014
Air Quality and Odour Impact Assessment	air quality assessment status report following the gap analysis and project workshop summarizing results of the review of existing information sources on emissions and ambient air quality levels in the region, and identifying the source/emission scenarios to be modeled for the HHRA and a description of the modeling approach to be used for each scenario air quality assessment report summarizing the results of the dispersion modeling analyses for the selected source/emission scenarios	30 January 2013 30 September 2013 30 October 2013 30 November2013
Noise Assessment	Draft Technical Noise Report for Client Review Disposition of Comments Final Technical Noise Report	31 July 2013 30 September 2013 30 November 2013
Public Consultation	Form Stakeholder Committee Communication's Plan Phase 2 Engagement Report, summarizing the process and outcomes. Recommendations for Phase 3 process	31 October 2012 30 January 2013 28 February 2014 28 February 2014
Project Management	Bi-weekly meetings and summary of meetings	Throughout project

2.2 THE PROJECT TEAM

The strength of our proposal is based on the strength and experience of our project team. The team members have a comprehensive understanding of the scope of work. SENES in cooperation with MH, has put together a strong team of experts that collectively have experience and expertise to successfully complete this project. All of team member has have previously completed many similar tasks required in this study.

The detailed team member profiles are provided in Section 4 and the CVs of the team members are provided in Appendix B. Table 4.1 provides a summary of the staff qualifications.

We believe that the following attributes of the team will contribute to the successful implementation and completion of this important project:

- Extensive and direct experience with risk assessment and with large jurisdictional projects in the Northwest Territories and the Yukon.

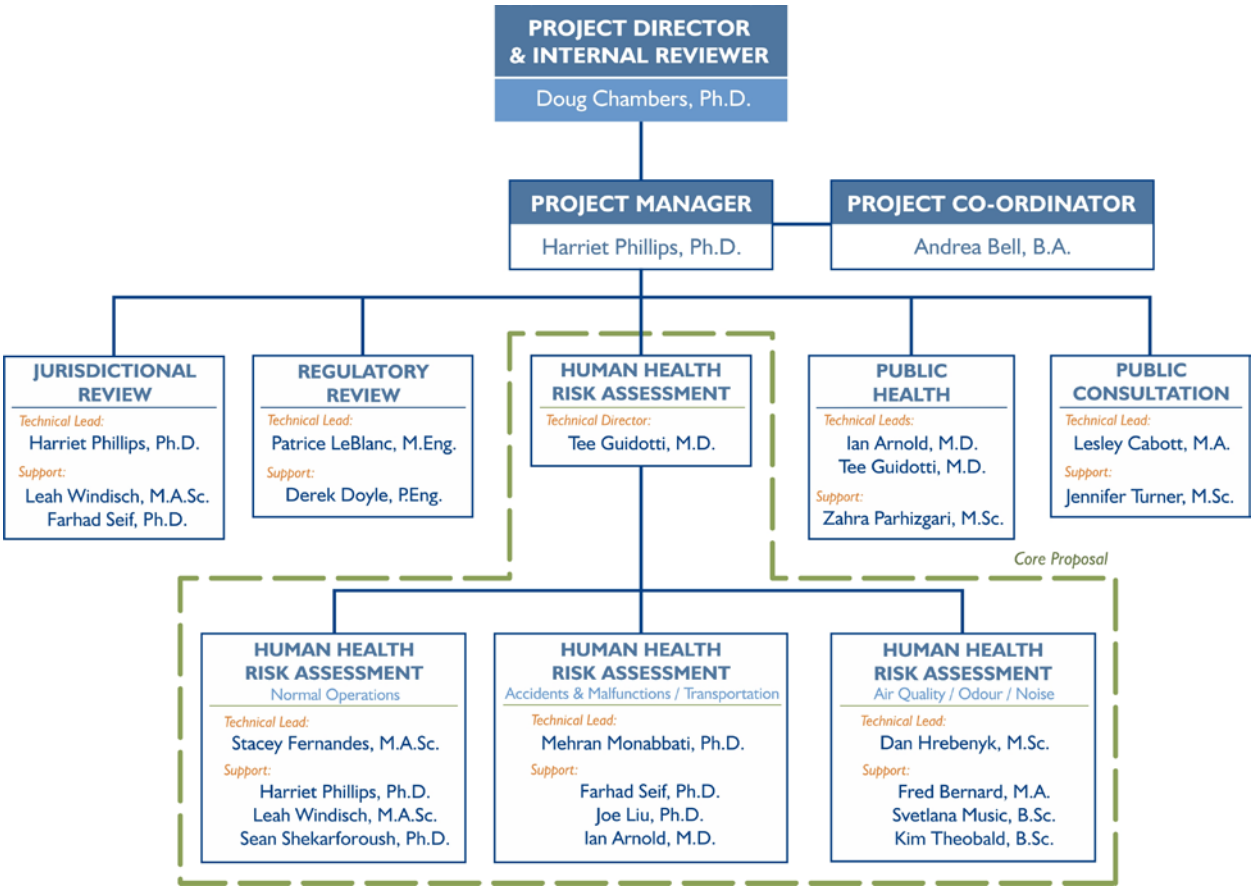
- Fresh objective and unbiased scientific knowledge.
- Direct experience in Oil and Gas activities.
- A proven ability to integrate “traditional” and “scientific” knowledge systems.
- A track record of delivering high quality.

2.2.1 Organization Chart

Figure 2.1 identifies the members of the SENES team who we propose to involve in this most interesting and challenging undertaking. Also identified in this figure is the organizational structure of the project team. By design, the proposed team comprises a core group who will be involved with implementing the Phase 2 Program and a number of support staff who will provide input as required.

Project Management activities will be the responsibility of Dr. Harriet Phillips who will direct the other team members and liaise with the Project Authority. Dr. Douglas Chambers will act as the Project Director and will be responsible for the overall direction and quality of the deliverables. The Project Manager will be responsible for the general and detailed planning, day to day execution, and adherence to timelines and schedules.

Figure 2.1 Organizational Chart



2.3 PROJECT MANAGER

The following table provides the qualifications of the Project Manager Dr. Harriet Phillips and the rationale for her selection.

Table 2.3 Project Manager

HARRIET PHILLIPS, Ph.D.	
Education & Qualifications	Ph.D., Chemical Engineering, 1991, University of Waterloo, Waterloo M.Eng., Chemical Engineering, 1984, McGill University, Montreal B.Sc., Biochemistry, 1981, University of Western Ontario, London
Professional Affiliations	Society of Risk Analysis
Project Role(s) and Responsibilities	Project Manager - overall responsibility for the entire project Technical Lead Jurisdictional Review – Lead researcher on the Jurisdictional review Technical Support Human Health Risk Assessment – Support role in human health risk assessment
Strengths that are relevant to this Project	• Over 20 years' experience in human health risk assessments • Experience coordinating multi-disciplinary teams • Good Organizational Skills • Effective Communicator • Experience with communicating risks to communities including First Nations
Rationale for Role(s) (Relevant Experience)	• Extensive Project Management experience on multi-disciplinary projects • Wide-ranging experience on human health assessments in Canada including British Columbia, Saskatchewan, Northwest Territories, Yukon, Nunavut, Manitoba, Nova Scotia, New Brunswick and Ontario • Extensive experience on human health assessments for a number of different Sectors including natural gas-fired generating stations, coal and nuclear generating stations, smelters, mining operations (development, operation and decommissioning), coal mines, contaminated and industrial sites • Experience in liaising with regulators such as Health Canada, Environment Canada, Canadian Nuclear Safety Commission and Provincial agencies • Designated as a Qualified Person for Risk Assessment under the Ontario Regulation 153/04

HARRIET PHILLIPS, Ph.D.	
	• Experience in conducting risk assessments Internationally including the United States, Germany, Guyana and Trinidad and Tobago • Peer review experience in reviewing many risk assessments on behalf of First Nations, Lawyers, regulatory agencies and the private sector
Public Sector vs Private Sector work	• Experience in working with public sector clients including regulators such as Health Canada, Environment Canada, Alberta Environment, Ontario Ministry of the Environment as well as Atomic Energy Canada Limited, Ontario Power Generation, Public Works and Government Services Canada, Aboriginal Affairs and Northern Development Canada, Cape Breton Development Corporation, New Brunswick Health and Welfare, Canada-United States-Ontario-Michigan Border Transportation Partnerships, Yukon Government, B.C. Health • Experience in working with private sector clients including AREVA Resources Canada, Cameco Corporation, TransCanada
Examples of Relevant Project Experience (last 5 years)	• Project Manager of team conducting reviews of risk assessments for the Ontario Ministry of the Environment. This project involves the review of risk assessments under Ontario Regulation 153/04 on behalf of the Ministry. The Project Manager role involves liaising with the client, sending the documentation to the expert reviewers and collating the overall review as well as a senior review function. Billings are also completed as part of the function. • Project Manager and Senior Scientist on a Jurisdictional Review and Guidance Manual for Green Chemistry on behalf of the Ontario Ministry of the Environment. This project involved carrying out a jurisdictional review in North America and Worldwide on Green Chemical Substitution and the Development of a Guidance Manual for Industries to consult when changing their process chemicals to a greener alternative. Liaison with the client through bi-weekly meetings and several face-to-face meetings as well as a presentation to industry representatives. • Project Manager and Senior scientist of updating of the Canadian blood lead guidance for Health Canada. This project involved the development of a guidance document for physicians and public health practitioners. Liaison with the client was key for this project as well as a workshop was presented to the Health Departments of all the Provinces and Territories to present the guidance.

HARRIET PHILLIPS, Ph.D.	
	• Project manager and senior scientist involved in a number of risk assessments for the Yukon Government including the Anvil Range Mine site, Yukon, the Mount Nansen Mine Site and the United Keno Hills Mine Site. These projects involved the collection of information from other disciplines, reviewing the material and carrying out the assessment using the Health Canada framework. Public consultation with First Nations communities and other affected communities was an integral part of these projects as well as liaising with regulators. • Project manager and risk assessor for a human health and ecological risk assessment of a proposed aluminium smelter in Trinidad. The first ever risk assessment conducted there. This involved obtaining information from the air quality specialist team and integrating this information into a risk assessment framework following the U.S. EPA framework. Public presentations to the community as well as the Environmental Management Authority were part of this project as well as an educational presentation to the EMA. • Project Manager on behalf of Atomic Energy of Canada Limited on the development of clean-up criteria for uranium in soil in Port Hope. • Project Manager on the evaluation of health effects as a result of exposure to air pollutants from transportation and industrial sources in the City of Hamilton. • Senior risk assessor involved with human health risk assessments of a number of projects in the Northwest Territories including the Canol Trail (an abandoned pipeline), and numerous abandoned mine sites including the Giant Mine, and a number of mine sites on Great Slave Lake. These projects involved the collection of information from other disciplines, reviewing the material and carrying out the assessment using the Health Canada framework. Public consultation with First Nations communities and other affected communities was an integral part of these projects as well as liaising with regulators. • Senior risk assessor for a number of gas-fired generating stations in Ontario on behalf of TransCanada including Portlands Energy Center, Halton Hills and Oakville. These projects involve obtaining information from the air quality specialists and biologists and integrating this information into a risk assessment framework. Public presentations and liaising with regulators was an integral part of these projects.

HARRIET PHILLIPS, Ph.D.	
	• Senior Risk Assessor for a number of proposed uranium mine developments in Northern Saskatchewan as well as for remediation activities at a number of coal mine sites in Nova Scotia. These projects involve obtaining information on source terms from a number of different disciplines and integrating them into the risk assessment framework. Presentations and discussions with regulators were integral to these projects.
Conflicts of Interest	There are no conflicts of interests. While we work for TransCanada, the projects conducted are related to electricity generation.
Confidentiality / Non-disclosure Agreement	Prepared to sign any documentation related to confidentiality/non-disclosure
References	s.22

2.4 ROLES AND RESPONSIBILITY OF PROJECT TEAM AND CONTINGENCIES

Throughout the technical sections of this proposal as well as in Table 2.3 below, we have identified resources and their roles and responsibilities for the Project. We are confident that the proposed resources will be capable of responding to the requirements associated with this Project. However, it should be noted that the depth of skills at SENES extend well beyond the members identified in this bid. Collectively, the depth offered by the project team is such that the group is capable of filling any gaps that may occur in the event that an individual team member is unable to assume their intended role. Some members of the SENES staff that can assume the roles of Technical leads have been indicated by an asterix (*) in Table 2.3 and their CV's have been supplied in Appendix B. Alternates have only been provided for the Technical leads as the support roles can be filled in by our company resources.

Finally, it is worth noting that even large numbers of staff do not ensure that the needs of a particular project will be met. The other element needed is corporate commitment to the project. The SENES team has demonstrated corporate commitment to our projects over the last 30+ years and all team members in this proposal are committed to ensuring the success of this project.

Table 2.3 Roles and Responsibilities

Proposed Team Member	Level of Education	Years of Experience	Role and Responsibility					
			Project Director	Project Manager	Project Coordinator	Technical Lead	Technical Support	Alternate for Lead Roles
SENES								
Chambers, Douglas	Ph.D.	40+	The project director and is responsible for overall quality of the project delivery Internal Reviewer					Gerd Wiatzka*
Phillips, Harriet	Ph.D.	20+		Project manager and primary point of contact, overall responsibility for the entire project		Technical lead in jurisdictional review	Support role in human health risk assessment – normal operation	Stacey Fernandes
Bell, Andrea	B.A.	15+			Project coordinator and secondary point of contact			Catherine Cone*
Bernard, Fred	M.A.	25+					Technical lead noise	Nick Shinbin*
Fernandes, Stacey	M.A.Sc.	20+				Technical lead in human health risk assessment – normal operation		Harriet Phillips
Hrebenyk, Dan	M.Sc.	30+				Technical lead in air quality, odour, and noise		Jennifer Kirkaldy*
LeBlanc, Patrice	M.Eng.	40+				Technical lead in regulatory review		Derek Doyle
Liu, Joe	Ph.D.	12+					Support role in human health risk assessment – accidents and transportation	Mehran Monabbati
Monabbati, Mehran	Ph.D.	20+				Technical lead in human health risk assessment – accidents and transportation		Douglas Chambers
Music, Svetlana	B.Sc.	25+					Support role in air quality modelling	
Parhizgari, Zahra	M.Sc.	10+					Support role in public health relating to spatially enabled data	
Shekaforoush, Sean	Ph.D.	18+					Technical support hydrology	
Theobald, Kim	B.Sc.	5+					Support role in air quality, odour, and noise	
Windisch, Leah	M.A.Sc.	8+					Support role in human health risk assessment – normal operation Support role in jurisdictional review	

Proposed Team Member	Level of Education	Years of Experience	Role and Responsibility					
			Project Director	Project Manager	Project Coordinator	Technical Lead	Technical Support	Alternate for Lead Roles
MORRISON HERSHFIELD								
Cabott, Lesley	M.A.	20+				Technical lead in public consultation		Zoe Morrison*
Turner, Jennifer	M.Sc.	10+					Support role in public consultation	
INDEPENDENTS								
Arnold, Ian	M.D.	35+				Technical lead in public health	Support role in human health risk assessment – public health	Tee Guidotti
Doyle, Derek	P.Eng	35+					Support role in regulatory review	
Guidotti, Tee	M.D.	35+				Technical director in human health risk assessment Technical lead in public health		Ian Arnold
Seif, Farhad	Ph.D.	35+					Support role in jurisdictional review Support role in human health risk assessment – accidents and transportation	

Note:* Other members of senior SENES staff that can be used for Contingencies and are not named in the proposal. The CVs are presented in Appendix B.

2.5 PROJECT MANAGEMENT STRATEGY

2.5.1 Quality Assurance Program

The SENES Quality System, implemented at its Richmond Hill Head Office, has been certified to the ISO 9001:2008 standard

SENES is a strong believer in the importance of strong internal quality assurance and quality control (QA/QC) mechanisms. The team has an internal Corporate Quality Manual developed as part of the Quality Assurance Program for executing studies and projects detailing key components and actions. The Program assures us and our clients that the deliverables that we are producing are of high quality.

Our team's Quality Assurance Program provides a framework for a planned and disciplined consideration of all the factors that influence the quality of the work undertaken from the early stage of project initiation, to project execution and project close-out. The Program follows the ISO 9001:2008 requirements and includes requirements for documentation, management responsibility, resource management, employee training, product realization and monitoring. This is achieved by developing standard operating procedures, assigning responsibilities and establishing appropriate document control.

Operating procedures provide standards against which performance and progress are measured. Responsibility assignment ensures that there is accountability for all project activities and document control procedures ensure project records are systematically archived, easily retrievable and in a standard and consistent format. The QA/QC Program is an integral part of Project Management.

Our project management approach has enabled us to achieve this consistently and is demonstrated by our long list of repeat clients.

The Quality System adopted for this project includes the following major actions:

- Project Management Tracking Form:
  - Identify and document client requirements
  - Define project work plan
  - Identify deliverables and quality assurance/review requirements
  - Identify and track project change requests
  - Document internal review and acceptance of deliverables

- Internal Review of Objectives and Specification
    - Review of draft methodology by senior staff and all appropriate technical experts
    - Revision of objectives and specifications based on internal review
- Client Review of Objectives and Specifications
    - Review by client of draft methodology
    - Revision of objectives and specification based on client review
- Internal Review of Project Work
    - Review by senior staff and all appropriate technical experts of preliminary or draft product or other work completed
    - Revision of preliminary or draft product or other work completed based on results of internal review
- Client Review of Project Work
    - Client Review of preliminary or draft product or other work completed
    - Revision and finalization of product or completion of work
- Signatures on Final Reports
    - By two senior staff members familiar with the project
    - Indicates that we stand behind our work
    - Provides specific contacts to readers

Project managers are also required to prepare regular forecasts of staff requirements on all projects, and to seek resolution of conflicting demands on team members if they arise. This management procedure helps to ensure that projects are kept on schedule.

2.5.2 Project Management Approach and Scope

Administration, direction and coordination of the assignment will be the responsibility of the management team introduced in Section 5.6. Dr. Douglas Chambers (SENES) will be the Project Director and Dr. Harriet Phillips will be the Project Manager. Andrea Bell (SENES) will provide project management support and assistance with a particular focus on ensuring coordination of the administration / budget tracking activities.

Recognizing the importance of the project management function to successful conduct of Phase 2, we commit to:

- Supporting Client throughout all stages of the assignment;
- The availability of Dr. Phillips for whatever time is necessary to ensure Client's requirements and expectations are met;
- Dr. Phillips returning all phone calls from Client within the same day;

- The seamless transfer of information from Dr. Phillips to project management team to ensure effectiveness as a back-up to Dr. Phillips on a continuing basis.

We have structured and scoped our project management program such that it not only provides for all of the assignment administration requirements (e.g., client liaison, team coordination, budget and schedule management) but also is the vehicle for conducting the general and often undefined aspects of assignment that do not conveniently fall under a technical work package umbrella. Specifically, the project management program includes the following in terms of function and assignment budget allocation (i.e., for consistency of approach and apportioning of costs, the project management budget includes funds that will be distributed to the technical team to provide for their individual input to collective tasks:

- Client liaison through regular meetings and progress reports (e.g., Bi-Weekly Reports);
- Technical and administrative coordination of the project team;
- Schedule monitoring and compliance assurance;
- Quality Control;
- Cost control and budget management;
- Scope of work control and management (e.g., Project Change Directives);

It has been our experience on large multi-disciplinary projects that this management approach allows for dealing with unforeseen circumstances and allows for timely delivery of the project. The following subsections provide further insight to the key aspects of the foregoing list of project management responsibilities.

2.5.2.1 Client Liaison and Reporting

Dr. Phillips, Ms. Bell and, as appropriate Dr. Chambers will hold "Go To Client" Web Meetings with the Client on a bi-weekly basis throughout the course of the assignment. Each meeting will be preceded by a bi-weekly progress report which will form the basis for the meeting that will follow. Each report will describe:

- status of deliverables;
- scope changes;
- schedule and budget compliance and variance;
- status of reviews and inputs; a rolling list of assignment risks and issues;
- suggested agenda for the subsequent meeting

After each meeting, we will prepare and distribute minutes to the participants and other interested parties.

2.5.2.2 Technical and Administrative Coordination

We will kick off the assignment with a project initiation meeting/workshop to introduce our team to the assignment, ensure roles and responsibilities are understood, and clarify objectives and expectations.

Once the project is underway, a bi-weekly teleconference involving all key members of the Project Team (i.e. Team Leads) will be convened, with Dr. Phillips as the Chair, throughout the course of the project. These calls will serve as the means for reviewing work progress and status; facilitating interaction among the team; and for identifying issues, risks and management strategies. These regular telephone meetings will be complemented by face-to-face meetings involving the technical teams on an as-required basis to address and resolve issues. All team members will also be required to liaise directly among themselves to ensure their technical packages are effectively integrated, where required.

2.5.2.3 Scope, Schedule and Budget Management

Management of work scope and schedule and budget compliance will be performed under the direct control of the Project Manager, Dr. Phillips, working with the experienced assistance of Ms. Bell who has provided similar management support on recent work assignments. This administration team will facilitate timely, efficient conduct of the assignment; monitor and ensure schedule and cost control; promote efficient resource allocation; and ensure that quality standards are met during the assignment. They will monitor project deliverables against agreed timelines; review project costs against established budgets, converse with the team and Client concerning compliance and adjustments that may be required; ensure that adequate and qualified staff resources are assigned to the work to meet the project deliverables and schedule; and monitor the quality of the work carried out to ensure that it meets the applicable standards.

Scope Management

The scope of the work will be established through the contracting process which will result in a signed Agreement accompanied by a detailed description of the services to be provided. The agreed scope will be altered only through the Project Change Directive process specified in the Services Agreement. In practice, this results in Work Change Order (WCO) documents that detail and authorize the change. The potential requirement for a WCO may be identified by either party and if deemed necessary by both parties, we (as the Contractor) will prepare the WCO for signature. Each WCO will describe the nature of the change and the associated consequences of the change on budget and schedule. Only when both parties have signed will the change be initiated.

Schedule Management

The schedule will be created and maintained in MS Project. Progress of the work will be a topic of ongoing management-level discussions during the bi-weekly teleconferences. The schedule will be reviewed each month and formally updated to graphically track actual versus planned progress. These updates will also address adjustments resulting from WCOs. Progress will be tracked individually for each scheduled work element. All efforts will be taken to expedite delivery but if slippage occurs, a recovery plan will be developed by the Team and proposed to the Management Team. Recovery opportunities will include increased staffing, and strategic adjustments to the approach and/or scope of the activity.

Budget Management

Our budget submission reflects our best estimate of the cost of the necessary services at the time this proposal was prepared. Invoices will be submitted in accordance with the approved milestones schedule. The invoiced amounts will be justified with a progress report describing the work completed in terms of actual hours and costs incurred against the proportion of the total hours and costs projected to that point in the work.

2.5.3 Project Risk Management

As a component of the ISO 90001 quality management system, SENES has written policy and procedures to ensure that:

- The projects are provided with adequate resources. The project core team are assigned to this project within the timeframe of the project and are available. In the case of emergency, alternative team members are assigned for the core roles and responsibilities. These alternative team members will take on the tasks with the written permission of the client. The alternative team members are provided in Table 2.3.
- The projects are completed within the timeline of the project. In case, the project is delayed due to the reasons beyond our control, the issue will be communicated with the client and the timeline will be revised with the approval of the client.
- The projects are completed within the allocated budget.

The detailed project management approach is provided in Section 2.5.2 above.

2.5.4 Time commitment of the project team

SENES has assigned the team members to this project within the timeframe and guarantees that the team members are available to take on the tasks as planned.

2.5.5 Time Commitment of the BC Health and Partners

We are anticipating that the B.C Ministry of Health and its partners will participate in the study team workshop for defining scenarios to be evaluated in the HHRA. This will be a 2-day workshop in Richmond Hill, Ontario. A webcast can be used to minimize travel costs. This workshop will be held in February 2013.

We are anticipating the B.C. Ministry of Health will participate in the stakeholder workshop to present the scenarios and obtain their input. This is anticipated to be 1-day in the communities.

It is assumed that the relevant Agencies will provide the information that is available to assess the exposure pathways namely:

- Ambient Air Quality;
- Source Emissions to air;
- Surface water Quality;
- Effluents released to Surface Water and Groundwater;
- Groundwater quality;
- Soil Quality; and
- Food (vegetables, berries, fish etc.).

Therefore there may be a time commitment to provide some of this data.

There will be bi-weekly conference calls with the Representative for the project from B.C. Health and the management team over the course of the project.

3.0 WORK AND COMMUNICATIONS PLAN

Section 1 provided some comments on the nature of the scope of work and our understanding of the contract. Section 3 provided the detailed approach to carrying out the project and this section provides the work and communications plans. Table 3.1 provides the work plan for the project.

Table 3.1 Work Plan

Deliverable / Milestone	Proposed Schedule	Team Lead		Team Support		Total Estimated Working Hours
		Staff	# of Hours	Staff	# of Hours	
Project Kick-Off	10/1/12 – 10/31/12	H. Phillips	10	T. Guidotti	10	20
Jurisdictional Review (Scan Report)						
Jurisdictional Review	10/1/12 – 3/31/13	H. Phillips	50	D. Chambers	5	205
				T. Guidotti	5	
				F. Seif	10	
				P. LeBlanc	7.5	
				L. Windisch	115	
				Graphics	7.5	
				WP	5	
Prepare Report	10/1/12 – 1/31/13	H. Phillips	20	L. Windisch	40	60
Respond to Comments	2/1/13 – 2/28/13	H. Phillips	10	L. Windisch	20	30
Finalize Report	3/1/13 – 3/31/13	H. Phillips	20	L. Windisch	40	90
				Graphics	15	
				WP	15	
Human Health Risk Assessment						
Data Gap Analysis	12/1/12 – 2/28/13	S. Fernandes	35	D. Chambers	10	100
				T. Guidotti	10	
				H. Phillips	10	

Deliverable / Milestone	Proposed Schedule	Team Lead		Team Support		Total Estimated Working Hours
		Staff	# of Hours	Staff	# of Hours	
				M. Monabbati	25	
				F. Seif	10	
Scenario Development and Source Terms	1/1/13 – 2/28/13	S. Fernandes	10	D. Chambers	5	45
				H. Phillips	10	
				T. Guidotti	5	
				P. LeBlanc	5	
				M. Monabbati	10	
Workshop	2/1/13 – 2/28/13	S. Fernandes	20	D. Chambers	10	130
				H. Phillips	20	
				T. Guidotti	20	
				I. Arnold	20	
				P. LeBlanc	20	
				M. Monabbati	20	
Framework for Assessing Scenarios	2/1/13 – 3/31/13	S. Fernandes	20	D. Chambers	10	90
				H. Phillips	30	
				T. Guidotti	10	
				M. Monabbati	20	
Assessment of Effects	5/1/13 – 11/29/13	S. Fernandes	120	D. Chambers	50	820
				H. Phillips	70	

Deliverable / Milestone	Proposed Schedule	Team Lead		Team Support		Total Estimated Working Hours
		Staff	# of Hours	Staff	# of Hours	
				T. Guidotti	10	
				M. Monabbati	120	
				F. Seif	80	
				J. Liu	120	
				S. Shekarforoush	50	
				L. Windisch	200	
Air Quality Assessment	12/1/12 – 9/30/13	D. Hrebenyk	150	S. Music	200	750
				K. Theobald	400	
Noise Assessment	4/1/13 – 9/30/13	F. Bernard	80	K. Theobald	95	175
Risk Perspective	11/1/12 – 1/31/13	S. Fernandes	30	D. Chambers	20	150
				H. Phillips	30	
				T. Guidotti	40	
				I. Arnold	30	
HHRA Report (Respond to Comments / Finalize Report)	2/1/14 – 3/31/14	S. Fernandes	45	H. Phillips	40	180
				T. Guidotti	10	
				M. Monabbati	35	
				L. Windisch	50	
Regulatory Review (Review of BC Statutory, Regulatory and Policy Framework)						
Identify Whether Acceptable for	10/1/12 - 10/31/12	P. LeBlanc	20	D. Doyle	20	40

Deliverable / Milestone	Proposed Schedule	Team Lead		Team Support		Total Estimated Working Hours
		Staff	# of Hours	Staff	# of Hours	
Managing Health Risk						
Identify Gaps	3/1/13 - 8/31/13	P. LeBlanc	30	T .Guidotti	2.5	47.5
				H. Phillips	5	
				D. Doyle	10	
Identify Benefits	5/1/13 - 8/31/13	P. LeBlanc	30	T .Guidotti	2.5	47.5
				H. Phillips	5	
				D. Doyle	10	
Report	7/1/13 - 9/30/13	P. LeBlanc	50	T .Guidotti	7.5	92.5
				H. Phillips	5	
				D. Doyle	30	
Public Health						
Review Health Issues from Phase I Report	10/1/12 - 11/30/12	I. Arnold	10	T. Guidotti	10	30
				H. Phillips	5	
				Z. Parhizgari	5	
Review Health in Communities with Oil & Gas Activities	12/1/12 - 2/28/13	I. Arnold	20	T. Guidotti	20	55
				H. Phillips	5	
				Z. Parhizgari	10	
Understand Current Status of Health in the Area	12/1/12 - 2/28/13	I. Arnold	20	T. Guidotti	20	55
				H. Phillips	5	

Deliverable / Milestone	Proposed Schedule	Team Lead		Team Support		Total Estimated Working Hours
		Staff	# of Hours	Staff	# of Hours	
				Z. Parhizgari	10	
Summarize Information for Input into HHRA	2/1/13 - 9/30/13	I. Arnold	40	T. Guidotti	40	175
				H. Phillips	5	
				Z. Parhizgari	80	
				WP	10	
***Stakeholder Communication (proposed to be ongoing throughout the project)**						
Work the Ministry to establish Stakeholder Committee	10/1/12 – 12/31/12	L. Cabott	10	J. Turner	20	30
Review the Results from Phase 1 Report	10/1/12 – 12/31/12	L. Cabott	40	J. Turner	80	120
Communication Plan	10/1/12 – 12/31/12	L. Cabott	10	J. Turner	30	40
Scenario Development Workshop	01/01/13- 2/28/13	L. Cabott	40	J. Turner	70	110
Workshop Follow up	3/1/13-12/31/13	L. Cabott	20	J. Turner	45	65
Summary Engagement Report	1/1/13 - 2/28/14	L. Cabott	40	J. Turner	60	100
Project Management	10/1/12 - 3/31/14	H. Phillips	135	A. Bell	395	530

3.1 COMMUNICATIONS PLAN

Table 3.2 below provides a summary of the proposed communications plan for the Client, project team and stakeholders over the course of the project.

Table 3.2 Communications Plan

Key Group	Communications Plan
Client	• "Go To Client" Web Meetings with the Client on a bi-weekly basis throughout the course of the assignment • Use of a bi-weekly progress report preceding the meeting • Workshop to discuss the evaluation of scenarios in February 2013 • Once draft reports have been submitted, comments will be dispositioned in tabular form 2 weeks after receipt of comments
Project Team	• Bi-weekly teleconference involving all key members of the Project Team (i.e. Team Leads) • Face-to-face meetings to complement bi-weekly teleconference call on an as-required basis to address and resolve issues. • Direct liaison of all team members among themselves to ensure their technical packages are effectively integrated, where required • The Use of a web-based ftp site for all information pertaining to the project
Regulators	• Meeting at the Start of the Project to discuss the Project • On-going communications throughout the Project when needed
Stakeholders	• Formation of a Stakeholder committee • Use of email, web, and local media with news stories • Development of a stakeholder communications plan with the stakeholder committee as experience indicates the need for flexibility with respect to how people particularly FN's want to participate. It may be in the form of newsletters or a one page update to Chief and Council, it may or not be the use of email

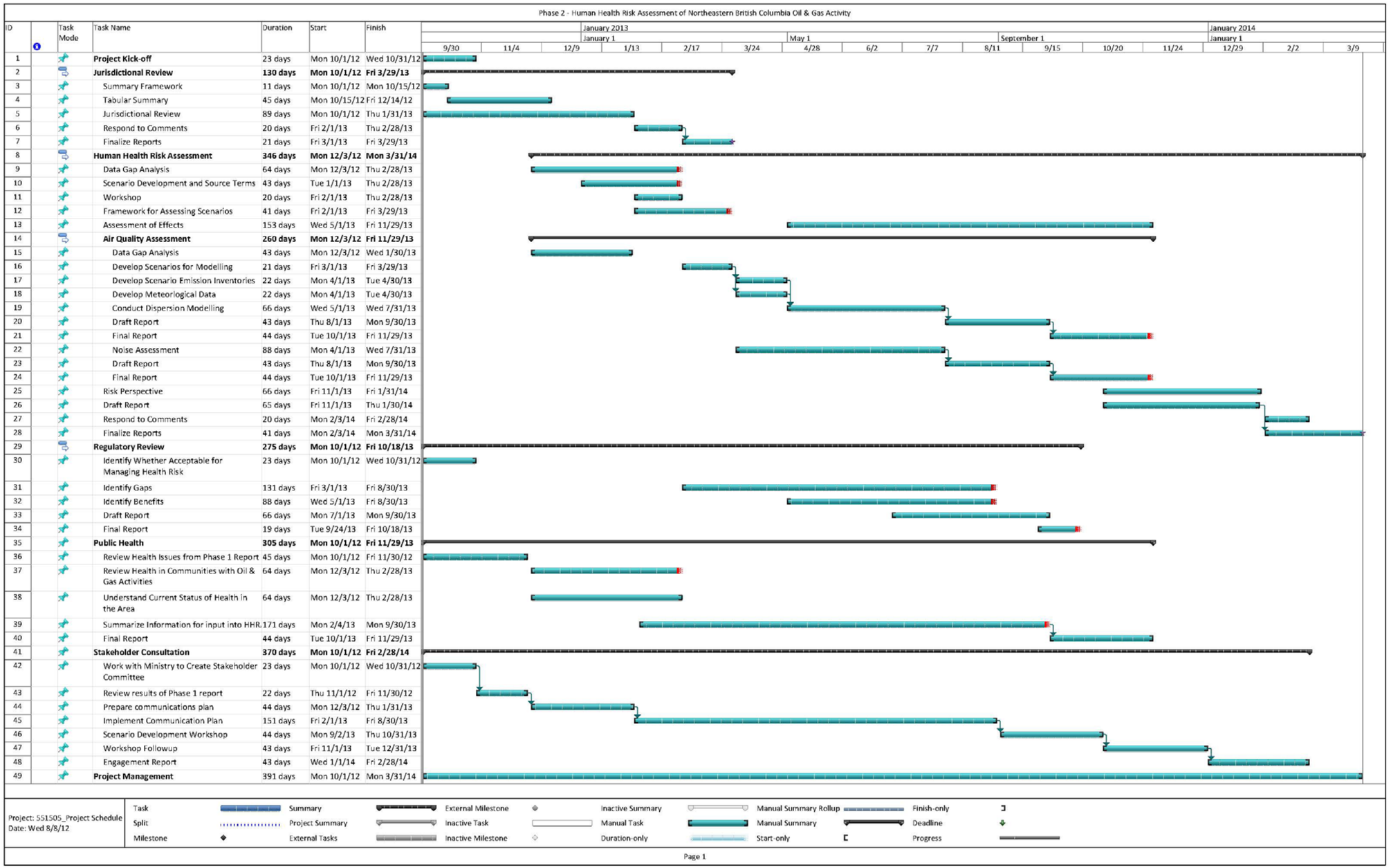
3.2 ADHERENCE TO SCHEDULE

3.2.1 Project Schedule

The schedule we propose for performance of the assignment is illustrated graphically as shown in Figure 3.1. Upon award, we will review the schedule with Client and revise it as may be appropriate to establish firm dates for the key assignment deliverables. When the key dates have been confirmed, we will further elaborate the schedule to articulate the work plan and timelines in greater detail, and freeze it as the baseline upon which to track the progress of the work.

The Project Management team will monitor the schedule on an ongoing basis. Every effort will be made to optimize the timeline, and where schedule slippage is evident, corrective action will be taken to recover.

Figure 3.1 Proposed Project Schedule



ID	Task Mode	Task Name	Duration	Start	Finish
1		**Project Kick-off**	23 days	Mon 10/1/12	Wed 10/31/12
2		**Jurisdictional Review**	**130 days**	**Mon 10/1/12**	**Fri 3/29/13**
3		Summary Framework	11 days	Mon 10/1/12	Mon 10/15/12
4		Tabular Summary	45 days	Mon 10/15/12	Fri 12/14/12
5		Jurisdictional Review	89 days	Mon 10/1/12	Thu 1/31/13
6		Respond to Comments	20 days	Fri 2/1/13	Thu 2/28/13
7		Finalize Reports	21 days	Fri 3/1/13	Fri 3/29/13
8		**Human Health Risk Assessment**	**346 days**	**Mon 12/3/12**	**Mon 3/31/14**
9		Data Gap Analysis	64 days	Mon 12/3/12	Thu 2/28/13
10		Scenario Development and Source Terms	43 days	Tue 1/1/13	Thu 2/28/13
11		Workshop	20 days	Fri 2/1/13	Thu 2/28/13
12		Framework for Assessing Scenarios	41 days	Fri 2/1/13	Fri 3/29/13
13		Assessment of Effects	153 days	Wed 5/1/13	Fri 11/29/13
14		**Air Quality Assessment**	**260 days**	**Mon 12/3/12**	**Fri 11/29/13**
15		Data Gap Analysis	43 days	Mon 12/3/12	Wed 1/30/13
16		Develop Scenarios for Modelling	21 days	Fri 3/1/13	Fri 3/29/13
17		Develop Scenario Emission Inventories	22 days	Mon 4/1/13	Tue 4/30/13
18		Develop Meteorlogical Data	22 days	Mon 4/1/13	Tue 4/30/13
19		Conduct Dispersion Modelling	66 days	Wed 5/1/13	Wed 7/31/13
20		Draft Report	43 days	Thu 8/1/13	Mon 9/30/13
21		Final Report	44 days	Tue 10/1/13	Fri 11/29/13
22		Noise Assessment	88 days	Mon 4/1/13	Wed 7/31/13
23		Draft Report	43 days	Thu 8/1/13	Mon 9/30/13
24		Final Report	44 days	Tue 10/1/13	Fri 11/29/13
25		Risk Perspective	66 days	Fri 11/1/13	Fri 1/31/14
26		Draft Report	65 days	Fri 11/1/13	Thu 1/30/14
27		Respond to Comments	20 days	Mon 2/3/14	Fri 2/28/14
28		Finalize Reports	41 days	Mon 2/3/14	Mon 3/31/14
29		**Regulatory Review**	**275 days**	**Mon 10/1/12**	**Fri 10/18/13**
30		Identify Whether Acceptable for Managing Health Risk	23 days	Mon 10/1/12	Wed 10/31/12
31		Identify Gaps	131 days	Fri 3/1/13	Fri 8/30/13
32		Identify Benefits	88 days	Wed 5/1/13	Fri 8/30/13
33		Draft Report	66 days	Mon 7/1/13	Mon 9/30/13
34		Final Report	19 days	Tue 9/24/13	Fri 10/18/13
35		**Public Health**	**305 days**	**Mon 10/1/12**	**Fri 11/29/13**
36		Review Health Issues from Phase 1 Report	45 days	Mon 10/1/12	Fri 11/30/12
37		Review Health in Communities with Oil & Gas Activities	64 days	Mon 12/3/12	Thu 2/28/13
38		Understand Current Status of Health in the Area	64 days	Mon 12/3/12	Thu 2/28/13
39		Summarize Information for input into HHR	171 days	Mon 2/4/13	Mon 9/30/13
40		Final Report	44 days	Tue 10/1/13	Fri 11/29/13
41		**Stakeholder Consultation**	**370 days**	**Mon 10/1/12**	**Fri 2/28/14**
42		Work with Ministry to Create Stakeholder Committee	23 days	Mon 10/1/12	Wed 10/31/12
43		Review results of Phase 1 report	22 days	Thu 11/1/12	Fri 11/30/12
44		Prepare communications plan	44 days	Mon 12/3/12	Thu 1/31/13
45		Implement Communication Plan	151 days	Fri 2/1/13	Fri 8/30/13
46		Scenario Development Workshop	44 days	Mon 9/2/13	Thu 10/31/13
47		Workshop Followup	43 days	Fri 11/1/13	Tue 12/31/13
48		Engagement Report	43 days	Wed 1/1/14	Fri 2/28/14
49		**Project Management**	391 days	Mon 10/1/12	Mon 3/31/14

4.0 QUALIFICATIONS AND EXPERIENCE

4.1 CORPORATE PROFILE

SENES is a leading Canadian environmental consultancy with national offices in Toronto, Ottawa, Vancouver, Calgary and Yellowknife. During its 32-year history, the company has successfully completed over 5000 projects throughout North and South America, Europe, Asia, and Africa. Through these assignments, SENES has established itself as a leader and innovator in the provision of expert environmental services. SENES is a full service environmental firm specializing in the provision of environmental expertise to private and public sector clients operating in the areas of manufacturing, mineral resource development and processing, and in the energy sector. Our staff services have ranged from the provision of individual expert advice on critical issues or events, through to the full scale development and management of major multi-disciplinary projects.

SENES' core disciplines include:

- risk assessments including facility and transportation risk, human health, and ecological risk;
- development and application of pathways and predictive models;
- application of simple and complex air dispersion models;
- air, water, soil, sediment, and biota quality assessments including environmental effects monitoring, assimilative capacity assessments and impact predictions;
- environmental assessments ranging from screening level evaluations to full scale comprehensive assessments for new and existing projects;
- development of weather forecasting tools and prediction of climate change impacts on projects;
- environmental site assessments, audits, due diligence and liability reviews;
- development of waste management programs for industrial, municipal, hazardous, and radioactive wastes;
- environmental management plans and the application of ISO14000;
- assessment and development of remedial action, decommissioning and closure plans;
- assessment and development of site cleanup levels;
- development of regulatory clean-up levels;
- institutional training and capacity building; and
- public consultation.

As can be seen on the following pages, SENES offers a wealth of relevant environmental and resource management expertise, and directly relevant regional experience that can be brought to bear on the project. An example of work related to some aspects of this project is provided in the text box below.

The NWT Environmental Audit:
An Example of Project with Some Elements of the RfP

SENES was selected to perform the first "NWT Environmental Audit" (the Audit)[1], a requirement of the Mackenzie Valley Resource Management Act (MVRMA). This multi-disciplinary assignment involved a comprehensive assessment of the environmental and resource management regimes of the Mackenzie Valley and the Inuvialuit Settlement Region. Components of the Audit included evaluations of: 1) processes for land-use planning, Environmental Impact Assessment, regulation, and enforcement; 2) processes to monitor cumulative impacts on the environment; and 3) an assessment of the status of the environment.

SENES conducted extensive research and interviewed virtually all of the organizations that actively participate in the NWT's environmental management regimes. This included resource management boards, government regulators, government scientific authorities, Aboriginal land claim organizations, industry, non-governmental organizations, and members of the public.

At the highest level, the objective of the Audit was to determine the extent to which the NWT's environmental management regimes are effective in protecting the environment. However root causes that have resulted in the under-performance of the system were also identified and evaluated.

This challenging assessment highlights the breadth of experience available with the SENES team

4.2 EXAMPLES OF REGULATORY AND JURISDICTIONAL REVIEWS

- **Toolkit on Development of Legal and Institutional Infrastructures for Sound Management of Chemicals in Developing Counties - SAICM office in Geneva -** A Guidance Document for the Strategic Approach to International Chemicals Management (SAICM) was prepared to assist in developing legal and institutional infrastructures for the sounds management of chemicals in developing countries. A jurisdictional review was also conducted assess the baseline of existing guidance on legal and institutional infrastructures.
- **Review of Current and Proposed Regulatory and Non-Regulatory Management tools Pertaining to Selected Petroleum Substances Under the Chemicals Management Plan-Health Canada -** This involved the development of a comprehensive

[1] An electronic version of the 2005 NWT Environmental Audit and Status of the Environment Report can be downloaded from http://nwt-tno.inac-ainc.gc.ca/nwt-a_e.htm

list of regulatory and non-regulatory tools in place (or proposed) for the management of approximately 160 selected high priority petroleum substances. While the focus was on Canadian tools, part of the study was to review current and proposed tools in other jurisdictions.

4.3 EXAMPLES OF OIL & GAS EXPERIENCE

- **Natural Gas Pipeline Facility Risk Assessment** - The purpose of this study was to identify hazards, assess the probability and consequences of the hazard scenarios, risk assessment, ranking the hazard scenarios, and identifying the risk management measures to mitigate and prevent the risks for a natural gas pipeline which feeds a number of industrial facilities. The consequence analysis included the assessment of fire, and explosion from release of natural gas from the pipeline and its components and the assessment of impact on the members of public, and surrounding natural environment.

- **Petroleum Product Pipeline Facility Risk Assessment** - The purpose of this study was to identify hazards, assess the probability and consequences of the hazard scenarios, risk assessment, ranking the hazard scenarios, and identifying the risk management measures to mitigate and prevent the risks for a petroleum product pipeline in Ontario and Quebec in Canada. The consequence analysis included the assessment of fire, and explosion from release of petroleum products.

- **LNG Storage Facility Environmental Assessment** - SENES was contracted to support a hazard and risk assessment evaluation of a large liquefied natural gas storage (peak storage) facility in order to assist in the assessment of potential risks and to evaluate conformance with facility design requirements. SENES assisted in the identification and quantification of potential hazards and subsequently performed a consequence-risk analysis. In addition, SENES provided input to regulatory discussions and provided a risk-context for the results of the risk assessment. Specifically, the facility evaluation included: assessment of conformance with facility design requirements; assessment of likely conformance with anticipated changes to Canadian standards; identification of potential facility upgrades inciated as required to conform to anticipated standards; HAZOPS analysis; event tree analysis; consequence analysis (including scenario development, dense gas plume modelling, fire modelling); identification of potential upgrades to mitigate identified risks; provision of risk context for upgraded LNG storage facility.

- **Bahamas LNG Facility Environmental Assessment -** The consultancy focused on evaluation of environmental impacts, environmental management planning, occupational health and safety, socio-economics, hazard mitigation and emergency response planning.

Based in the Bahamas, the SENES team coordinated all components of the multi-discipline technical review. External technical experts provided technical oversight in the following area: air quality, noise and vibration, site remediation, groundwater, marine biology, replacement of coral reefs, risk assessment and oceanography. A comprehensive Environmental Management Plan for the undertaking was reviewed and an extensive public consultation program was conducted throughout the country. The project also involved training BEST staff on all aspects of the review.

- **Pumping station Facility Risk Assessment** - SENES conducted a facility risk assessment for a petroleum product pumping station which pumps gasoline. Diesel fuel and jet fuel from Montreal to Toronto. The old pump station was to be replaced with a new one which was designed to be located within the transient zone, rather than heavy industrial zone. The purpose of the study was to show that the risk of fire, explosion, and fatality to a light industrial zone located at the vicinity of the facility is less than 10E-4 and to provide technical recommendations to be implemented to reduce such risks from the operation of the pumping station.

- **Study of Anticipated LNG Impacts -** On behalf of THE Government of Canada, SENES undertook a qualitative assessment of the potential impacts/risks associated with the development of three (3) Liquefied Natural Gas (LNG) terminals in Maine, on the United States side of Passamaquoddy Bay. This included, but was not limited to, the impacts that may result from marine traffic through Canadian waters (the approaches to Head Harbour Passage, Head Harbour Passage and Passamaquoddy Bay). Several hazard scenarios were assessed including vapour cloud, pool fire, LNG spill, cold gas hazards, etc. The assessment considered the potential impacts on the marine environment and, because this is linked through coastal ecosystems and wetlands to the terrestrial environment, potential impacts on local land-based flora and fauna. A significant aspect of the work involved assessment of the potential risks of these LNG facilities to environmentally significant areas including significant species such as the Right Whales. A detailed regulatory review was also undertaken. A project report was prepared and was accepted by the Government of Canada.

- **LNG Ontario** - Project management services and co-ordination of a multi-disciplinary team of engineers and scientists selecting a site for a peak shaving Liquefied Natural Gas (LNG) storage plant in southern Ontario were provided. The process involved liquefying the natural gas and storing it in domes under high pressure. Gas would be collected during low use periods and released during high energy demand periods. The project included an extensive site selection process followed by the preparation of

comprehensive environmental and socio-economic assessments that included in-house technical expertise in air quality, noise, surface water quality and risk assessment.

- **Review of Current And Proposed Regulatory and Non-Regulatory Management Tools Pertaining to Selected Petroleum Substances under the Chemicals Management Plan -** The objective of this study was to develop a comprehensive list of regulatory and non-regulatory tools in place (or proposed) for the management of petroleum substances to be addressed under the PSSA. While the focus was on Canadian tools, a brief review of current and proposed tools in other jurisdictions was completed. The regulations or guidelines overseeing ambient conditions that affect the operations of the petroleum facilities indirectly were covered in this study. Management tools identified in this study were classified as being either regulatory (e.g., laws, regulations and regulatory guidelines) or non-regulatory (e.g., codes of practice, best management practices and industry initiatives) in nature.

4.4 HUMAN HEALTH RISK ASSESSMENT

The emergence of risk assessment as an environmental management and decision-making tool is new for some, but is a long-standing strength of SENES. Risk assessment methodologies and techniques have been combined with uncertainty analysis by SENES to provide clients with a dynamic framework for technical and management decision-making. This approach allows taking into account the inherent and natural variability associated with various options, as well as allowing for the consideration of the degree of confidence that can be assigned to each element.

SENES' expertise in the application of risk-based scientific analysis has been recognized by such organizations as:

- INAP (the International Network for Acid Prevention) for who SENES developed a state of the art document on the application of risk assessment to acid mine drainage;
- the NMA - National Mining Association (formerly the American Mining Congress) to whom we have provided guidance and support since the early 1980's;
- the NRC - Nuclear Regulatory Agency, for whom we carried out a UF_6 source characterization assessment and atmospheric dispersion modelling;
- the IAEA - International Atomic Energy Commission, who have requested our input into various advisory groups on waste management and international inspections;
- the FIPR - Florida Institute of Phosphate Research for whom we are investigating the potential risk associated with commercial use of phosphogypsum for road construction and agriculture;

- Health Canada – for whom we have developed a radiological risk manual, developed estimated daily intakes for a number of contaminants and carried out assessments of trihalomethanes in drinking water.
- the U.S. EPA - we have successfully argued/contested EPA interpretations and opinions on behalf of various clients and have appeared as expert witnesses;
- in addition to the above we have worked for numerous mining industry and commercial clients both directly and through association with legal counsel (e.g. Covington Burling; Shaw Pittman Potts & Trowbridge) for such clients including ATLAS Corporation, Homestake, Barrick, Placer, Kerr-McGee, Everest Minerals, Cleveland Cliffs, INCO, Inmet and many more.

SENES uses standard procedures as outlined by various regulatory bodies (U.S. EPA, CCME, Health Canada, etc.) to carry out ecological and human health risk assessments using site characterization data. To facilitate the assessment of future conditions, SENES has developed customized proprietary models to determine the transport and fate of metals, organics and radionuclides in the environment. In addition to the broad range of engineering and scientific skills within the firm, SENES also offers expertise in epidemiology and toxicology that is brought to bear on these assessments. The unique blend of SENES' risk assessment skills and experience has been recognized by many national and international organizations.

Through risk assessment and other areas of expertise, SENES has worked on high profile contaminated sites around the world. This has included sites contaminated by past industrial activities such as metal refining and processing and other heavy and secondary industries in urban settings, sites affected by coal and petroleum use and storage, areas impacted by radioactivity resulting from uranium, radium, or other heavy minerals recovery and refining or naturally occurring radioactivity materials (NORM). The sites have ranged in size from small industrial and residential properties, to large parcels of land managed by private or public sector organizations. A few examples are provided below:

Preparation of a Guidance Manual for Radiological Risk Assessment for Human Health - Under the Federal Contaminated Sites Action Plan (FCSAP) program, SENES prepared a guidance manual for radiological risk assessments for human health at federal contaminated sites in Canada. This manual is designed as a "how to" document for conducting typical radiological risk assessments. The manual also provides a background to the principles applied to radiological risk assessments and a comparison to conventional chemical risk assessments.

Human Health and Ecological Risk Assessment for a Proposed Aluminium Smelter Facility in Trinidad and Tobago - SENES was retained to conduct a human health and ecological risk assessment for emissions from a proposed aluminium smelter complex in Trinidad and Tobago.

The risk assessment entailed the use of emission estimates from an Air Dispersion model for the facility itself as well as cumulative emissions from other proposed facilities such as a power plant and urea plants that are proposed in the area as well as the asphalt lake. The results of the assessment were presented to the regulatory agency in Trinidad and Tobago as well as to the locally affected community. As part of the project, a presentation was also made at a symposium for the general public where international experts were also present.

Development of Estimated Daily Intake Limits for the Canadian Population - The objective of the project was to assist Health Canada in the development of scientifically defensible and critically evaluated probabilistic estimated daily intake rates (EDIs) for fourteen (14) pre-selected chemicals. The focus of the information was Canadian data; however data from other jurisdictions such as the United States and Europe were also reviewed. These Estimated Daily Intakes will be used in the updating of Soil Quality Guidance as well as inputs to the Preliminary Quantitative and Detailed Quantitative spreadsheets that have been developed by Health Canada for use in the Federal Contaminated Sites Action Plan (FCSAP) program. The review of the data encompassed various media such as ambient air, indoor air, indoor settled dust, soil, water, breast milk and food. As part of the review process, a scoring sheet was developed in consultation with Health Canada in order to standardize the evaluation of the data quality. Probabilistic distributions of the various media concentrations were developed from the summarized data and probabilistic EDIs were developed for various age groups using probability distribution functions for intakes provided by Health Canada.

4.5 PUBLIC HEALTH

Development of Blood Lead Guidance for Health Canada - Health Canada retained SENES in association with Azimuth and E &OH Plus to provide expert advice in developing current, evidence-based draft guidance for Canadian public health officials and clinicians on issues relevant to responding to atypical environmental lead exposures in individuals and communities. A fundamental principle of the draft guidance was that the requirement for intervention was based not on an absolute blood lead level but on comparing the blood lead test result to what is normal, or typical, for the general Canadian population.

Medical Officer of Health in Newfoundland, Eastern Region - An assessment of the potential health risk to residents of a community consuming elevated levels of arsenic in drinking water was completed for the Medical Officer of Health in Newfoundland, Eastern Region. As part of this assessment the current issues in the toxicology of arsenic were reviewed, community exposure data were reviewed and a quantitative health risk assessment was conducted. Throughout the project, risk communication was of utmost importance as the information was

provided in order to assist the medical officers in public discussions with the community and with local medical practitioners.

Simcoe County District Health Unit - SENES completed an assessment to address the current risk of exposure to residential areas above a trichloroethene (TCE) ground water plume. Health based criteria were developed for indoor air concentrations of TCE and its degradation products.

4.6 TEAM EXPERTISE

Core Team qualification summaries are presented in Table 4.1 below. In addition, the resource capabilities and qualifications of each of the members of our Core Team are provided in the following Staff Qualification Tables. Curricula Vitae are provided in Appendix B.

Table 4.1 Core Team Experience

Proposed Team	Level of Education	Years of Experience	PM: Project Management	Environmental Pathways of Exposure: Atmospheric	Noise	Water Quality & Quantity	Groundwater	Land	Food	Environmental Hazards: Monitoring & Compliance	Regulation & Enforcement	Communication	Emergency Response	Hazards Posed through Events: Fluid Releases	Incidents	Increased Traffic	Health: Public Health	Occupational Health	Public Consultation	Oil & Gas Operations: Exploration & Drilling	Processing	Wells & Pipelines	Traffic & Transportation	Geology & Hydrogeology	Environmental Reviews
SENES																									
Bell, Andrea	B.A.	15+	✓								✓														
Bernard, Fred	M.A.	25+	✓		✓							✓													✓
Chambers, Douglas	Ph.D.	40+	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓			✓			✓
Fernandes, Stacey	M.A.Sc.	20+				✓		✓	✓	✓		✓		✓	✓	✓		✓	✓							✓
Hrebenyk, Dan	M.Sc.	30+		✓						✓	✓				✓											
LeBlanc, Patrice	M.Eng.	40+	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓				✓
Liu, Joe	Ph.D.	10+												✓	✓	✓										
Monabbati, Mehran	Ph.D.	20+									✓		✓	✓	✓	✓					✓		✓			
Music, Svetlana	B.Sc.	25+		✓																						
Pathzgan, Zahra	M.Sc.	10+				✓		✓	✓					✓	✓	✓										
Phillips, Harriet	Ph.D.	20+	✓			✓		✓	✓		✓	✓		✓			✓		✓							✓
Shekarforoush, S.	Ph.D.	25+					✓																	✓		
Theobald, Kim	B.Sc.	5+		✓																						
Windisch, Leah	M.A.Sc.	5				✓	✓	✓	✓																	
MORRISON HERSHFIELD																										
Cabott, Lesely	M.A.	20+									✓	✓	✓													
Turner, Jennifer	M.Sc.	10+				✓	✓	✓	✓	✓	✓	✓								✓			✓			
INDEPENDENTS																										
Arnold, Ian	M.D.	35+		✓					✓	✓	✓	✓	✓	✓	✓		✓	✓	✓							
Doyle, Derek	P.Eng.	35+									✓	✓	✓						✓	✓	✓	✓				
Guidolin, Tee	M.D., MPH	35+	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Seif, Farhad	Ph.D.	35+											✓								✓	✓	✓			

NOTE:
✓ Equals Expertise and Knowledge

4.6.1 Project Director

DOUGLAS CHAMBERS, PhD	
Education & Qualifications	Ph.D., Physics 1973, McMaster University B.Sc., Physics, 1968, University of Waterloo; in addition, supplementary courses, including amongst others • Graduate Courses on biostatistics (U of T) • Air Dispersion Modelling USEPA Research Triangle Park
Professional Affiliations	Numerous, including US EPAs Science Advisory Board, Canadian Standards Association, Member of Technical Committee on Environmental Radiation Protection (1978 to 1994, Chairman 1987 to 1994); Member of Technical Committee on Risk Analysis (1989) 2006 Member CSA N288 TC and many others
Project Role(s) and Responsibilities	Project Director and Internal Advisor • Ensure that adequate resources are available for the project to deliver on time and budget • Planning and strategic advice • Technical review and quality assurance • Risk Communication
Strengths that are relevant to this Project	• Over 40 years' experience in hazard assessment and human health risk assessment • Experienced co-ordinating large multi-disciplinary, multi-year teams • Good Organizational Skills • Effective Communicator • Experience with communicating risks to communities including First Nations
Rationale for Role(s) (Relevant Experience)	• Extensive Project Management experience on large multi-disciplinary and multi-year projects • Wide-ranging experience on human health risk assessments throughout Canada, the United States and internationally • Canadian experience includes projects for government and industry in British Columbia, Alberta, Saskatchewan, Northwest Territories, Nunavut, Nunatsiavut, Yukon, Manitoba, Ontario, Quebec, New Brunswick, Nova Scotia and Newfoundland and Labrador. • Extensive experience on air quality and human health risk assessments for a various Sectors ; examples include risk assessment of drinking water and distribution sources and development of risk informed decision tool (BC Health), Hazard and Risk assessment for Tilbury Island LNG

DOUGLAS CHAMBERS, PhD	
	storage (BC Gas), management of radioactive wastes from oil and gas exploration and production (American petroleum Institute), hazard and risk assessment for LNG carriers passing through Canadian waters in New Brunswick enroute to Maine LNG terminus (Foreign Affairs Canada). • Air quality and risk assessments for numerous electrical generation facilities natural gas-fired generating stations, coal and nuclear generating stations, air quality and risk assessments for numerous industrial facilities including smelters, mining operations (development, operation and decommissioning), , contaminated and industrial sites, develop and present training courses on risk assessment and risk informed decision making for governmental organizations, South Africa Council on Nuclear safety, AREVA, Walkerton Clean Water Centre amongst others. • Epidemiological feasibility studies, including amongst others, epi feasibility for Deline ore carriers (for the Deline Canada Uranium team). • Experience in liaising with regulators such as Health Canada, Environment Canada, Canadian Nuclear Safety Commission, USEPA, USNRC, European Commission, various Provincial and State agencies; Government agencies in Germany (Federal Ministry of Environment (BMU) and states of Saxony and Theuringea), South African regulators, Chilean regulators, UK regulators, French regulators amongst others. • Experience in designing, supervising and conducting air quality and risk assessments throughout North America and Peer review experience in reviewing many air quality and risk assessments on behalf of lawyers, regulatory agencies and the private sector.
Public Sector vs Private Sector work	• Experience in working with public sector clients including regulators such as Health Canada, Environment Canada, Alberta Environment, Ontario Ministry of the Environment, Canadian Nuclear Safety Commission, the USNRC, the US EPA, Florida DPHS, Colorado DPHS etc. Atomic Energy Canada Limited, Ontario Power Generation, Bruce Power, Manitoba Hydro, Alberta Environment, BC Health, Walkerton Clean Water Centre, and others. • Experience in working with private sector clients including AREVA Resources Canada, Cameco Corporation, TransCanada Pipelines, Florida Institute of Phosphate

DOUGLAS CHAMBERS, PhD	
	research (FIPR), Billiton, Rio Tinto, New Brunswick Power, The Fertilizer Institute (USA) amongst others.
Examples of Relevant Project Experience (last 5 years)	• Project Director for evaluation of hazards and risk assessment of LNG transport though New Brunswick waters to a proposed LNG terminal in Maine. • Project Director and technical contributor to large multi-year environmental assessment for renewal of uranium refining and conversion facility in Port Hope Ontario. • Evaluated risks from radon in natural gas (from fracking in upper New York and Pennsylvania) for use in New York City. • Director of several air quality and risk assessment projects for a number of gas-fired generating stations in Ontario on behalf of TransCanada including Portlands Energy Center, Halton Hills and Oakville. Directed exposure pathways and risk assessments for a number of proposed new uranium mine developments in Northern Saskatchewan and the United States. • Presentations and discussions with local communities and regulators were integral to these projects.
Conflicts of Interest	There are no conflicts of interests. While we work for TransCanada, the projects conducted are related to electricity generation.
Confidentiality / Non-disclosure Agreement	Prepared to sign any documentation related to confidentiality/non-disclosure.
References	s.22

4.6.2 Project Manager

HARRIET PHILLIPS, Ph.D.	
Education & Qualifications	Ph.D., Chemical Engineering, 1991, University of Waterloo, Waterloo M.Eng., Chemical Engineering, 1984, McGill University, Montreal B.Sc., Biochemistry, 1981, University of Western Ontario, London
Professional Affiliations	Society of Risk Analysis
Project Role(s) and Responsibilities	Project Manager - overall responsibility for the entire project Technical Lead Jurisdictional Review – Lead researcher on the Jurisdictional review Technical Support Human Health Risk Assessment – Support role in human health risk assessment
Strengths that are relevant to this Project	• Over 20 years' experience in human health risk assessments • Experience coordinating multi-disciplinary teams • Good Organizational Skills • Effective Communicator • Experience with communicating risks to communities including First Nations
Rationale for Role(s) (Relevant Experience)	• Extensive Project Management experience on multi-disciplinary projects • Wide-ranging experience on human health assessments in Canada including British Columbia, Saskatchewan, Northwest Territories, Yukon, Nunavut, Manitoba, Nova Scotia, New Brunswick and Ontario • Extensive experience on human health assessments for a number of different Sectors including natural gas-fired generating stations, coal and nuclear generating stations, smelters, mining operations (development, operation and decommissioning), coal mines, contaminated and industrial sites • Experience in liaising with regulators such as Health Canada, Environment Canada, Canadian Nuclear Safety Commission and Provincial agencies • Designated as a Qualified Person for Risk Assessment under the Ontario Regulation 153/04 • Experience in conducting risk assessments Internationally including the United States, Germany, Guyana and Trinidad and Tobago • Peer review experience in reviewing many risk assessments on behalf of First Nations, Lawyers, regulatory agencies and the private sector

HARRIET PHILLIPS, Ph.D.	
Public Sector vs Private Sector work	• Experience in working with public sector clients including regulators such as Health Canada, Environment Canada, Alberta Environment, Ontario Ministry of the Environment as well as Atomic Energy Canada Limited, Ontario Power Generation, Public Works and Government Services Canada, Aboriginal Affairs and Northern Development Canada, Cape Breton Development Corporation, New Brunswick Health and Welfare, Canada-United States-Ontario-Michigan Border Transportation Partnerships, Yukon Government, B.C. Health. • Experience in working with private sector clients including AREVA Resources Canada, Cameco Corporation, TransCanada.
Examples of Relevant Project Experience (last 5 years)	• Project Manager of team conducting reviews of risk assessments for the Ontario Ministry of the Environment. This project involves the review of risk assessments under Ontario Regulation 153/04 on behalf of the Ministry. The Project Manager role involves liaising with the client, sending the documentation to the expert reviewers and collating the overall review as well as a senior review function. Billings are also completed as part of the function. • Project Manager and Senior Scientist on a Jurisdictional Review and Guidance Manual for Green Chemistry on behalf of the Ontario Ministry of the Environment. This project involved carrying out a jurisdictional review in North America and Worldwide on Green Chemical Substitution and the Development of a Guidance Manual for Industries to consult when changing their process chemicals to a greener alternative. Liaison with the client through bi-weekly meetings and several face-to-face meetings as well as a presentation to industry representatives. • Project Manager and Senior scientist of updating of the Canadian blood lead guidance for Health Canada. This project involved the development of a guidance document for physicians and public health practitioners. Liaison with the client was key for this project as well as a workshop was presented to the Health Departments of all the Provinces and Territories to present the guidance. • Project manager and senior scientist involved in a number of risk assessments for the Yukon Government including the Anvil Range Mine site, Yukon, the Mount Nansen Mine Site and the United Keno Hills Mine Site. These projects involved the collection of information from other disciplines,

reviewing the material and carrying out the assessment using the Health Canada framework. Public consultation with First Nations communities and other affected communities was an integral part of these projects as well as liaising with regulators.

- Project Manager and senior risk assessor on behalf of Atomic Energy of Canada Limited on the development of clean-up criteria for uranium in soil in Port Hope.
- Project Manager and Senior risk assessor on the evaluation of health effects as a result of exposure to air pollutants from transportation and industrial sources in the City of Hamilton.
- Senior risk assessor involved with human health risk assessments of a number of projects in the Northwest Territories including the Canol Trail (an abandoned pipeline), and numerous abandoned mine sites including the Giant Mine, and a number of mine sites on Great Slave Lake. These projects involved the collection of information from other disciplines, reviewing the material and carrying out the assessment using the Health Canada framework. Public consultation with First Nations communities and other affected communities was an integral part of these projects as well as liaising with regulators.
- Senior risk assessor for a number of gas-fired generating stations in Ontario on behalf of TransCanada including Portlands Energy Center, Halton Hills and Oakville. These projects involve obtaining information from the air quality specialists and biologists and integrating this information into a risk assessment framework. Public presentations and liaising with regulators was an integral part of these projects.
- Project manager and risk assessor for a human health and ecological risk assessment of a proposed aluminium smelter in Trinidad. The first ever risk assessment conducted there. This involved obtaining information from the air quality specialist team and integrating this information into a risk assessment framework following the U.S. EPA framework. Public presentations to the community as well as the Environmental Management Authority were part of this project as well as an educational presentation to the EMA.
- Senior Risk Assessor for a number of proposed uranium mine developments in Northern Saskatchewan as well as for remediation activities at a number of coal mine sites in Nova Scotia. These projects involve obtaining information on source terms from a number of different disciplines and

HARRIET PHILLIPS, Ph.D.	
	integrating them into the risk assessment framework. Presentations and discussions with regulators were integral to these projects.
Conflicts of Interest	There are no conflicts of interests. While we work for TransCanada, the projects conducted are related to electricity generation.
Confidentiality / Non-disclosure Agreement	Prepared to sign any documentation related to confidentiality/non-disclosure.
References	s.22

4.6.3 Project Coordinator

ANDREA BELL, B.A.	
Education & Qualifications	Post-Diploma (High Honours), Regulatory Law and Public Administration, 1996, Seneca College, Toronto B.A. (Honours), Law & Justice and Sociology, 1995, Laurentian University, Sudbury
Professional Affiliations	N/A
Project Role(s) and Responsibilities	Project Coordinator - overall responsibility for budget tracking, invoicing, reporting, coordination of project team, schedule maintenance and adherence
Strengths that are relevant to this Project	• Over 10 years' experience in large-scale project coordination and reporting, • Over 5 years' experience in managing multi-million dollar budgets, including tracking and invoicing • Experience working with multi-disciplinary teams • Good Organizational Skills • Good Stakeholder / Public Consultation logistical coordination skills
Rationale for Role(s) (Relevant Experience)	• Extensive Project Coordination experience on multi-disciplinary projects • Extensive knowledge of budget tracking and reporting mechanisms to manage large-scale projects • Experience in coordinating logistics for stakeholder consultation and public information centres

ANDREA BELL, B.A.	
Public Sector vs Private Sector work	• Experience in working with public sector clients including regulators such as Health Canada, Hydro One and Ontario Power Generation. • Experience in working with private sector clients including Enbridge Consumers Gas, GO Transit, and TransCanada.
Examples of Relevant Project Experience (last 5 years)	• Project Coordinator of multi-disciplinary team conducting environmental assessments for Ontario Power Generation's Darlington Nuclear Generating Station. The Project Coordinator role involves acting as the single point of contact between the client and sub-consultants related to administration activities and adherence to schedule of deliverables, providing regular project status reports, leading weekly project team teleconference calls, tracking budget expenditures and preparing billings. • Project Coordinator of multi-disciplinary team conducting environmental assessments for Ontario Power Generation's Pickering Nuclear Generating Station. The Project Coordinator role involves providing regular project status reports, tracking adherence to schedule of deliverables, leading weekly project team teleconference calls, tracking budget expenditures and preparing billings. • Project Workshop Coordinator for updating of the Canadian blood lead guidance for Health Canada. This project involved the development of a guidance document for physicians and public health practitioners. Organized the logistics for the workshop including organizing venue, flight and accommodations for participants and presentation materials. • Assisted with organization of Public Information Centres for the Hydro One Woodstock Transmission Line Environmental Assessment. Arranged venues and assisted with production of presentation materials.
Conflicts of Interest	There are no conflicts of interests. While we work for TransCanada, the projects conducted are related to electricity generation.
Confidentiality / Non-disclosure Agreement	Prepared to sign any documentation related to confidentiality/non-disclosure
References	s.22

4.6.4 Technical Team

4.6.4.1 Technical Director

TEE L. GUIDOTTI, MD, MPH, FRCPC, FCBOM, FFOM, DABT, QEP	
Education & Qualifications	MD, University of California at San Diego, 1975 MPH, The Johns Hopkins School of Hygiene and Public Health, 1981 BS (Biological Sciences), University of Southern California, 1971 FRCPC, Fellow of the Royal College of Physicians of Canada, 1984 FCBOM, Fellow of the Canadian Board of Occupational Medicine, 1984 FFOM, Fellow of the Faculty of Occupational Medicine, Royal College of Physicians (London) DABT, Diplomate of the American Board of Occupational Medicine, 1997 QEP (Air Quality), Qualified Environmental Professional, Institute for Professional Environmental Practice
Professional Affiliations	• American College of Occupational and Environmental Medicine (Past President) • Association of Occupational and Environmental Clinics (Past President) • Canadian Association of Physicians for the Environment (Founding President) • Energy Institute (Fellow) • International Society for Environmental Epidemiology (Founding member) • Occupational and Environmental Medical Association of Canada • Society for Risk Analysis • University of Alberta (adjunct faculty, Centre for Advanced Business Research in Energy and Environment)
Project Role(s) and Responsibilities	• Co-Team leader on Public Health, collaboratively leading feasibility and benefit evaluation of spatially-enabled population surveillance system • Technical Director of the Human Health Risk Assessment • Risk perception interpretation of community consultation data • Advice and input into toxicological significance of exposure pathways for oil and gas emissions and effluent and issues of toxicokinetics • Advice and input into toxicological significance of toxicodynamics and toxicity of oil and gas emissions and effluent (e.g. sulfides) • Input into human health implications of operational characteristics

TEE L. GUIDOTTI, MD, MPH, FRCPC, FCBOM, FFOM, DABT, QEP	
	of the oil and gas industry, including conventional oil and gas, shale gas, coal-bed methane • Medical and public health interpretation of analytical results of human health risk assessment • Input into gaps analysis for human health risk assessment and protection • Emergency response planning for acute risks associated with the oil and gas industry
Strengths that are relevant to this Project	• 35 years of experience in community health risk assessment; equivalent duration of experience in occupational health risk assessment • Practical experience in the oil and gas industry • Project management and scientific oversight experience on large-scale projects directly relevant to oil and gas industry • Scientific research achievements on questions directly related to oil and gas, to toxicology of relevant exposures, to community health assessment methodology, and to risk perception • Wide-ranging experience in contrasting industries and sectors: conventional energy (other than oil and gas), alternative energy, mining and smelting, public services, contaminated sites • Conducted years of research on Canadian populations with respect to risk perception and risk management • Deep experience with aboriginal environmental health and related issues • Global work experience: Canada, US, Turkey, China, Mexico, Zambia, Saudi Arabia, UN agencies • Practical experience with litigation, rules of evidence, environmental law, expert services • Ability to write, edit
Rationale for Role(s) (Relevant Experience)	Dr. Guidotti is a medical doctor specializing in occupational and environmental medicine who has devoted his career mostly to public and population health in which he is proficient, however beyond the health field he has additionally qualified himself with environmental science credentials. This is unique. He still treats individual patients and has the perspective of the individual (and can so relate to personal viewpoints for risk perception), while having a deep understanding of population health and at the same time understanding the technical issues of environmental impact and exposure.
Public Sector vs Private Sector work	• Public sector work has involved all levels of government in Canada, from municipal to federal, especially regulatory agencies, in Alberta and federal (inc. Health Canada, Environment Canada, Public Health Agency of Canada)

TEE L. GUIDOTTI, MD, MPH, FRCPC, FCBOM, FFOM, DABT, QEP	
	• Private sector work has involved numerous clients, from large corporations (some in oil and gas sector) to small enterprises • Extensive experience in providing expert services for legal services, ranging from individual clients and small businesses to large companies and public agencies • Familiarity with class action (mass tort) legal process in environmental law • Was a key prosecution witness in the first conviction obtained under Alberta's then-new Environmental Protection Act in the mid-1990's • History of working collegially and creatively in a multi-stakeholder model (e.g. Western Canada Study [on health effects of emissions downwind from gas facilities], Clean Air Strategic Alliance [Alberta], etc.)
Examples of Relevant Project Experience (last 5 years) *Please note that this list only covers activities up to 5 years ago, as directed.*	• Co-Chair, Scientific Advisory Panel for the Western Canada Study, Western Interprovincial Scientific Studies Association; 7-year C$17M project to assess downwind effects of emissions from gas facilities in Alberta; project ended in 2006, some follow-up activities extended into 2007 • Assessment of occupational health risks of alternative energy and energy conservation technologies for World Health Organization briefing paper before Rio+20 environmental summit in 2012 • Consultant to Saudi Aramco (world's largest oil company) on strategic planning for occupational health (environmental health played a smaller role) • Risk assessment, communication, and management consultation to Washington DC-area water utility during a period of lead exceedance • Pediatric Environmental Health Specialty Unit for US EPA Region III, co-PI; PEHSUs are academically-based centres for community and professional education in children's environmental health • Building Health Sciences, Inc.: Air quality investigation in a facility sensitive with respect to US national security, Washington DC, 2007 • Atsugi AFB: Environmental health risk associated with emissions from a toxic waste incinerator US Air Force, consultant under contract to Batelle, 2007
Conflicts of Interest	None. Dr. Guidotti is not currently involved in any activities related to the oil and gas sector in British Columbia.
Confidentiality / Non-disclosure Agreement References	Prepared to sign relevant documentation related to confidentiality/non-disclosure

s.22

TEE L. GUIDOTTI, MD, MPH, FRCPC, FCBOM, FFOM, DABT, QEP	
	s.22

4.6.4.2 Health Professional

IAN ARNOLD, M.D.	
Education & Qualifications	MD – Queen's University at Kingston – 1968; M. Sc. – McGill University – 1971 DOHS – McMaster University - 1981
Professional Affiliations	Fellow of the Royal College of Physicians and Surgeons of Canada (FRCPC) Fellow of the Canadian Board of Occupational Medicine (FCBOM) Certified Environmental Auditor (CEA) Canadian Registered Safety Professional (CRSP)
Project Role(s) and Responsibilities	Co Team Lead Environmental/Public Health
Strengths that are relevant to this Project	• Government, Industry, Site-based and Senior Corporate roles; • Oil and Gas field experience • Good Organizational Skills • Effective Communicator
Rationale for Role(s) (Relevant Experience)	• When working as the Medical Director for the Carol Project at the Iron Ore Company of Canada, Dr. Arnold was closely involved with health risk assessments related to dust and, in particular, pneumoconiosis. • As consultant, then Director, for Alberta Workers Health and Safety Medical Service Branch, Dr. Arnold dealt with multi-sectorial issues including many aspects of health risk assessment in the oil and gas industry – from workplace related issues (simle injuries to multiple fatalities) to environmental effects of noise, community exposure to hydrocarbons, to risks related to the presence of noxious levels of hydrogen sulphide emanating from catastrophic events such as the Lodgepole blowout. • Shortly after joining Dow Chemical, Dr. Arnold was catapulted into a front seat role dealing with community concerns related to a spill of perchloroethylene ("perc") in the St. Clair River. Later community health issues included dealing with concerns related to pesticide use in community buildings (including schools) and development and implementation of an assessment process for a

IAN ARNOLD, M.D.	
	major historical prospective study of morbidity in the Dow Sarnia site. • While working as the Medical Director at Noranda, Dr. Arnold was involved closely in the mining, forestry, and oil and gas industry. This latter aspect of his role included dealing with community health concerns that developed as a result of Noranda's Oil and Gas division (Canadian Hunter Exploration, and North Canadian Oil) activities in the Grand Prairie/Peace River area of Alberta. Various Forestry division activities also resulted in community health concerns due to noise and odours from pulp processing activities. In the mining sector, community health concerns also arose related to issues such as lead. • At Alcan, Dr. Arnold held responsibility for H and S (and later Environment) for 55,000 employees spread over 25 countries. During this tenure, he led the development and implementation of integrated approaches to managing EHS in a diverse global environment including mining, refining, smelting, and downstream. Numerous community concerns were dealt with on the local level (e.g. the health of residents of Ouro Preto, a world heritage site in Brazil and community PAH issues near several smelters) and global issues on the human health effects of aluminium and its products. • As an independent consultant Dr. Arnold has been a lead industry participant (with Dr. Eirik Nordheim) on developing and implementing an extensive human health risk assessment on aluminium, aluminium oxide, and aluminium hydroxide carried out by Dr. Dan Krewski at the Risk Sciences International. • Dr. Arnold has also commented extensively on an Environmental Risk Assessment done for a proposed mine in Northern Canada and has also been involved in a health risk assessment process for a major marine operation in eastern Canada. • Recently, Dr. Arnold has been involved extensively in the development of a CSA/BNQ based standard on Psychological Health and Safety in the Workplace as well as in community based approaches to managing psychological health.
Public Sector vs Private Sector work	• Please see above section for a full description of public/private aspects of Dr. Arnold's work. • In both industry and government roles, Dr. Arnold has also worked effectively with all stakeholders to drive for solution based approaches rather than engaging in confrontational activities. This has led to several successful outcomes of potentially contentious issues.

IAN ARNOLD, M.D.	
Examples of Relevant Project Experience (last 5 years)	• Environmental Health Consultant for Environmental Review of a proposed mine in northern Canada; • Human health risk assessment activities related to several aluminium products; • Development of approaches to managing risks due to psychological health issues.
Conflicts of Interest	None
Confidentiality / Non-disclosure Agreement References	Prepared to sign relevant documentation related to confidentiality/non-disclosure s.22

4.6.4.3 Senior Technical Team - Human Health

STACEY FERNANDES, M.A.Sc., P.Eng.	
Education & Qualifications	M.A.Sc., Chemical Engineering, 1994, University of Waterloo, Waterloo B.Sc., Chemical Engineering, 1992, University of Calgary, Calgary
Professional Affiliations	Professional Engineers of Ontario Society of Environmental Toxicology and Chemistry
Project Role(s) and Responsibilities	Technical Lead Human Health Risk Assessment (Normal Operations)
Strengths that are relevant to this Project	• 20 years' experience in human health risk assessments • Extensive experience with exposure assessment using quantitative and qualitative approaches • Knowledge of wide range of contaminants, including petroleum hydrocarbons, sulphur compounds, metals, polycyclic aromatic hydrocarbons, industrial compounds, radioactivity • Effective risk communicator, including members of the public and First Nations
Rationale for Role(s) (Relevant Experience)	• Wide-ranging experience on human health assessments in Canada including British Columbia, Saskatchewan, Northwest Territories, Yukon, Nunavut, Manitoba, Nova Scotia, New Brunswick and Ontario • Extensive experience with various risk assessment methods including Health Canada's Preliminary Quantitative Risk

STACEY FERNANDES, M.A.Sc., P.Eng.	
	Assessment and Detailed Quantitative Risk Assessment tools, U.S. EPA Superfund guidance, U.S. EPA's protocol for hazardous waste combustion facilities • Conducted numerous detailed water quality assessments for impacts from industrial facilities such as mines, industrial effluents and landfills. • Human health assessments for a number of different sectors including natural gas-fired generating stations, nuclear generating stations, mining operations (development, operation and decommissioning), contaminated and industrial sites • Experience in liaising with regulators such as Health Canada, Environment Canada, Canadian Nuclear Safety Commission and Provincial agencies • Designated as a Qualified Person for Risk Assessment under the Ontario Regulation 153/04
Public Sector vs Private Sector work	• Experience in working with public sector clients including regulators such as Health Canada, Environment Canada, Public Works and Government Services Canada, Ontario Ministry of the Environment, several school boards, Toronto Port Authority as well as Atomic Energy Canada Limited, Ontario Power Generation, Yukon Government, B.C. Health, International Atomic Energy Agency • Experience in working with private sector clients including AREVA Resources Canada, Cameco Corporation, TransCanada, Pollutech Inc.
Examples of Relevant Project Experience (last 5 years)	• Technical responsibility for reviewing human health and ecological risk assessments on a team reviewing assessments for contaminated sites. This project involves the review of risk assessments under Ontario Regulation 153/04 on behalf of the Ministry of Environment. • Lead risk assessor for developing a risk-based standard for contact with natural gas pipelines containing PCB-impacted coatings on behalf of the Canadian Gas Association. Involved reviewing other protocols (e.g. World Trade Center Working Group, Health Canada), determining approach, conducting sensitivity analysis on parameter values and participating in technical meetings. • Lead risk assessor for numerous contaminated site risk assessments including an office building on a site contaminated with coal tar, shopping centre with chlorinated solvents and former industrial contaminated site. These projects involved the review of site characterization data,

STACEY FERNANDES, M.A.Sc., P.Eng.	
	carrying out the assessment using the appropriate risk assessment framework and addressing technical comments. • Lead risk assessor for several federal contaminated sites for Department of Fisheries and Oceans, Transport Canada, Agriculture and Agri-Food Canada and Natural Resources Canada. • Risk assessor involved with human health risk assessments of a number of projects in the Northwest Territories including the Canol Trail (an abandoned pipeline), former Giant Mine, and a proposed rare earth mine site on Great Slave Lake. These projects involved the collection of information from other disciplines, reviewing the material and carrying out the assessment using the Health Canada framework. Public consultation with First Nations communities and other affected communities was an integral part of these projects as well as liaising with regulators. • Participated in the development of a risk assessment standard on behalf of Canadian Standards Association. • Conducted review of proposed refinery in Ontario on behalf of a First Nations group. Project involved a technical review of the risk assessment as well as ensuring the assessment reflected the land use and culture of the First Nations group. As a component, attended public meetings. • Lead risk assessor for assessment of potential effects of a proposed refinery in Newfoundland. The project involved obtaining information from the air quality specialists and biologists and integrating this information into a risk assessment framework based on the U.S. EPA approach. Review of community health information was a component of the assessment. • Senior Risk Assessor for a number of proposed uranium mine developments in Northern Saskatchewan as well as Nunavut. These projects involve obtaining information on source terms from a number of different disciplines, conducting detailed water quality assessments and fate and transport modelling and integrating all of the information into the risk assessment framework. Presentations and discussions with regulators were integral to these projects.
Conflicts of Interest	There are no conflicts of interests. While we work for TransCanada, the projects conducted are related to electricity generation.
Confidentiality / Non-disclosure Agreement	Prepared to sign any documentation related to confidentiality/non-disclosure

STACEY FERNANDES, M.A.Sc., P.Eng.
References

MEHRAN MONABBATI, Ph.D.	
Education & Qualifications	Ph.D. Chemical Engineering, University of Toronto, 1999 M.Sc. Chemical Engineering, Shiraz University, Iran, 1992 B.Sc. Chemical Engineering, Shiraz University, Iran, 1989
Professional Affiliations	ACS – American Chemical Society LEED AP
Project Role(s) and Responsibilities	Technical Lead Human Health Risk Assessment – Accident Assessment / Transportation / Emergency Response
Strengths that are relevant to this Project	• Over 20 years' experience in probability and impact assessment of process operations including oil and gas. • Emergency management and response • Human health risk assessments • Good Organizational Skills
Rationale for Role(s) (Relevant Experience)	• Extensive experience on the Quantitative Risk accidents (QRA) and probability risk assessment (PRA) of a number of different Sectors including fractionation plants, transmission pipelines, steel manufacturing, mining and milling operations, uranium conversion and refining, natural gas-fired generating stations, smelters, port operation, nuclear power plants, petrochemical plants. • Experience in conducting risk assessments Internationally including the United States, Surinam, Middle East, and Trinidad and Tobago • Assessment of various transportation mode (air, marine, road, rail) risk assessment. • Experiences of the assessment of the effects of natural disasters, including flood, land slide, earthquake, tornado, and forest fire • Vast experience in emergency response planning and preparation • Peer review experience in reviewing many risk assessments on behalf of government and private sectors • Experience on accident impact assessment including the exposure pathways and human health assessments in Canada

MEHRAN MONABBATI, Ph.D.	
Public Sector vs Private Sector work	• Experience in working with public sector clients including regulators such as Health Canada, Environment Canada, Manitoba Ministry of Environment, Ontario Ministry of the Environment, Canadian Nuclear Safety Commission, as well as Atomic Energy Canada Limited, Canadian Council of Ministers of the Environments, Ontario Power Generation, Minnesota Department of Transportation, Public Works and Government Services Canada, and various municipalities • Experience in working with private sector clients including BP Canada Energy Corporation, U.S. GE Hitachi, Steel, AREVA Resources Canada, Cameco Corporation, TransCanada, Ontario mining association
Examples of Relevant Project Experience (last 5 years)	• Project manager for several spill risk assessment and spill prevention and contingency plans for a wide range industrial facilities including a NGL fractionation plant, nuclear power plants, an uranium conversion facility, an uranium refining plant, and an integrated steel manufacturing plant, as well as 2 associations. These studies included: o Identification and characterization of the spills to land and surface water as well as release to air. o Probability assessment of the spill scenarios o Assessment of the risk to the human receptors o Spill prevention measures o Contingency planning for spill scenarios • Project manager and lead technical investigator for a comprehensive risk assessment for various mode of transportation (truck, rail, air, and marine) of yellow cake from Canada to various destinations in Europe and North America. The assessment included the probability assessment of the transportation accidents (transportation truck accidents, rail accidents, and marine vessel accidents and aircraft crash). The impact assessment included the calculations of the effects on the natural environment and human receptors. • Project management and technical lead for quantitative risk assessment of natural gas transmission pipeline. The assessment involved the probability assessment of various failure mode of the pipeline. The impact assessment involves the calculation of the blast overpressure and fire damage due to fire and explosion of the release natural gas.

MEHRAN MONABBATI, Ph.D.	
	• Technical lead for several facility risk assessment for an integrated steel manufacturing facility, a natural gas –fired power generation, two uranium mine , three uranium milling operation, a LNG terminal, an aluminum smelter, and a nuclear fuel fabrication facility. The assessments included the risk ranking and prioritization using risk matrix. The probability assessment was based on the failure rates and reliability assessment of the process components. The impact assessment included calculating the effects of the spills, fire, and explosion in these facilities. The assessments also included the recommendations for the preventive and mitigative measures for the reduction of the risk. • Project manager and lead technical investigator for several projects involving the assessment of the risk of truck transportation of uranium ore in Northern Saskatchewan. • Technical lead for a project involving national and international review of regulatory and non-regulatory tools for managing chemicals released from oil and gas sectors in Canada. o The regulatory tolls included the municipal by-laws, provincial acts and regulations, and federal acts and regulations. o The non-regulatory tools included best industry practices, guideline, codes and standards. • Technical investigator for pre-closure risk assessment of deep geological repository for disposal of low and intermediate-level nuclear waste. The risk assessment included comprehensive hazard identification, probability assessment of the hazard scenarios, release source characterization, impact assessment, and risk characterization and ranking. • Technical investigator for the assessment of the risk associate with the marine traffic of the LNG carriers in eastern Canada. • Course development and delivery of the risk assessment course for the drinking water systems across Ontario. The course was delivered more than 40 times during past four years.
Conflicts of Interest	There are no conflicts of interests. While we work for TransCanada, the projects conducted are related to electricity generation.
Confidentiality / Non-disclosure Agreement	Prepared to sign any documentation related to confidentiality/non-disclosure
References	s.22

MEHRAN MONABBATI, Ph.D.
s.22

BOHDAN HREBENYK, M.Sc.	
Education & Qualifications	M.Sc., Geog. (Climatology), McGill University, 1980 B.Sc., Geography, McGill University, 1974
Professional Affiliations	Former Chair, Air and Waste Management Association (Pacific Northwest International Section) Chair of the organizing committee, Joint Symposium by the B.C. & Yukon Chapter of the Air & Waste Management Association and the B.C. Branch of the Canadian Water Resources Association, Vancouver, B.C., April 22-23, 2008
Project Role(s) and Responsibilities	Technical Lead Air Quality & Odour Impacts
Strengths that are relevant to this Project	• Over 33 years' experience in air quality assessments, and over 25 years of experience in odour impact assessment • Experience in working with multi-disciplinary teams, including air quality impact assessments in support of human health and ecological risk assessments • Experience with design, operation and interpretation of air quality monitoring, development of emission inventories, dispersion modelling for regulatory impact assessment, peer reviews, participation as expert witness in public hearings before the B.C. Environmental Appeal Board, the B.C. Environmental Assessment Office, the B.C. Farm Practices Board (on odour impacts), the Alberta Energy Utilities Board, the Wek'eezhii Land and Water Board, and the Washington Energy Facility Site Evaluation Council • Experience with communicating air quality issues to communities, including First Nations
Rationale for Role(s) (Relevant Experience)	• Wide-ranging experience on air quality assessments in Canada, including British Columbia, Yukon, Northwest territories, Alberta, Saskatchewan, Manitoba, Ontario, Quebec and New Brunswick, as well as in the United States in Washington, Idaho and California • Extensive experience on air quality assessments for a number of different Sectors including exploration sour gas test well emissions, natural gas-fired generating stations, coal and oil-fired generating stations, petroleum refineries, smelters, iron and steel mills, mining operations, contaminated and industrial sites

BOHDAN HREBENYK, M.Sc.	
	• Peer review experience for a selected number of pre-flaring and post-flaring well-test assessment reports associated with oil and gas exploration in British Columbia on behalf of the Oil and Gas Commission and the provincial Ministry of the Environment • Peer review of air dispersion modelling assessments in support of permit applications for a critical sour gas well near the community of Maycroft, Alberta and testimony before the Alberta Energy Utilities Board (EUB) • participated in peer reviews of the Environmental Impact Assessments (EIAs) for two oils sands development projects in Alberta as third party reviewer on behalf of Alberta Environment
Public Sector vs Private Sector work	• Experience in working with public sector clients including regulators such as B.C. Ministry of Environment, Oil and Gas Commission, Metro Vancouver, Capital Regional District of Victoria, Environment Canada, Transport Canada, Health Canada, Alberta Environment • Experience in working with private sector clients including Port Metro Vancouver, Translink, B.C. Hydro, Yukon Energy Corporation, Manitoba Hydro, Yukon Electrical Company Limited, Secure Energy Services, Catalyst Power, Plasco, Chevron, Unocal, Westshore Terminals, Pacific Coast Terminals, B.C. Lung Association, Hupacasath First Nation, Snuneymuxw First Nation, Fort Nelson First Nation, Tsawwassen First Nation, Independent Environmental Monitoring Agency, Environmental Monitoring Advisory Board, International Finance Corporation of the World Bank
Examples of Relevant Project Experience (last 5 years)	• Project Manager for the assessment of air quality impacts from remediation of a coal tar contaminated site, including refined, probabilistic mode dispersion modelling analysis of organic and inorganic contaminants, development of an air quality monitoring program, and human health risk assessment of potential contaminants of concern • Project Director for air quality assessments of diesel generator emissions in four communities in the Yukon in support of air emission permit renewals, including comprehensive emission inventories for each community and dispersion modelling for Whitehorse and Dawson City • Peer reviews of air quality assessments for two Alberta oil sands projects on behalf of Alberta Environment • Air quality monitoring of volatile organic compound emissions from an industrial landfill used to store waste from oil and gas industry operations on behalf of Secure Energy Services • Project Director for the air quality assessments related to road

BOHDAN HREBENYK, M.Sc.	
	and rail infrastructure upgrades associated with increased cargo handling at the Deltaport container terminal and Westshore coal terminal at Roberts Bank in Delta, B.C. • Review of the AirCare vehicle inspection and maintenance program in the Lower Fraser Valley, British Columbia, including estimating anticipated improvements in air quality, associated health benefits and monetary valuation of health benefits of emission reductions due to the continuation of the program to 2020 • Odour impact assessment of wastewater treatment plants for Metro Vancouver, including odour monitoring and dispersion modelling • Peer review of the Fortune Creek Gas Plant near Fort Nelson on behalf of The Firelight Group and the Fort Nelson First Nation
Conflicts of Interest	There are no conflicts of interests. Most of the work for the oil and gas industry has been related to peer reviews for the Oil and Gas Commission, Alberta Environment, First Nations or other public citizens groups. Work for Unocal was related to an accidental release at an oil refinery in California in 1995-96. Work for Chevron was related to odour impacts at the refinery in Burnaby, B.C. in 1997.
Confidentiality / Non-disclosure Agreement	Prepared to sign any documentation related to confidentiality/non-disclosure
References	s.22

FREDERICK BERNARD, M.A.	
Education & Qualifications	M.A., Environmental Geography, 1992, University of Toronto B.A., Environmental Studies, 1986, University of Toronto (Honours Specialist)
Professional Affiliations	
Project Role(s) and Responsibilities	Technical Lead Noise
Strengths that are relevant to this Project	• Over 25 years of experience undertaking and peer reviewing noise studies across a broad spectrum of industrial sectors including oil and gas, power generation, mining, transportation, etc. throughout Canada and overseas.
Rationale for Role(s) (Relevant Experience)	• Extensive experience designing and undertaking noise studies within the oil and gas sector including refineries, compressor

FREDERICK BERNARD, M.A.	
	stations and tank farms. • Extensive experience as Lead Peer Reviewer for environmental assessments completed for proposed LNG onshore facilities and underwater pipeline, seismic studies for offshore petroleum exploration, and for expansion plans for on-shore petroleum facilities; • Extensive experience undertaking sector-specific regulatory reviews for implementing best practices for noise control. • Participated in several noise studies for projects in British Columbia as part of environmental assessment and permitting processing including infrastructure, transportation and manufacturing. • Extensive experience liaising and negotiating with government agencies, designing and implementing public consultation programs on aspects of noise associated with high profile, and sometimes controversial, projects.
Public Sector vs Private Sector work	• Experience working with public sector clients include Ontario Ministry of Transportation, Ontario Ministry of Correctional Services, Metrolinx, Transport Canada, Foreign Affairs Canada, Department of National Defence, City of Surrey, Town of Newmarket, York Regional Municipality, Toronto Port Authority, Ontario Power Generation, Hydro One, Manitoba Hydro, among others. • Experience working with private industry include TransCanada Energy; TransCanada Pipelines; West Coast Power, Irving Oil Limited, ATCO power, Cameco Corporation, INCO, Vale-INCO, Roxul, Nabisco Limited, Chrysler Canada, Honda of Canada Manufacturing, among others
Examples of Relevant Project Experience (last 5 years)	• Peer reviewer of acoustic study for the proposed shell Canada Sarnia Refinery Expansion involving facilities to process heavy crude oil and integration of extended facilities with Shell's existing refinery located approximately 20 km away. • Acoustic Specialist retained to complete noise and vibration assessments for three road/rail grade separation structures along the Roberts Bank Rail Corridor (RBRC) to meet CEAA requirements. • SENES Project Manager on behalf of Foreign Affairs Canada for a qualitative assessment of the potential impacts/risks associated with the development of three LNG Terminal(s) on the United States side of Passamaquoddy Bay. The assessment considered the potential impacts on the marine environment and, because this is linked through coastal ecosystems and wetlands to the terrestrial environment, potential impacts on local land-based

FREDERICK BERNARD, M.A.	
	flora and fauna. • Team Leader retained by the BEST Commission in The Bahamas responsible for a peer review of an Environmental Feasibility and Transport and Fate Study for seismic surveys and offshore drilling in The Bahamas. Responsibilities will include developing guidelines for the technical review of the two studies, providing technical and editorial comments to the project proponent, participating in designated meetings with the technical reviewers and project proponent to address environmental issues relating to the project • Part of a Project Team retained to conduct a thorough review of the regulatory framework pertaining to offshore drilling in Guyana. Responsibilities also include identifying offshore drilling permitting requirements. • Acoustic Specialist responsible designing and undertaking the noise and vibration assessments for the proposed new international crossing between Windsor, Ontario and Detroit, Michigan. The work involved developing criteria and conducting screening assessments to select alternative routes and to ultimately select a preferred route. Assessments covered both the construction and operation phases of the new crossing.
Conflicts of Interest	There are no conflicts of interests.
Confidentiality / Non-disclosure Agreement	Prepared to sign any documentation related to confidentiality/non-disclosure
References	s.22

FARHAD SEIF, Ph.D.	
Education & Qualifications	• Post-Doctoral Associate, Teaching and conducting research on organic chemistry, York University, 1979-1980, Toronto • Doctor of Philosophy, Ph.D., 1975-1977, University of Manchester, England • Master of Science, M.Sc., Petrochemicals and Hydrocarbon Chemistry, 1973-1975, University of Manchester, England
Professional Affiliations	• Member of the Canadian Petroleum Products Institute (CPPI) • Membership of a number of professional associations
Project Role(s) and Responsibilities	Technical support for Human Health Risk Assessment – Accident Assessment / Transportation / Emergency Response, Air quality

FARHAD SEIF, Ph.D.	
Strengths that are relevant to this Project	• Highly educated and experienced individual who has learned EH&S management and emergency response on the job over 30 years of service in various roles. • Has earned respect in petroleum industry and with governments for continued participation, dedication, knowledge and ability to perform. • Vast experience with communication and liaison with various Provincial and Federal government agencies. • Very familiar with Canadian Energy Pipelines Association (CEPA)
Rationale for Role(s) (Relevant Experience)	• Development of Environmental Information Management system
Public Sector vs Private Sector work	• As the EHS leader, developed vast experience with the communication and liaison with various Provincial and Federal government agencies with respect to the compliance and due diligence. • Over 30 years' experience in managing all aspects of EH&S and Emergency Response for the oil and gas industry in Canada (Petro Canada, Worley Parsons, Trans-Northern Pipelines Inc.
Examples of Relevant Project Experience (last 5 years)	**Manager Environment, Health, Safety, Security and Emergency Response** • Managed all aspects of EH&S and Emergency Response for the pipeline operation in Quebec, Ontario and Alberta • Managed all EH&S projects and site clean ups • Lead and maintained the corporation's Emergency Response Plans and coordinate various exercises **Senior Consultant and Technical Specialist** • Worked on various projects and provide Environment, Health and Safety support **Leader Environment Health &Safety** • Provided EH&S support for all Lubricant Operations in Canada, US, Europe and China • Maintained contact with government agencies (Deputy and Assistant Deputy Ministers levels) • Ensured compliance with all regulations and conducted audits • Conducted benchmarking on emergency response within Petroleum Industry to streamline the Incident Command System (ICS) and create single activation process • Managed a number of projects in the area of groundwater

FARHAD SEIF, Ph.D.	
	monitoring, waste management and meeting new Land Disposal Regulation, application of revised air regulation and land reclamation • Provided guidance and leadership to operation mangers to achieve their Loss Management targets (Environmental, Health, Hygiene and Safety) • Worked with governments to decommission Petro-Canada Oakville Refinery and convert it to a terminal - achieved objective at lowest possible cost with no delay
Conflicts of Interest	There are no conflicts of interests. No involvement in exploration and production of oil and gas in BC
Confidentiality / Non-disclosure Agreement	Prepared to sign any documentation related to confidentiality/non-disclosure
References	s.22

4.6.4.4 Intermediate Technical Team - Human Health

JOE LIU, Ph.D.	
Education & Qualifications	Ph.D., Quantum Engineering & Systems Science, 2002, University of Tokyo, Tokyo, Japan M. Eng., Energy & Power Engineering, 1999, Xi'an Jiaotong University, Xi'an, China B.Eng., Energy & Power Engineering, 1994, Xi'an Jiaotong University, Xi'an, China
Professional Affiliations	
Project Role(s) and Responsibilities	Technical Support Human Health Risk Assessment - Accidents and Malfunctions
Strengths that are relevant to this Project	• Over 10 years' experience in accidents and malfunctions analysis • Experience in quantitative risk assessment of complex engineering systems • Experience in human factors and human reliability analysis
Rationale for Role(s) (Relevant Experience)	• Experience in hazard identification and scenario development of accidents and malfunctions of mines & mills and fuel processing facilities

JOE LIU, Ph.D.	
	• Experience in probabilistic safety assessment of nuclear systems and water treatment systems
Public Sector vs Private Sector work	• Experience in working with public sector clients, such as Japan Nuclear Energy Safety Organization, Japan Ministry of Education • Experience in working with private clients, including Tokyo Electric Power Company, Cameco Corporation, GE-Hitachi
Examples of Relevant Project Experience (last 5 years)	• Accident and malfunction scenario development and risk assessment of a uranium mine in the United Sates, a Toronto-based uranium fuel processing facility • Fault tree development and quantification of a water treatment plant in Ontario • Development of a generic failure database for a Japanese uranium fuel processing facility • Accident analysis and simulation of nuclear systems
Conflicts of Interest	There are no conflicts of interests.
Confidentiality / Non-disclosure Agreement	Prepared to sign any documentation related to confidentiality/non-disclosure

SVETLANA MUSIC, B.Sc.	
Education & Qualifications	B.Sc., Meteorology, 1981, University of Belgrade, Serbia
Professional Affiliations	
Project Role(s) and Responsibilities	Technical Support Air Quality Modelling Assessment – Senior air quality meteorologist in air quality assessment • review of existing air dispersion modelling analyses; • gap analysis for air dispersion modelling requirements in Phase 2 • completing new dispersion modeling analyses for Phase 2, if required
Strengths that are relevant to this Project	• Experience in air quality assessments for several mine developments, as well as transportation corridors in Canada • Experience in applying an assortment of regulatory air dispersion models (such as CALMET/CALPUFF, AIRMOD, ISCSC3, CAL3QHCR) • Extensive experience in meteorological data processing
Rationale for Role(s) (Relevant Experience)	• Experience in air quality assessments for mining operations (development, operation and decommissioning) in Canada • Experience in air quality assessments for a number of different transportation corridors in Ontario
Public Sector vs Private Sector work	• Experience working with public sector including City of Toronto, Saskatchewan Ministry of Environment, Ministry of

SVETLANA MUSIC, B.Sc.	
	Transportation Ontario • Experience working with private sector clients including AREVA Resources Canada, Cameco Corporation, Hydro One Corporation
Examples of Relevant Project Experience (last 5 years)	• Air quality meteorologist involved in several air quality assessment projects for uranium mine sites in Nunavut and Saskatchewan (Kiggavik, McClean Lake Operation and Rabbit Lake Operation). Applied CALMET/CALPUFF air dispersion modelling system to evaluate the effects of the site activities on the atmospheric environment. • Air quality modelling technical support in the environmental assessment of the Detroit River International Crossing. This project involved carrying out extensive air quality modelling and conducting screening assessments of both construction and operation phases by applying the CAL3QHC model and processing and analysis of model results. • Air quality modelling technical support for a number of air quality assessment projects for the development of transportation corridors in York Region (e.g. Yonge Street, 407 Transitway) and Toronto
Conflicts of Interest	There are no conflicts of interests.
Confidentiality / Non-disclosure Agreement	Prepared to sign any documentation related to confidentiality/non-disclosure.

SEAN SHEKARFOROUSH, Ph.D.	
Education & Qualifications	Ph.D. Applied Science, 1999 University of New South Wales, Sydney, Australia. M.App.Sc. Hydrogeology and Groundwater Management 1994, University of New South Wales, Sydney, Australia,. B.Sc. Geology, 1985 Shiraz University, Shiraz, Iran.
Professional Affiliations	Association of Professional Geoscientists of Ontario
Project Role(s) and Responsibilities	Technical Support Hydrogeology and Groundwater Management
Strengths that are relevant to this Project	• Over 20 years' experience in Hydrogeology and Groundwater Management
Rationale for Role(s) (Relevant Experience)	• Extensive experience in chemical modelling of groundwater using geochemical equilibrium speciation programs. • Numerous groundwater investigations over the course of his career and research

SEAN SHEKARFOROUSH, Ph.D.	
	• Wide-ranging experience on groundwater flow and contaminant transport modelling and hydrogeological investigations. • Peer review experience in reviewing many hydrogeological and risk management components on various risk assessments (RAs) on behalf of the Ministry of the Environment. • Designated as a Qualified Person for Risk Assessment under the Ontario Regulation 153/04
Public Sector vs Private Sector work	• Experience in working with public sector clients including regulators such as, Environment Canada, Ontario Ministry of the Environment as well as Ontario Power Generation, Public Works and Government Services Canada. • Experience in working with private sector clients including, Cameco Corporation, TransCanada
Examples of Relevant Project Experience (last 5 years)	• Investigation of petroleum hydrocarbon contamination in groundwater, Langton Ontario. Ministry of the Environment, West Central Region. • Cape Breton Development Corporation: Undertook a comprehensive contaminant hydrogeological assessment and groundwater migration evaluation of the former Princess Coal Mine in North Sydney, NS using Visual MODFLOW as part of a decommissioning and AMD mitigation program. • Halton Hills Power Station: Hydrogeologic characterization and site conceptual model was developed using MODFLOW computer software to evaluate the impact of a storm water management pond on the nearby Sixteen Mile Creek tributary. • Hydrogeological Investigation of a proposed condominium tower at 45 Charles St., Toronto. Investigation included pump test design and data analysis, and Modflow dewatering modeling. • Preparation of annual groundwater monitoring reports for Inmet's Winston Lake mine site from 2004 through 2010. • Preparation of the hydrogeologic assessment of Trans-Canada Pipeline's woodwaste landfill (now owned and operated by Capital Power). • The hydrogeologic investigation of a former gasoline spill, Dies Property, Mohawks of Bay of Quinte (MBQ), near Shannonville, Ontario. • Investigation of groundwater contamination in bedrock

SEAN SHEKARFOROUSH, Ph.D.	
	originating from the former Aerospace Maintenance and Development Unit (AMDU) landfill adjacent to Canadian Forces Base Trenton in Ontario. • Brockville Shopping Centre: Site characterization and contaminant fate and transport modeling. • Preparation of annual groundwater monitoring reports for Former Neo Industries Property in Hamilton Ontario from 2006 to present.
Conflicts of Interest	There are no conflicts of interests. While we work for TransCanada, the projects conducted are related to electricity generation.
Confidentiality / Non-disclosure Agreement	Prepared to sign any documentation related to confidentiality/non-disclosure

ZAHRA PARHIZGARI, M.S.C., P.ENG.	
Education & Qualifications	M.Sc., Environmental Applied Science and Management, Ryerson University, 2009 M.Sc., Civil and Environmental Engineering, Sharif University of Technology, 2000 B. Sc., Chemical Engineering, Sharif University of Technology, 1997
Professional Affiliations	Professional Engineers Ontario
Project Role(s) and Responsibilities	Technical Support Human Health Risk Assessment – responsible for preparing the 'Spatial Data' report
Strengths that are relevant to this Project	• Over ten years' experience in environmental consulting including: o database design and implementation o environmental policy analysis o analyzing spatial data using ArcGIS o human health risk assessments o report preparation
Rationale for Role(s) (Relevant Experience)	• Extensive data management experience on multi-disciplinary projects • Broad knowledge of and experience with ArcGIS • Experienced with data and policy gap analysis for both public and private sector clients • Experienced with human health assessments in Canada for a number of different sectors including mining operations

ZAHRA PARHIZGARI, M.S.C., P.ENG.	
	(development, operation and decommissioning) and industrial sites • Good writing and presentation skills
Public Sector vs Private Sector work	• Experience in working with public sector clients including Ontario Power Generation, Canada-United States-Ontario-Michigan Border Transportation Partnership, and a number of Ontario municipalities • Experience in working with private sector clients including AREVA Resources Canada and Cameco Corporation
Examples of Relevant Project Experience (last 5 years)	• Analyzed spatial data using ArcGIS for multiple projects related to impacts assessment for highways, transmission lines and abandoned mines • Prepared reports on data and policy gap analysis, and assisted in updates of environmental and water resources policies for a number of municipalities in Ontario. One of the projects involved development of a natural heritage system for a municipality based on selection criteria developed during consultation with stakeholders • Compiled, analyzed and interpreted data on human and ecological receptor characteristics, environmental indicators, and regulatory limits • Involved in several risk assessment studies including modeling of environmental systems and assessment of environmental impacts for various facilities including several uranium mine developments in Northern Saskatchewan.
Conflicts of Interest	There are no conflicts of interests. While SENES works for TransCanada, the projects conducted are related to electricity generation.
Confidentiality / Non-disclosure Agreement	Prepared to sign any documentation related to confidentiality/non-disclosure

4.6.4.5 Junior Technical Team - Human Health

KIM THEOBALD, B.Sc.	
Education & Qualifications	Diploma of Meteorology, 2008, Dalhousie University, Halifax B.Sc., Environmental Science, 2007, University of Guelph, Guelph
Professional Affiliations	n/a
Project Role(s) and Responsibilities	Data analysis and interpretation of ambient air quality monitoring data

KIM THEOBALD, B.Sc.	
	Gap analysis for future emissions inventory and monitoring requirements
Strengths that are relevant to this Project	• Participation in air quality monitoring programs and review of annual monitoring network data • Experience completing various air emissions inventories and air dispersion modelling • Good data management and analytical skills
Rationale for Role(s) (Relevant Experience)	• Experience in data management and analysis for various air quality monitoring programs including a proposed uranium mine, a pit and quarry operation, a waste transfer station, and a regional monitoring program within the Capital Regional District in B.C. • In support of air quality assessments, environmental licensing applications and environmental reporting, experience preparing air emissions inventories for industry including the mining, energy, automotive and transportation (road and rail) sectors. • Experience in air dispersion modelling using the Industrial Source Complex Version 3 (ISC3) Model, AERMOD and CAL3QHCR.
Public Sector vs Private Sector work	• Experience in working with public sector clients including Health Canada, City of Toronto, Manitoba Clean Environment Commission, Capital Regional District of British Columbia • Experience in working with private sector clients including AREVA Resources Canada, Cameco Corporation, Aurora Energy Ltd, Uranium One Inc., General Motors Canada, Holcim (Canada) Inc.
Examples of Relevant Project Experience (last 5 years)	• Currently prepare quarterly and annual emissions reports for Portlands Energy Centre for the purpose of demonstrating compliance with emissions limits set out in the facility's Certificate of Approval. Responsible for analysis and interpretation of Continuous Emissions Monitoring (CEM) data in addition to report preparation. • Currently prepare annual emissions inventories for submission to the National Pollutant Release Inventory, Canada's Greenhouse Gas Inventory, and Ontario's Greenhouse Gas Emissions reporting program as well as Toronto's ChemTRAC program for two natural gas power generation facilities in Ontario. • Currently responsible for data collection, management and analysis as well as annual reporting for a baseline monitoring program in Goose Bay, NL for Aurora Energy Ltd. Monitoring includes passive sampling of ambient NO_2, NO_x and SO_2. • Participated in a dustfall monitoring program for the City of

KIM THEOBALD, B.Sc.	
	Toronto Solid Waste Management Services from 2008 to 2011. Responsible for sample collection, data management, data analysis and annual reporting. • Involved in the preparation of the 2008 and 2009 annual air quality reports for the Capital Regional District in British Columbia which required statistical data analysis, data interpretation and report preparation. • Participated in air quality assessments in support of Environmental Impact Assessments for the mining sector, including a proposed uranium mine in Nunavut (Kiggavik Project) and a proposed silver-lead mine in Argentina (Navidad Project). Responsible for preparing the emissions inventories as inputs to air dispersion modelling, as well as interpretation of modelling results.
Conflicts of Interest	There are no conflicts of interests.
Confidentiality / Non-disclosure Agreement	Prepared to sign any documentation related to confidentiality/non-disclosure

LEAH WINDISCH, M.A.Sc.	
Education & Qualifications	M.A.Sc., Chemical Engineering and Applied Chemistry (specialization in Biomedical Engineering), 2008, University of Toronto. B.A.Sc. (Honours), Chemical Engineering and Applied Chemistry, 2006, University of Toronto.
Professional Affiliations	Laurentian Chapter of the Society of Environmental Toxicology and Chemistry
Project Role(s) and Responsibilities	Technical Support Human Health Risk Assessment – Support role in human health risk assessment
Strengths that are relevant to this Project	• Four years of experience in human health risk assessments • Good organizational skills • Effective communicator • Excellent quantitative and qualitative analytical skills
Rationale for Role(s) (Relevant Experience)	• Experience on human health assessments in Canada including Saskatchewan, Northwest Territories, Yukon, Nunavut, Quebec and Ontario • Experience on human health assessments for a number of different Sectors including natural gas-fired generating stations, mining operations (development, operation and decommissioning), and contaminated and industrial sites • Experience in liaising with regulators such as Health Canada

LEAH WINDISCH, M.A.Sc.	
Public Sector vs Private Sector work	• Experience in working with public sector clients including regulators such as Health Canada, Ontario Ministry of the Environment, Public Works and Government Services Canada, Aboriginal Affairs and Northern Development Canada, Canada-United States-Ontario-Michigan Border Transportation Partnerships and Yukon Government • Experience in working with private sector clients including Cameco Corporation and TransCanada
Examples of Relevant Project Experience (last 5 years)	• Key scientist on a Jurisdictional Review and Guidance Manual for Green Chemistry on behalf of the Ontario Ministry of the Environment. This project involved carrying out a jurisdictional review in North America and Worldwide on Green Chemical Substitution and the Development of a Guidance Manual for Industries to consult when changing their process chemicals to a greener alternative. Liaison with the client through bi-weekly meetings and several face-to-face meetings as well as a conducting a workshop and delivering a presentation to industry representatives and stakeholders. • Participated in several risk assessments for Northern Canada including the United Keno Hills Mine site in the Yukon and the Canol Trail (an abandoned pipeline) in the Northwest Territories. These projects involved the collection of information from other disciplines, reviewing the material and carrying out the assessment using the Health Canada framework. • Team member conducting a risk assessment for a gas-fired generating station in Ontario on behalf of TransCanada. This project involved the integration of information from air quality specialists and biologists into a risk assessment framework. • Revised a watershed dispersion model to evaluate the potential human health impacts of several reclamation alternatives for a flooded open pit uranium mine in Northern Saskatchewan. • Involved in the compilation of data on background concentrations of more than ten chemicals in the Canadian environment in order to derive estimated daily intakes of these chemicals by the Canadian population.
Conflicts of Interest	There are no conflicts of interests. While we work for TransCanada, the projects conducted are related to electricity generation.
Confidentiality / Non-disclosure Agreement	Prepared to sign any documentation related to confidentiality/non-disclosure

4.6.4.6 Senior Technical Team - Regulatory Review

PATRICE LEBLANC, M.Eng.	
Education & Qualifications	M. Eng., Environmental and Chemical Engineering, 1976, University of Toronto Master of Environmental and Resource Management Studies Program, 1978-80, Dalhousie University Business Administration Program, 1972-74, Humber College of Applied Arts and Technology B. Sc., Spécialisation Bio/Chimie, 1968, l'Université de Moncton
Professional Affiliations	American Fisheries Association International Association for Impact Assessment
Project Role(s) and Responsibilities	Technical Lead Regulatory Review – Lead researcher on the regulatory review.
Strengths that are relevant to this Project	• Over 40 years' experience in developing and implementing policies, legislation, regulations, guidelines, management practices and tools related to environmental assessment and management, occupational health, fisheries and habitat management • Experience coordinating multi-disciplinary teams • Good Organizational Skills • Effective Communicator • Experience with communicating environmental impacts and risks to Ministers, senior government and industry officials, Aboriginals and the public
Rationale for Role(s) (Relevant Experience)	• Extensive experience in oil and gas exploration and pipelines as well as Liquified Natural Gas (LNG) facilities • Extensive Project Management experience on multi-disciplinary projects • Wide-ranging experience in developing and applying environmental, occupational health and fisheries-habitat related policies, legislation and regulations, management practices and tools throughout Canada, other countries (Trinidad and Tobago, The Bahamas) and advising a number of countries (China, Japan, Denmark) on environmental policies, legislation and regulations • Extensive experience with a number of different Sectors including transportation, harbours, oil, coal and nuclear generating stations, smelters and mining operations, oil and gas exploration and pipelines, LNG facilities • Experience as a federal regulator and in liaising with other federal regulators (Health Canada, Environment Canada, Canadian Nuclear Safety Commission) and Provincial and territorial agencies

PATRICE LEBLANC, M.Eng.	
	• Experience in developing a risk management framework to support the application of the Fisheries Act
Public Sector vs Private Sector work	• Experience in working with public sector clients including regulators such as Fisheries and Oceans Canada and Ontario Ministry of the Environment as well as Ontario Power Generation • Experience in working with private sector clients including AREVA Resources Canada, Cameco Corporation, TransCanada, Enbridge, Spectra, Nova Scotia Power, Canadian Nuclear Association
Examples of Relevant Project Experience (last 5 years)	• Project Director of team conducting reviews of federal legislation to improve the regulatory system for environmental review and permitting This project involved the review of seven major federal laws regulating impacts of development activities on the environment and developing recommendations for their amendments (included as part of Bill C-38) The Project Director role involved liaising with federal departments; chairing a committee of Directors and Director Generals from federal departments; designing and directing policy and regulatory research projects; reviewing draft technical and policy reports; presenting results to senior officials; and preparing a final report for senior officials approval. • Project Manager on developing a position paper on amendments to the Fisheries Act for the Canadian Nuclear Association. This project involved carrying out a review of documented industry concerns about the Fisheries Act; interviewing members about their views and perspective as well as concerns about the application of the act; organizing and facilitating an experts' workshop; and developing recommendations and rationale for amendments to provisions of the Fisheries Act for regulating impacts to fish and fish habitat. • Project Director in developing recommendations for amendments to the Fisheries Act that were integrated into Bill C-32 and C-45; briefing Ministers, MPs and senior officials on the proposed amendments; developing communications material; and conducting consultations with industry, NGOs, Provinces and Territories, Aboriginal groups and other federal departments.
Conflicts of Interest	There are no conflicts of interests.
Confidentiality / Non-disclosure Agreement	Prepared to sign any documentation related to confidentiality/non-disclosure
References	s.22

PATRICE LEBLANC, M.Eng.
s.22

DEREK V. DOYLE, P.Eng., MBA	
Education & Qualifications	P.Eng., MBA
Professional Affiliations	Member, Professional Engineers BC & Ontario
Project Role(s) and Responsibilities	Support and Advisory role on Regulatory aspects
Strengths that are relevant to this Project	Commissioner of Oil & Gas for BC 2001 to 2006 Director Environmental Assessment, Ontario, 1991 to1996, ADM Natural Resources, Manitoba, 1986 to 1991
Rationale for Role(s) (Relevant Experience)	Lead the BC Oil & Gas Commission Developed many processes for public concern resolution, Extensive consultation and Agreement negotiation with Treaty 8 FN Steering Committee for major animal health study covering 3-years and 30,000 head in Alb., Sask & BC.
Public Sector vs Private Sector work	Public Sector in resource, environment and regulation for BC, Ontario & Manitoba at the executive level. Private sector as VP and General Manager for three environmental and engineering consulting firms. Plant and production engineer in pulp and paper, metals and plastics industries.
Examples of Relevant Project Experience (last 5 years)	Regulation of the Engineering and Geoscience professions in BC with 26,000 members 2007 to 2012 with program renewal, professional guidelines & strategic planning as prime focus. Developed six Consultation Agreements with Treaty 8 First Nations in 2006 which continue today. Responsible for entire operations of the Oil & Gas Commission for a five year period while residing in Fort St. John.
Conflicts of Interest	None as retirement from current position of CEO & Registrar at APEGBC is scheduled before commence of support and advice to this project.
Confidentiality / Non-disclosure Agreement	Prepared to sign any reasonable confidentiality agreement.
References	s.22

4.6.5 Stakeholder Consultation

LESLEY CABOTT, M.A.	
Education & Qualifications	MA Town and Regional Planning, 2009 Leeds Metropolitan University, Leeds, UK BA Geography, 1987, Saint Mary's University, Halifax, NS
Professional Affiliations	Canadian Institute of Planners Royal Town Planning Institute National Charrette Institute
Project Role(s) and Responsibilities	Public Consultation Technical Lead
Strengths that are relevant to this Project	• Over twenty years of experience developing and leading successful and award winning multi-stakeholder and public consultation processes • Over twenty years of experience consulting with aboriginal governments and people • Community Planner working with small communities throughout BC, NWT and Yukon • Energy Resource Planning Experience • Excellent communicator • Innovative
Rationale for Role(s) (Relevant Experience)	• Developed and led successful multi-stakeholder community consultation and engagement processes focused on complex issues • Over twenty years of experience working with aboriginal people and governments in northern, BC, Yukon and NWT • Advisor to the National Roundtable on Economy and Environment on northern issues • Recent projects include managing multi-stakeholder and territorial wide processes for energy projects in Yukon and NWT. • Developed and managed stakeholder (industry, government, public) liquefied natural gas energy workshop. • An expert in northern community sustainability
Public Sector vs Private Sector work	• Experience leading multi-stakeholder consultation processes that include public sector, private sector, non-government organisations, and general public and aboriginal groups. • Worked for all levels of government: municipal, territorial/provincial, federal, and aboriginal.

LESLEY CABOTT, M.A.	
	• Worked for energy utilities and with private sector companies on energy and sustainability projects.
Examples of Relevant Project Experience (last 5 years)	• Developed and led the Yukon Energy Charrette which was awarded the Canadian Electricity Association Award in 2012 for Consultation and Social Responsibility. The 3-day energy charrette informed the development of Yukon Energy's Resource Plan. • Project Manager Liquefied Natural Gas Stakeholder Engagement and Workshop for Yukon Energy Corporation. • Project Manager and Consultation Manager for City of Whitehorse Strategic Sustainability Plan. The project included developing and working with a multi-disciplinary team of government, academic, NGOs, first nations and business representatives to develop with the community of Whitehorse a 50 year sustainability plan and vision. The development of the plan has led to the City accessing over 50 million dollars in funding for sustainable infrastructure as well as leading the development of the City's OCP. This project was awarded the Yukon Energy Community Sustainability Award. • Currently leading the consultation and facilitation for the development of the Government of the Northwest Territories Energy Strategy.
Conflicts of Interest	There are no conflicts of interests.
Confidentiality / Non-disclosure Agreement	Prepared to sign any documentation related to confidentiality/non-disclosure
References	s.22

JENNIFER TURNER, M.Sc.	
Education & Qualifications	M.Sc., Forest Science, Faculty of Forestry, University of British Columbia B.Sc., Natural Resources Conservation, Faculty of Forestry, University of British Columbia
Professional Affiliations	Registered Professional Biologist
Project Role(s) and Responsibilities	Consultation and Engagement Support, Regulatory Approvals Support
Strengths that are relevant to this Project	• Over ten years of experience related to permitting and approvals for proposed projects in B.C., and associated regulatory, public and First Nations consultation and engagement processes. • Consultation and engagement experience with numerous northeast B.C. aboriginal communities, including Treaty 8 First Nations.
Rationale for Role(s) (Relevant Experience)	• Experience in the development and delivery of consultation processes for numerous large-scale projects. • Experience in consultation and engagement of First Nations and regulatory agencies in northeast B.C. • Understanding of the issues and concerns relevant to northeast B.C., including potential for adverse cumulative effects from multiple industry sectors with an interest in the area. • Development of successful processes related to the engagement and involvement of B.C. First Nations communities into projects including in-community information sharing sessions, site visits, one-on-one meetings, and capacity building initiatives.
Public Sector vs Private Sector work	• Presented at and participated in numerous multi-stakeholder consultation processes that include public sector, private sector, non-government organisations, and general public and aboriginal groups. • Led federal, provincial and municipal regulatory agency consultation processes for a wide variety of projects and environmental assessments, including several mining and energy-related projects in northeast British Columbia.
Examples of Relevant Project Experience (last 5 years)	• Managed the environmental work on two B.C. coal mining projects for First Coal Corporation (FCC) from 2008 - 2010. Specific responsibilities included leading the small mine

JENNIFER TURNER, M.Sc.	
	environmental assessment process and environmental management plan development for their South Central Project. This was a controversial project requiring extensive consultation with regulatory agencies and Treaty 8 First Nations. Jennifer coordinated the work of several other consultants as part of environmental assessment and permitting phases. She presented at and led many project-related information sessions, including field workshops and regulatory agency meetings. • Overall project coordinator and backup project manager, and technical lead for the vegetation baseline and impact assessment program. Responsible for development of capacity building opportunities for local First Nations, participation in numerous public consultation events, as well as ongoing communication with the BC Hydro Project Manager, local First Nations and various regulatory agencies including B.C. Ministry of Environment and Ministry of Forests and Range. • Project Manager on the BC Hydro Williston Reservoir Field Survey and Trends Project. Responsible for ongoing communication with Tsay Keh Dene representatives, including the acting Chief, to discuss progress on the project. Developed a business plan that resulted in additional funding from BC Hydro to provide project-specific training and capacity building to Tsay Keh Dene community members. • Developed regulatory agency and public consultation reports as part of the the Highland Valley Copper Sustainable Waste Management Environmental Assessment Certification Application.
Conflicts of Interest	There are no conflicts of interests.
Confidentiality / Non-disclosure Agreement	Prepared to sign any documentation related to confidentiality/non-disclosure
References	s.22

Pages 330 through 331 redacted for the following reasons:
- -
s.22

APPENDIX A
CORPORATE PROFILE

SENES Consultants Limited

Specialists in Energy, Nuclear and Environmental Sciences

SENES

Specialists in Energy, Nuclear and Environmental Sciences

1980 - 2010
30
YEARS OF
ENVIRONMENTAL EXCELLENCE
WORLDWIDE
SENES
Consultants
Limited

THE COMPANY

SENES Consultants Limited is a wholly Canadian-owned company that specializes in the fields of energy, nuclear, and environmental sciences with offices in: Toronto and Ottawa, Ontario; Edmonton, Alberta; Vancouver, British Columbia; Yellowknife, NWT; and Denver, Colorado. Since its inception in 1980, the company has participated in over 5,000 projects throughout North and South America, the Caribbean, Africa, Australia, Europe, Asia, the Middle East and the Far East.

TECHNICAL SPECIALISTS

The technical resources within *SENES* include many engineering disciplines, physical and natural sciences, mathematics, statistics and computer sciences. One of our strengths is our desire to build upon the technical areas we do well, rather than attempt to provide services on all aspects of the environment. This concentrated technical effort is looked upon favourably by the legal profession who continually use our services and by other consulting firms who retain us as technical experts in specialized areas.

The strength of *SENES* is a direct reflection of the extensive knowledge and experience of our staff. The firm is committed to providing its staff with challenging opportunities and to motivating them to upgrade their professional skills on a continuing basis.

SENES has also established three other companies: *SENES Oak Ridge Inc.*, Center for Risk Analysis, Decommissioning Consulting Services Limited, and *SENES Consultants India Pvt. Ltd.* to provide additional services in selected specialized areas. Clients can take advantage of the working relationships among *SENES* and our affiliated companies to access the outstanding technical and scientific capabilities offered by each company.

EXCEPTIONAL SERVICE

The business philosophy of the firm is to provide an exceptional level of service to our clients while ensuring that our common interest in preserving the environment is enhanced. In the rapidly changing world in which we live, creative and innovative solutions are often required to resolve complex problems. We at *SENES* pride ourselves on staying in the forefront of technological advancement to allow us to continue to satisfy our clients' needs. We strongly believe that this attribute distinguishes us from our competitors.

CREDIBILITY

The resolution of complex environmental issues often requires an in-depth understanding of the movement of contaminants through environmental media and the effects on humans. Pathways analysis of contaminant migration from source to man and assessment of the uncertainties and risks of exposure, form the foundation of much of the work undertaken by the firm. Of equal importance, of course, is the knowledge our staff brings to bear on means of managing the environment to minimize risks.

At *SENES* we feel that it is important to be able to look at all sides of a problem in a professional manner. For this reason, we intentionally split our work among private sector companies, industrial associations, regulatory agencies and all levels of government, and various public interest groups. Our success is attributable, in part, to our ability to maintain credibility with all sectors.

SERVICES OFFERED

SENES provides specialty services on a broad spectrum of projects which typically involve provision of expert advice on specific environmental issues; preparation of environmental and risk assessments on proposed undertakings; environmental audits of existing facilities; site investigations; air quality assessment and air emission control; assessment of industrial and municipal water and waste treatment technologies; integrated water resources and basin management; planning and development of water resources system; capacity building and institutional development; sustainable development and global climate change programs; preparation of solid waste management master plans; development of waste management strategies; biotechnology evaluation; development and supervision of remedial action projects; and development and implementation of public participation programs. An outline of the types of services offered, in selected subject areas, is provided below.

Acid Mine Drainage
- ❑ assessment of the acid generation potential of reactive mine tailings and waste rock
- ❑ laboratory and field investigations
- ❑ modelling of acid generation processes
- ❑ evaluation and development of treatment systems
- ❑ reclamation and decommissioning strategies

Aquatic Environment
- ❑ development and implementation of monitoring for biota, sediments, surface and groundwater
- ❑ interpretation of environmental monitoring data
- ❑ modelling and analysis of contaminant movement
- ❑ watershed management studies
- ❑ assessment of river assimilation capacity and lake eutrophication status

Atmospheric Environment
- ❑ ambient monitoring for air quality, meteorology, noise, odour, greenhouse gases and dust
- ❑ field investigation of emission sources
- ❑ atmospheric dispersion modelling of environmental contaminants
- ❑ impacts of air toxics from existing and proposed developments on air quality and human health
- ❑ investigation and review of air emission control systems and development of mitigative measures

Biotechnology
- ❑ bioremediation assessments and biochemical engineering including bio-reactors, bio-leaching and bio-filters
- ❑ biological treatment of waste water using anaerobic digestion, wetlands, etc.
- ❑ assessment of the use of bioremediated feedstocks for the production of energy, fuels and bioproducts
- ❑ microbiological assessments and health effects
- ❑ institutional strengthening and assessment of genetically modified organisms and biobased industrial processes

Climate Change
- ❑ adaptation to climate change and reducing climate change emissions on a sector and basis
- ❑ developing greenhouse gas emissions inventories, monitoring, modelling and air quality management
- ❑ development of Clean Development Mechanism (CDM) and Joint Implementation (JI) projects, sustainable development needs and indicators
- ❑ technical and economic review of new technologies for climate change and sustainable development
- ❑ development of base line methodologies (UNFCCC) for certifying emission reductions

Data Management and Statistical Analysis
- ❑ development of database applications for environmental data management, environmental fate modelling and risk assessment
- ❑ statistical modelling including multi-variate methods, spatial/temporal analyses, regression, hypothesis testing and probabilistic simulation in support of environmental decision-making
- ❑ development and peer review of scientific monitoring and characterization programs

Drinking Water/Source Protection
- ❑ development of drinking water systems and training manuals for operators
- ❑ development of best management practices for drinking water systems
- ❑ development of stormwater management facilities and best management practices
- ❑ development of risk assessment and decision analysis for drinking water systems

Environmental Assessment
- ❑ collection and interpretation of environmental data
- ❑ modelling of environmental components including the dispersion and behaviour of contaminants
- ❑ site selection studies
- ❑ preparation of screening level assessments, Class EAs and individual EAs
- ❑ interpretation of, and advice on, EA processes and regulations
- ❑ expert testimony at public inquiries and hearings

EHS Audits/Management
- ❑ assistance with ISO 14001 implementation
- ❑ assessment of facility EHS compliance with regulations and operating permits
- ❑ EMS/HSMS audits/reviews
- ❑ site surveys to measure contaminant levels

- identification of potential liabilities
- hazard identification, quantification and alternative reduction strategies
- development of environmental management plans

Hazardous Waste Management
- site inspection of management practices and compliance with regulations for PCBs, heavy metals, asbestos and other hazardous materials
- assessment of treatment technologies
- site selection and disposal methods
- risk and accident analysis
- contingency planning for accidental releases

Low-Level Radioactive Waste Management
- site selection and evaluation studies of existing and proposed disposal facilities
- assessment of impacts from contaminated areas
- development of site clean-up criteria
- development and supervision of remedial programs
- review of management practices
- review of relevant legislation and regulations
- contingency planning for accidental releases

Mining
- collection and evaluation of environmental data
- assessment of environmental effects of mine facility releases and evaluation of mitigative measures
- tailings site selection and management studies
- development of wastewater treatment systems
- identification and evaluation of close-out, decommissioning, and reclamation options
- review of relevant legislation and regulations
- assessment of workplace conditions and worker protection practices
- regulatory negotiations and expert testimony

Occupational Health
- assessment of public health and worker exposure
- inspection of facilities to identify and characterize potentially-hazardous workplace conditions and development of corrective programs
- development of codes of practice
- preparation and presentation of occupational health and safety training courses

Public Participation
- identification of stakeholder groups and key issues
- development of information materials including news releases, fact sheets, poster displays and public notices
- organization and facilitation of public meetings, public information centres and workshops
- pre-submission consultation with public, government agencies, ratepayer groups and other parties
- conflict resolution

Radioactivity
- field monitoring of radon, external radiation and radionuclides in all environmental media
- pathways analysis of radionuclide transfer through the environment
- evaluation of health effects of worker and public exposure to radiation and radioactive materials
- analysis of the radiological impact of existing and proposed developments
- modelling of underground mine ventilation systems
- investigation of management alternatives for radioactively-contaminated soils and wastes

Remedial Actions and Decommissioning
- site investigations to measure contaminant levels in soil, buildings and equipment
- development of clean-up criteria for inorganic, organic and radioactive contaminants
- pathways modelling of contaminant migration through the environment to humans
- clean-up strategies and decommissioning plans
- development and supervision of remedial activities

Risk Assessment
- ecological and human health risk analysis
- identification of risk sources and risk characterization
- quantitative estimation of risk
- quantitative uncertainty analysis
- development of risk management strategies
- effective communication of risks and benefits to specific interest groups and the public

Solid Waste Management
- development of waste management master plans
- evaluation of alternative 3R's methods
- waste audits
- evaluation of material recovery, composting, incineration and landfill technologies
- site selection and evaluation studies
- EA preparation and hearing testimony
- landfill gas and leachate control

Water Resources Management
- sustainable water resources development planning
- watershed studies, modeling and master plan development
- surface water and groundwater quantity and quality studies
- groundwater /aquifer study
- wetland and lake management planning
- water quality and ecosystem management
- coastal management and planning
- water policy, strategy and regulatory procedures
- River morphology, flood and erosion management study
- Participatory water management planning

EXECUTIVES

Donald M. Gorber, Ph.D., P.Eng.
President and Director of Environmental Assessment and Sustainability Studies

Don Gorber is involved in a wide spectrum of international multidisciplinary environmental risk and sustainability studies for all levels of government and industrial clients. He specializes in the environmental assessment process and regulatory review and approvals. He has been retained as project manager/co-ordinator on many major studies involving mining, oil refineries, petrochemical plants, solid and hazardous waste management, nuclear, gas fired and hydro generating stations and site decommissioning. He has acted as a facilitator and peer reviewer on many complex environmental problems and served as a technical liaison between public interest groups, industry and regulatory agencies.

Douglas B. Chambers, Ph.D.
Executive Vice-President and Director of Risk and Radioactivity Studies

Doug Chambers has an international reputation as an expert on risk and radioactivity. His experience includes numerous risk assessments of human exposure to radiation, environmental radioactivity and hazardous chemicals. His special skills include exposure pathways analysis, air dispersion modelling, analysis of radiation and chemical risks, and environmental statistics. He serves on many international committees and has appeared as an expert witness at public inquiries, environmental hearings and court proceedings.

Bruce E. Halbert, M.Sc.
Secretary-Treasurer and Director of Aquatic Environmental Studies

Bruce Halbert directs investigations into the impact of municipal and industrial projects on the aquatic environment and on the selection of municipal waste water treatment technologies. He has extensive experience in preparing of environmental assessments, investigation and modelling of acid generation in reactive mine tailings and waste rock, modelling of contaminant movement through the environment, and application of uncertainty analysis concepts.

Gerd Wiatzka, B.A.Sc., P.Eng.
Vice-President and Director of Mining Group

Gerd Wiatzka specializes in mine site evaluations, due diligence and environmental audits, environmental assessments, site and risk assessments, strategic planning, closure assessments and mine planning. He has experience in all stages of the mine life cycle and has managed large mining multi-disciplinary projects including engineering design, construction management, and information systems for mines throughout North America. He has carried out international mining projects in Asia, Africa, Europe and South America.

John F. Peters, M.Eng., P.Eng., EP(CEA)
Vice-President and Director of Air Group and Director of Management Systems/Audit Group

John Peters specializes in the areas of air permitting and approvals, emissions inventories and reporting, environmental management systems, environmental auditing and facility risk assessment. He has extensive multi-media experience in environmental and occupational health and safety legal requirements and management system application and development. Mr. Peters has prepared corporate EHS policy and program manuals, provided environmental training and has audited EHS systems for a wide range of government, industrial and mining clients worldwide.

Murali Ganapathy, M.A.Sc, P.Eng., DEE
Vice-President - India and Director of Solid and Hazardous Waste Management Group

Murali Ganapathy has over 25 years experience in process engineering, industrial technology assessment and hazardous waste management. He is a process engineer by training and has been involved with regulations and guidelines development, plant operations and troubleshooting, energy and utilities optimization studies, safety, health and environmental studies including failure assessments, and HAZOP studies in a wide variety of industrial sectors. Mr. Ganapathy is also responsible for establishment and operations of SENES India operations.

Leo M. Lowe, Ph.D., P.Phys., CRadP
Vice-President and Director of Environmental Radioactivity Group

Leo Lowe is a Senior Health and Environmental Physicist with over 30 years experience in investigations of radioactivity in the environment and the workplace, across Canada and internationally. He has prepared environmental impact assessments of uranium mining and refining facilities, and studies of the potential radiation hazards of industries associated with naturally occurring radioactive material (NORM). He has extensive experience in radon modelling, risk and environmental pathways analysis, and radiation dosimetry and risk calculations. He has authored or co-authored over 50 technical papers and presentations.

BRANCH MANAGERS

Bohdan W. (Dan) Hrebenyk, M.Sc.
Manager of British Columbia Office

Dan Hrebenyk is a Senior Climatologist /Environmental Scientist with extensive experience in meteorological and air pollution monitoring; and air dispersion modelling for industrial and mining facilities. He has managed studies on control technologies for pollution abatement, the implications of proposed new regulations for air toxics and the control of nuisance odours from landfills, sewage treatment plants, and pulp mills.

Shelagh Montgomery, Ph.D.
Manager of Yellowknife Office

Shelagh Montgomery is a Senior Environmental Scientist focusing on projects involving multidisciplinary state of knowledge reporting, the assessment of development proposals, cumulative effects, water resources, and policy analysis. All of her professional experience involves working with northern and aboriginal communities and various orders of government. Over the past several years, she has been directly involved in issues related to resource development and environmental integrity in the NWT and Nunavut.

Alistair MacDonald, M.A.
Manager of Edmonton Office

Alistair MacDonald is an Environmental Assessment Specialist with over a decade of involvement in the international mining industry, and six years of experience in natural resource management issues in northern Canada and environmental impact assessment, including projects in the mining, oil and gas, hydroelectric, and forestry/paper sectors, with a focus on social, economic and cultural impact assessment. He has managed the environmental review of major projects and has served as an advisor to decision-makers on a wide variety of issues, including navigating environmental assessment processes, conducting social, economic and cultural impact assessment, strategic plan development, and community consultation.

Cynthia Levesque, B.Sc.
Manager of Ottawa Office

Cynthia Levesque is a Senior Environment Specialist with over 23 years experience in project management in areas of environmental impact assessment, policy development, program delivery, research and regulation. Throughout her career, Ms. Levesque has worked with both industries and municipal operations to help improve their environmental performance. This has included delivery of various municipal environmental strategies to address air quality, climate change and overall ecosystem health.

Steve Brown, CHP
Manager of Colorado Office

Steve Brown is a board-certified health physicist (CHP) and diplomat of the American Academy of Health Physics with over 35 years of nuclear industry experience. He has worked as a contractor to the U.S. Dept. of Energy (DOE) in the nuclear weapons program and for the cleanup of large sites contaminated with radioactive material as part of the Formerly Utilized Sites Remedial Action Program (FUSRAP). He is recognized as an expert in environmental, regulatory, safety and health aspects of Uranium processing facilities and of Technologically Enhanced Naturally Occurring Radioactive Material (TENORM) and is a member of national and international advisory committees in the areas of environmental, safety and health aspects of Uranium fuel cycle facilities and in nuclear waste management. He has authored over 30 technical papers and presentations on radiological and environmental aspects of Uranium mining, milling and alternative Uranium recovery processes. He is President Elect of the Central Rocky Mountain Chapter of the Health Physics Society and Chairman of the Colorado Mining Association's Uranium Subcommittee.

SENIOR PROFESSIONAL STAFF

The technical backgrounds of *SENES* staff include engineering disciplines, physical and natural sciences, mathematics, statistics, computer sciences, geography, planning and economics. More than half of the professional staff hold postgraduate degrees. Many participate on expert and standards committees or are members of professional organizations.

Highly-qualified technical staff provide a wide range of services and often take on major roles on projects that require the installation of field monitoring equipment, collection of field measurements and samples, calibration of field instruments, liaison with analytical laboratories, and the inspection of facilities for environmental compliance.

To complement and enhance the skills of its full-time staff, SENES can call upon the many years of experience of its select group of internationally recognized specialists.

Senior professional staff (those receiving first degree at least 15 years ago) are listed below with last degree, year of graduation and title.

Frederick Bernard, M.A., 1992 – Senior Environmental Specialist
Linda Boheim, B.Sc., 1985 – Senior Environmental Specialist
Gwen Brice, B.Sc., 1988 – Senior Environmental Planner
Tony Brown, M.Sc., 1997 – Manager, Northern Operations
Grant Feasby, M.Sc., 1966 – Senior Project Specialist, Mining and the Environment
Stacey Fernandes, M.Sc., 1994 – Senior Environmental Engineer
Jerry Fitchko, Ph.D, 1978 – Senior Environmental Specialist
Nava Garisto, Ph.D., 1977 – Senior Environmental Risk Assessment Specialist
Anneliese Grieve, MES, 1994 – Senior Specialist-Environmental Assessment & Public Consultation
Andrea Halbert, B.A., 1995 – EA Specialist and Logistics Coordinator
Yousry Hamdy, M.Sc., 1972 – Senior Water and Wastewater Specialist
Deborah Irwin, M.Sc., 1992 – Environmental Specialist
Kurt Johansen, M.Eng., 1975 – Senior Environmental Specialist
Paul Kirby, B.Sc., 1996 – Senior Environmental Scientist / Auditor
Jennifer Kirkaldy, B.A.Sc., 1991 – Senior Environmental Scientist
Randall Knapp, B.A.Sc., 1973 – Senior Consultant - Mining
Bernard Lebeau, Ph.D., 1992 – Senior Aquatic and Terrestrial Specialist
Patrice LeBlanc, M.Eng., 1976 – Marine Expert
Chris Marson, B.Sc., 1976 – Senior Environmental Engineer
Jeff Martin, B.Geog., 1985 – Senior Geological/Environmental Engineer
Mehran Monabbati, Ph.D., 1999 – Senior Environmental Scientist
Svetlana Music, B.Sc., 1981 – Senior Meteorologist – Numerical Meteorological Modelling
Paul Patrick, Ph.D., 1985 – Senior Aquatic Scientist
Harriet Phillips, Ph.D., 1991 – Senior Specialist, Risk Assessment/Toxicology
Zivorad Radonjic, B.Sc., 1978 – Senior Environmental Meteorologist
Abigail Salb, M.Sc., 2001 – Senior Environmental Engineer
Jeno Scharer, Ph.D., 1966 – Senior Scientist, Aquatic Environment
Phil Shantz, MES, 1993 – Manager – Aboriginal, Land, Resource and Northern Projects
Michael Sills, Ph.D., 1981 – Manager-Biorenewables
Deborah Simmons, Ph.D., 1996 – Senior Social Scientist
Ronald Stager, M.Sc., 1987 – Senior Environmental Statistician/Engineer
John Stolys, B.Eng. & Mgmt., 1993 – Senior Environmental Engineer
Valerie Story, M.Sc., 1982 – Senior Consultant - Environmental Assessment Studies
Mo-Ki Tai, M.Math, 1992 – Environmental Statistician
Bosko Telenta, M.Sc., 1979 – Senior Physicist-Weather Forecasting
Richard Urbanski, MBA, 2003 – Senior Air and Waste Quality Specialist
Krista Wenzel, M.S., 1995 – Certified Health Physicist
Sandy Willis, M.Eng., 1999 – Senior Environmental Engineer
Katherine Woolhouse, M.Sc., 2000 – Senior Environmental Engineer
James Young, Ph.D., 1973 – Senior Air Quality Specialist

SENES Oak Ridge Inc., Centre for Risk Analysis

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http://www.senes.com

SENES Oak Ridge has been established in association with *SENES* to provide comprehensive consulting services in relation to human health and ecological risk estimation, risk assessment and risk communication. The Center for Risk Analysis is committed to providing clients with state-of-the-art methods and practices in quantitative risk analysis and environmental assessment. One of the company's goals is to place the client beyond compliance and to do so in the most scientifically advanced and defensible position possible. Specialty services include:

- Ecological Risk Analysis;
- Human Health Risk Analysis;
- Land Use Planning and Sustainable Development;
- Methods for Risk Estimation; and
- Risk Communication.

Decommissioning Consulting Services Limited

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engineers@dcsltd.ca
http://www.dcsltd.ca

Decommissioning Consulting Services Limited (DCS) has been established in association with *SENES* to provide engineering solutions to site contaminant problems. DCS personnel are committed to providing cost-effective, achievable approaches to resolving the site and facility contamination and waste management concerns facing DCS clientele. The broad range of services offered by DCS include:

- Real Estate Environmental Audits;
- Site Remediation and Decommissioning Feasibility Studies, Planning Reports, Design Specifications and Contract Documents;
- Contract Administration and Quality Assurance;
- Soil, Groundwater and Surface Water Assessments, Management and Planning;
- Post-Remediation Monitoring and Site Sign-Off;
- Hazardous Substance (e.g. Asbestos) Management and Training;
- Hazardous Waste Management; and
- Occupational Health and Safety Services and Training.

SENES Consultants India Private Limited

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senes@senesindia.com

SENES India, with offices in New Delhi, Kolkata Mumbai and Hyderabad, provides specialty services on a broad spectrum of projects which typically involve provision of expert advice on specific environmental issues. SENES India has a team of multi-disciplinary specialists assisting clients from Government, municipal and industry sectors. The current areas of practice include:

- preparation of environmental, social and risk assessments on proposed undertakings;
- environmental audits of existing facilities;
- air quality assessment and air emissions control;
- preparation of solid waste management master plans; development of waste management strategies;
- development and supervision of remedial action projects; and
- development and implementation of public participation programs.

REPRESENTATIVE CLIENTS

INDUSTRY

Agnico Eagle Mines Limited
Albright & Wilson Americas
Alcan Ingot Alloys Canada Limited
Alexis-Nihon Corporation
AlliedSignal Inc.
Anachemia Chemicals Limited
AREVA Resources Canada Inc. (COGEMA Canada Ltd.*)
Armbro Enterprises Inc.
Atco Power
Bank of Montreal
Barrick Gold Corporation
BASF Inmont Canada Limited
Benjamin Moore & Co. Ltd.
Bramalea Limited
Bridgewater Golf and Country Club
Bristol-Myers Products Canada
Brock Aggregates
CAMBIOR Inc.
Cameco Corporation (Eldorado Resources Limited*)
Campbell Red Lake Mines
Canada Building Materials Co.
Canada Metal Limited
Canada International Rio Tinto Iron and Titanium Inc.
Canada Tungsten
Canada Wire Limited
Canadian Lencourt Mines Limited
Canadian Occidental Petroleum Limited
Cape Breton Development Corporation
Cigar Lake Mining Corporation
Citadel Gold Mines
Cleveland Cliffs Inc.
Colgate Palmolive Limited
Corona Corporation
Corundal Re-Refiners
Cyprus Minerals
Daimler Chrysler Canada
Denison Mines Limited
Detour Lake Mine
Dufferin Construction
East Kemptville Tin Corporation
East Woodbridge Development Inc.
Echo Bay Mines Limited
Effem Inc.
Emerald Lake Resources
Enbridge Inc.
ENTERAC Property Corporation
Equity Silver Mines
Esso Petroleum Canada Limited
Esso Resources Canada Limited
F&P Manufacturing Inc.
Falconbridge Limited
Fiberglas Canada Inc.
General Motors Limited
Grand & Toy Limited
Grant Forest Products
Halton Recycling
Hecla Mining Company
John T. Hepburn Limited
Honda Canada Inc.
Hydro One
ICI Canada
Imperial Tobacco
INCO Limited
Intermetco Limited
International Atlas Corporation
International Rössing Uranium Limited
Interprovincial Pipeline Limited
Johnson Controls Battery Division
Kerr Addison Mines Limited
Kidd Creek Mines Limited
King Business Centre Inc.
Kinross Gold Corporation
Kumtor Operating Company
Lac Des Iles Mines Ltd.
LAC Minerals Limited
Lafarge Canada Inc.
Laidlaw Waste Systems Ltd.
Les Mines Selbaie
Mandarin Golf Club
Manitoba Hydro
Marathon Realty
Marel Contractors Ltd.
Maritime Nuclear
Markborough Properties Limited
Midwest Joint Venture
Minnova Inc.
Mississauga Metals and Alloys Inc.
Mitsui and Company (Canada) Limited
MWI Industries
Nacan Products Limited
Nanisivik Mines
Neptune Resources
New Brunswick Electric Power Commission
Northern Telecom
Norton Advanced Ceramics of Canada Inc.
Ontario Power Generation
Ontario Redi-Mix
Placer Dome Inc.
Plasco Energy Group
PNC Exploration (Canada) Co. Ltd.
Quintette Coal Limited
Rahn Metals Plastics Limited
Ralston Purina Canada Inc.
Rio Algom Limited
Rogers Telecommunications Limited
ROXUL Inc.
Saskatchewan Mining Development Corp.
Shell Canada Limited
Skyline Gold Corporation
Slough Estates Canada Limited
Smartwood
St. Marys Canada Inc.
Steetley Quarry Products Inc.
Strathcona Mineral Services Limited
Taikisha Canada Inc.
Teck Corporation
Texaco Canada Limited
Topliss & Harding Canada Limited
Toronto Redi-Mix
Toronto Refiners and Smelters
Total Minatco Limited
TransCanada Energy Limited
Trans Northern Pipelines Inc.
Tricil Limited
TVX Gold Inc.
Union Carbide Canada Ltd.
Uranium Saskatchewan
Victoria Woods Development Corp.
Walker Brothers Quarry Ltd.
Westfield Minerals Limited
Westland Incinerators Limited
Westminer Canada Limited
Wingold Properties Limited
WMI Waste Management of Canada Inc.
York Consortium 2002
York Hanover Development Limited
(* Predecessor company also a client)

GOVERNMENT (CANADA)

B.C. Energy Mines and Petroleum Resources
B.C. Environmental Roundtable
B.C. Ports Authority
Canada General Standards Board
Canadian Council of Ministers of the Environment
Canadian International Development Agency
Canadian Nuclear Safety Commission
CANMET
Carleton Roman Catholic School Board
City of Nanticoke, Ontario
City of North York, Ontario
City of Oshawa, Ontario
City of Scarborough, Ontario
City of Toronto, Ontario
City of Victoria, British Columbia
City of Windsor, Ontario
County of Essex, Ontario
Dufferin Peel Separate School Board
ECO Canada
Energy, Mines and Resources Canada
Environment Canada
Etobicoke Public School Board
Fisheries & Oceans Canada
Forestry Futures Committee, Ontario
GO Transit
Greater Moncton Sewage Commission
Health and Welfare Canada
Indian and Northern Affairs Canada
Interim Waste Authority
Low-Level Radioactive Waste Management Office
National Capital Commission
National Resources Canada
New Brunswick Department of Health
Northwest Territories Chamber of Mines
Ontario Ministry of Government Services
Ontario Ministry of the Environment
Ontario Ministry of Health
Ontario Ministry of Housing
Ontario Ministry of Natural Resources
Ontario Ministry of Transportation
Ontario Realty Corporation
Parks Canada
Public Works Canada
Regional Municipality of Halton
Regional Municipality of Hamilton-Wentworth
Regional Municipality of Niagara
Regional Municipality of Peel
Regional Municipality of York
Saskatchewan Environment
Siting Task Force on Low-Level Radioactive Waste
Toronto Region Conservation Authority
Town of Lindsay, Ontario
Town of Markham, Ontario
Town of Vaughan, Ontario
Township of Georgian Bay, Ontario
Township of West Lincoln, Ontario
Transport Canada

INDUSTRIAL ASSOCIATIONS

Aggregate Producers Association
Canadian Automatic Sprinkler Association
Canadian Nuclear Association
National Mining Association
Ontario Mining Association
Ontario Restaurant Association
Ontario Stone, Sand & Gravel Aggregates
Redi-Mix Concrete Association of Ontario
Petroleum Association for Conservation of the Canadian Environment

PUBLIC GROUPS

Argonaut Rowing Club
Catchacoma Cottagers Association
Coalition to Maintain the Environment
Group of Eight
Pollution Probe
Rawson Academy
Save the Valley
Toxic Waste Research Coalition

INTERNATIONAL

United States
ABS Quality Evaluation
American Brands, Inc.
American Mining Congress
Anaconda Minerals Company
Atlas Corporation
Bethlehem Steel Corporation
Centerra Gold
City of Omaha, Nebraska
Commonwealth of Virginia
Cyprus Anvil Mining Corporation
Freeport McMoRan
Kerr-McGee Chemical Corporation
(IUC) International Uranium Corporation
McKesson Corporation
Mobil Mining & Minerals Company
Monsanto Chemical Company
Placer Pacific
Ridgeway Mining Corporation
Scranton Medical Society, Pennsylvania
Sequoyah Fuels Corporation
State of Michigan, Low-Level Radioactive Waste Authority
State of Washington, Department of Ecology and Air Programs
The Fertilizer Institute
UMETCO Inc.
United States Environmental Protection Agency
University of Cincinnati, Institute of Environmental Health

Others
Asian Development Bank Uzbekistan
Bahamas Environment Science & Technology (Best) Commission
Caribbean Development Bank
Council of Nuclear Safety, South Africa
Department of Science, Technology and Environment, Vietnam
Direction Régionale de l'Industrie de la Recherche et de l'Environnement, France
Environmental Management Authority Trinidad and Tobago
Essar Steel Caribbean Limited
European Bank for Reconstruction and Development, Kazakhstan, Kyrgyzstan
German Federal Ministry of Environment
Government of the Bahamas
Guyana Environmental Protection Agency
India Ministry of Environment and Forests
Instituto Nacional de Ecologia, Mexico
International Atomic Energy Agency, Vienna
International Finance Corporation
Mines Safety Department, Zambia
Ministry of Health Government of Montserrat
Ministry of Planning and Development, Trinidad and Tobago
Ministry of Public Works and Communications, Guyana
National Environmental Commission (CONAMA), Chile
PricewaterhouseCoopers
Royal Netherlands Embassy, Tanzania
Rio Tinto Iron and Titanium Inc.
Rössing Uranium Limited
Russian Project Finance Bank Kazakhstan
Solid Waste Corporation Government of St. Kitts and Nevis
Solid Waste Management Authority of Grenada
Tata Steel Limited
United Nations Development Program (UNDP)
United Nations Industrial Development Organization (UNIDO)
World Bank India, Nepal, Mexico, Turkey, Colombia, Ghana
World Health Organization

THE SENES GROUP

CANADA

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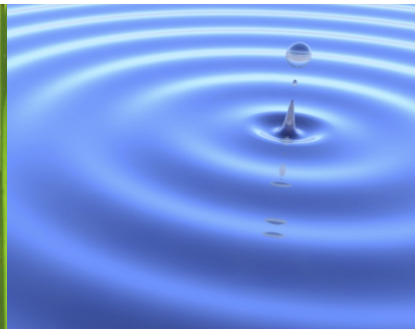
PROPOSAL:
Pricing

Human Health Risk Assessment of Northeastern British Columbia Oil & Gas Activity

RFP#: RFP HL173



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Proposal: Pricing

Human Health Risk Assessment of Northeastern British Columbia Oil & Gas Activity
RFP#: RFP HL173

Prepared for

British Columbia Ministry of Health
Purchasing Services Branch
c/o 2nd Floor, 563 Superior Street
Victoria, BC V8V 1T7

Prepared by

Pottinger Gaherty Environmental Consultants
1200 - 1185 West Georgia Street
Vancouver, BC V6E 4E6
604.682.3707

August 10, 2012

4113.00.01

1.0 CURRENCY

All costs in this proposal are shown in Canadian dollars.

2.0 BASIS FOR REIMBURSEMENT

PGL will perform this work on a cost-reimbursable basis up to a maximum upset price as broken down below.

Item	Man-hrs	Labour Fees	Expenses	Subtotal
Task 1A: Project Kick-off Meeting (ESP) Includes Review existing reports, data and resources available from the Ministry for the human health concerns to be evaluated in Phase 2				$69,900
Task 1B: Complete a jurisdictional review and report				$31,680
Task 1C: Assess the feasibility and applicability of the available information to complete a human health risk assessment and the best methodology for each concern				$93,750
Task 1D: Complete the human health risk assessment for each of the concerns identified		s.21		$230,350
Task 1E: Review the BC statutory, regulatory and policy framework				$77,420
Task 1F: Development of a report which includes recommendations to manage the human health risks identified through the use of spatially enabled data				$174,850
Task 1G: Limited engagement of key stakeholders and a subsequent report of nature and extent of the engagements				$72,300
Task 1H: Bi-weekly meeting via telephone conference or in person*				$33,200
Task 1I: Monthly Meeting in Northern BC[#]				$108,000
Maximum Upset Price (excluding applicable tax)				$893,950

Assumptions

Task 1 A: Kick-off Meeting (ESP)

Attendees from PGL-NovaTox Team: Simone Mol, Will Gaherty, Mark Chappel, Duncan MacDonald, Leslie Beckmann and Ian Blandford
Travel: $500 return/person (6 people)
Accommodation: $200 per night/person for 6 people 1 night

Task 1 G: Limited Key Stakeholders Engagement

Key Stakeholders meeting will coincide with one Northern BC Meeting for PM
Travel: $1000 return/person for 2 people, excluding PM
Accommodation: $200 a night/person for 2 people for 3 nights, excluding PM
Disbursements: include daily allowance at MOH rate, other charges (e.g., car, long distance calls covered under Northern BC Meeting Disbursements)

Task 1H: Bi-Weekly Meetings

35 bi-weekly meetings over the project for 2 hrs, 5 in-person in Victoria for 1 person
Travel: $500 return/person for 1 person for 5 trips

Task 1 I: Northern BC Meeting

10 trips over the course of the project for 5 days to Northern BC (Ft. St. John) for one person
Travel: $1000 return/person for 10 trips
Accommodation: $200 a night/person for 1 person for 4 nights a trip for 10 trips
Disbursements: include daily allowance at MOH rate, car rental, long distant calls

Applicable Taxes are not included in the Maximum Upset Price and will be invoiced as a separate line item.

Addenda received during the bidding period:

- Amended July 30/12 – Q&A #3 added to attachments
- Amended July 27/12 – Q&A #2 added to attachments
- Amended July 19/12 – Summary of Bidders Meeting held July 13, 2012 (attachment)
- Amended July 03/12 – Q&A #1 added to attachments
- Amended June 29/12 – attachments added, "Phase 1 Final for submission," "Phase 1 Compendium of Submissions"
- Amended June 29/12 – Contact information updated

2.1 Labour Charges

The Ministry of Health will compensate PGL for labour charges on an hourly basis in accordance with the table of rates below.

The all inclusive rate schedule for named individuals working on this project is as follows:

Name	Role	Project Hours	Rate, C$/hour
Simone Mol	Project Manager		
Will Gaherty	Technical Director/PGL Sponsor		
Stewart Brown	Air Specialist		
Duncan MacDonald	Regulatory Lead		
Mark Chappel	Human health risk assessment Lead		
Leslie Beckmann	Communications Lead		
Emma O'Neil	Environmental Engineer		
Stephanie Louie	Environmental Scientist		s.21
Carla Shaw	Phase 1 Manager		
Derek Hillis	Toxicological Assessment		
Hugh Scobie	Exposure Modeling		
Dino Manca	Exposure Modeling		
Ian Blandford	Geomatics Specialist		
Admin Assistant	Admin Assistant		

2.2 Project Expenses

PGL will be reimbursed at cost for project-related expenses according to the following:

- Reproduction, printing, plotting and related cost;
- Long distance and local phone/fax;
- Postage and document courier services;
- Leased or owned project vehicles;
- Reasonable travel and living expenses for project personnel, required to travel away from their home office in connection with the services;
- Analytical charges;
- Subconsultants;
- Personal vehicles on direct project requirements at $.53/Km; and
- Other reasonable costs associated with the project pre-approved by the client.

3.0 INVOICING AND PROJECT CONTROL

Project charges are collected and posted internally on a weekly basis for review and confirmation by the Project and Task Managers. On-line access to the project account is available to the Project Managers to facilitate tight ongoing control of the project spending. Draft invoices are prepared monthly for verification by project management staff prior to issue to the Ministry.

Two separate invoices will be prepared and submitted directly to the Ministry monthly. Each invoice will have the appropriate company work order number, a unique invoice number and a concise description of the services provided and work conducted for the period. Invoices will be complete with appropriate verification that the work has been performed.

Scope changes can be identified by the PGL Project Manager or by the client representatives. Before work can begin on a scope change, the Ministry's Contracting Authority and Project Manager(s) must approve a written description of the scope change, the associated budget adjustment and the impact on the project schedule.

4.0 PROPOSAL VALIDITY

This proposal is valid for acceptance for 90 days following the closing date, after which time a review of the personnel, terms and conditions offered herein may be required.

5.0 ASSUMPTIONS AND EXCLUSIONS

- The number of meetings will be as identified in the Request for Proposal.
- The schedule will be as identified in the Proposal.
- Fifteen hard-copies of draft interim reports and final interim reports will be issued to the Ministry.
- Fifteen hard-copies of the draft final report will be issued.
- The project schedule and costing does not account for peer review. The costs associated with addressing peer review comments are not included.

6.0 SUBCONSULTANTS

PGL proposes to use the following subconsultants on this project:

- Mark Chappel, NovaTox Inc.
- Hugh Scobie, NovaTox Inc.
- Derek Hillis, NovaTox Inc.
- Dino Manca, NovaTox Inc.

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PROPOSAL:
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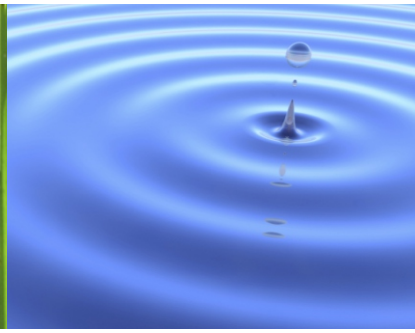
Human Health Risk Assessment of Northeastern British Columbia Oil & Gas Activity

RFP#: RFP HL173



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Proposal: Pricing

Human Health Risk Assessment of Northeastern British Columbia Oil & Gas Activity
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Prepared for

British Columbia Ministry of Health
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c/o 2nd Floor, 563 Superior Street
Victoria, BC V8V 1T7

Prepared by

Pottinger Gaherty Environmental Consultants
1200 - 1185 West Georgia Street
Vancouver, BC V6E 4E6
604.682.3707

August 10, 2012

4113.00.01

Executive Summary

INTRODUCTION AND BACKGROUND

The British Columbia Ministry of Health (Ministry) is completing a phased project to identify, explore and assess concerns about human health risks relating to oil and gas activity in northeastern BC. Phase 1, which included public engagement to inform the scope and terms of reference and identify concerns relating to oil and gas activity, was completed by the Fraser Basin Council on March 30, 2012. Phase 2 of the project will investigate and evaluate the potential for significant health effects associated with specific health concerns identified in the Phase 1 report. Phase 3 will involve the reporting of the results to stakeholders and the public.

The Ministry released a Request for Proposal, Phase 2 – Human Health Risk Assessment of Northeastern British Columbia Oil and Gas Activity on June 28th to initiate Phase 2 of the project. This proposal details the Human Health Risk Assessment project understanding, approach and methodology, timelines, deliverables, and schedule proposed by Pottinger Gaherty Environmental Consultants Ltd. (PGL) and our project partner, NovaTox Inc. (NovaTox).

THE PROPONENT TEAM: COLLABORATION FOR EXCELLENCE

Vancouver-based PGL and Ontario-based NovaTox have formed a strategic alliance to provide the Ministry with technical excellence, regional and industry experience, strong working relationships with regulators, proven stakeholder relations skills, and a project management strategy built on strong communication for on-time, on-budget delivery.

PROJECT OVERVIEW

Based on the scope of work detailed by the Ministry in the Request for Proposal, PGL and our project partner, NovaTox considers the overlying goals of the human health risk assessment to be:

- Review the human health concerns identified in Phase 1 of the study that are associated with environmental pathways of exposure (air, water and food), other environmental issues including accidents/incidents (e.g., spills, explosions) and increased traffic, as well as review the province's institutional framework with respect to oil and gas operational issues in northeastern BC to determine if risk assessment methods are available;
- Where appropriate and/or available apply the risk assessment paradigm to quantify the risk associated with the identified human health concerns through the use of existing data and various models. Where data or models are not available, qualitative techniques will be used to identify and validate areas of concern; and
- Improve public health outcomes through the development of reports and deliverables, which include recommendations to manage the risks identified through the quantitative and qualitative assessment of the identified human health concerns.

The PGL-NovaTox Team will meet these goals and objectives using the following approach:

- Apply a risk-based decision process to maximize use of existing data and minimize data collection needs and efforts;
- Work within standard guidance and protocol for the risk assessments, but apply the guidance and protocol as appropriate to site-specific conditions;
- Apply our integrated scientific expertise in toxicology, exposure assessment, risk analysis, air monitoring, engineering, geology, hydrogeology, geomatics, and communications to expediently resolve technical issues without unnecessary studies or data collection programs;
- Enhance productive relations with involved parties, regulatory agencies, and the community to achieve successful project completion; and
- Meet realistic schedules while maintaining high-quality professional performance.

Our approach incorporates the following key commitments:

- We will ensure a thorough intense initial review of existing information;
- We will ensure that data assessment activities are focused and support the key objectives, and the identified decision needs for the risk assessment; and
- We will identify data gaps consistent with the key objectives and decisions.

PROJECT EXECUTION

Our project team has identified Enhanced Systematic Planning (ESP) and project management as critical to the successful execution of the project. The ESP system is a unique, high-level planning process in which the project team members involved in different technical aspects of the problem, along with the sponsoring organization (Ministry of Health), ensure (through meetings and discussion) that important details of the study are not overlooked or ignored and technical challenges will be addressed appropriately. ESP is designed to assign responsibilities for the project so that conflicts can be resolved and progress is tracked. The deliverable is a coherent plan to achieve specific technical results while concurrently satisfying the requirements of the spectrum of stakeholders.

PGL believes that ESP is critical to:

- Confirming key objective and risk management goals that will form the unifying principles for the project;
- Providing a focused and common vision; and
- Establishing strong working relationships early in the project.

The end-product is a focused team working to achieve a tightly defined plan. Our plan will improve the effectiveness of the program by avoiding ill-defined “human health concerns,” delays in understanding data limitations, and ambiguity in the decisions that will be made throughout the course of the project. A key benefit of the ESP process is that it builds consensus among study participants on elements critical to study design and execution.

PROJECT MANAGEMENT

PGL has formed a project management team of senior specialists in the key areas of human health risk assessment, regulatory/policy review and communications planning. This team will ensure that a technically competent project is delivered with public acceptance within a defined budget, schedule and administrative process. This team has been assembled in response to the following challenges:

- The technical challenge requiring coordination of the efforts of senior technical specialists to satisfy the technical and schedule objectives of the Ministry;
- The communication challenge of communicating complex and potentially emotionally charged technical issues in a diverse and geographically dispersed community; and
- The management and technical challenge of ensuring that the local knowledge base and key project tools (reference database and risk data database) are effectively accessed for project delivery.

A single point of contact for the Ministry has been established through the designation of an overall project manager. The technical manager and senior leads will work as a team under the project manager's direction, with each member bringing to the table a particular area of expertise required for the successful completion of the project. This approach ensures that client has one point of contact with the project team, the project team remains focused on their individual tasks, and at the same time ensures that the appropriate expertise is included in project management and is available at the management level to the Ministry.

PROJECT PERSONNEL

PGL has assembled a team of highly qualified professionals to lead this project. Each team member is a recognized expert in their field bringing years of experience to the project in disciplines such as human health risk assessment, toxicology, exposure assessment, risk analysis, air monitoring, geology, hydrogeology, geomatics, process engineering, transportation engineering, as well as risk and crisis communication. Senior team members are:

- Technical Director/Senior Reviewer, Will Gaherty, M.S., P.Eng.
- Project Manager, Simone Mol, PhD., P.Chem, CSAP
- Human Health Risk Assessment Lead – Project Lead and Exposure Assessment, Mark Chappel, MSc., DABT
  - Toxicological Assessment, Derek Hillis, Ph.D.
  - Exposure Modelling, Hugh Scobie, MSc., DABT
  - Senior Technical Review, Dino Manca, Ph.D., DABT
- Regulatory Review Lead, Duncan Macdonald, B.Sc., P.Eng., CSAP
  - Environmental Engineer, Emma O'Neill, B.A.Sc., P.Eng.
  - Environmental Scientist, Stephanie Louie, M.Sc., R.P.Bio.
  - Phase 1 Manager, Carla Shaw
- Air Quality Specialist, Stewart Brown, M.Sc., P.Ag., R.P.Bio.
- Communications Coordinator, Leslie Beckmann, B.Sc.H, M.A.
- Geomatics Specialist, Ian Blandford, Dipl.

KEY TASKS

The key tasks for this project to successfully fulfill the objectives of the Phase 2, Human Health Risk Assessment of Northeastern British Columbia Oil and Gas Activity include:

1. Review existing reports, data and resources available from the Ministry for the human health concerns to be evaluated in Phase 2 including;
    - Human health exposure pathways (air, water and food);
    - Other environmental issues including accidents/incidents (spills, explosions) and increased traffic;
    - The province's institutional framework with respect to oil and gas activity.
2. Complete a jurisdictional review and report.
3. Determine the feasibility and applicability of the available information to complete a human health risk assessment and the best methodology for each concern including;
    - Deterministic quantitative risk assessment;
    - Probabilistic quantitative risk assessment;
    - Qualitative risk assessment; and
    - Other approach.
4. Complete the human health risk assessment for each of the concerns identified (exposure pathways, other environmental issues and institutional framework) with a full report detailing the problem formulation, exposure assessment, hazard assessment, and risk characterization of each concern.
5. Review the BC statutory, regulatory and policy framework to;
    - Identify where current statues, regulations and policies are sufficient or exceed a level to effectively manage and minimize human health risks;
    - Identify gaps in the current statues, regulations and policies necessary to effectively manage and minimize human health risks; and
    - Identify where current statues, regulations and policies would benefit from a change to improve the ability to manage and minimize human health risks.
6. Development of a report which includes recommendations to manage the human health risks identified through the use of spatially enabled data.
7. Limited engagement of key stakeholders and a subsequent report of nature and extent of the engagements.

DELIVERABLES

The following tasks and deliverables have been identified by PGL to ensure the successful execution of the project:

- Project award (kick-off meeting);
- Preliminary data review;
- Jurisdictional review;
- Enhanced Systematic Planning (ESP);

- Intensive data review;
- Exposure summary and modelling;
- Human health risk assessment;
- Statutory and regulatory review;
- Review of novel risk assessment techniques (i.e., GIS data, etc.); and
- Final reporting.

RELATED PROJECT EXPERIENCE

The PGL-NovaTox team has conducted human health and ecological risk assessments throughout North America. These have included all of the major classes of chemicals and have ranged in complexity from screening-level assessments to multi-pathway, multi-chemical assessments. In addition, NovaTox has also been successful in introducing new techniques to human health risks assessments, which have helped avoid the use of overly conservative exposure assumptions. Examples of such techniques include the use of geostatistical methods to estimate exposure concentrations, the derivation of site-specific bioavailability factors, and the development of micro-exposure event modelling to enhance the application of Monte Carlo analysis as a tool for characterizing exposure of individuals within a population.

In addition to having extensive experience under provincial regulatory programs, the PGL-NovaTox team has significant experience in the preparation of risk assessments under the federal government's Federal Contaminated Sites Action Plan consistent with guidelines from Health Canada, Environment Canada, and the Canadian Council of Ministers of the Environment (CCME), as well as various provincial regulatory agencies.

Our combined team of staff has conducted well over 100 risk assessments for a variety of situations and sites regulated by various provincial and federal environmental agencies. We are skilled at evaluating a wide range of chemicals including metals, volatile organic compounds, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons, petroleum-based products, pesticides, flame retardants, asbestos, perfluorinated chemicals, particulates, chlorinated solvents, chromium, and dioxins and furans. Our risk assessments are used to evaluate all types of media including soil, sediment, air, surface water, groundwater, and biota.

Our professional staff utilize scientifically valid, state-of-the-art toxicology and risk assessment approaches to complete routine evaluations as well as those that are more complex and unique. We are proficient in applying various statistical methods, probabilistic modelling and chemical fate transport modelling. The combined firms individually have a long history of offering strategic advice to clients, including government agencies.

Our scientists also have many years of experience in risk communication, disseminating information with lay audiences, technicians, physicians, senior scientists, public health officials, and community groups.

We are confident that few other firms can equal our combined ability to successfully confront the multi-layered issues that arise when humans are exposed to chemical agents and other non-chemical stressors that might occur as a result of oil and gas operations in northeastern BC.

Table of Contents

TABLES

FIGURES

APPENDICES

1.0 OVERVIEW AND CONTEXT

Oil and gas resources in northeastern BC have been under development for more than 60 years. With increasing concern over the impacts of this development, the BC Ministry of Health has begun a phased multi-year project to understand public concern about health risks (Phase 1, now completed), identify and validate specific concerns and make recommendations on how to reduce risk (Phase 2, the subject of this proposal), and communicate the findings in a stakeholder-appropriate fashion (Phase 3). The Phase 2 scope of work must be built on the findings of Phase 1 and with a view to supporting Phase 3.

With the current focus on the Northern Gateway Pipeline project, Phase 2 needs to be delivered with the highest degree of both technical competence and transparency to ensure that the final product is accepted by the communities whose health outcomes it is designed to improve.

Pottinger Gaherty Environmental Consultants Ltd. (PGL), in association with NovaTox Inc. (NovaTox), is pleased to be able to present a proposal for the Phase 2 scope of work that is built on technical risk assessment expertise, experience with the oil and gas sector, experience with communities in northeast BC, and an integrated team with strong communication skills.

2.0 PGL AND NOVATOX – CORPORATE OVERVIEW AND RELATIONSHIPS

Founded in 1991, PGL is an employee-owned company based in Vancouver that specializes in contaminated sites investigation, remediation and risk assessment. Our technical team consists of highly experienced engineers, scientists, planners, and regulatory specialists. We have built this team with members who are keen to both be at the front of their profession and provide exceptional customer service. As individual consultants or a group they single-handedly manage and advise on a variety of environmental and planning projects, big or small, simple or complex. Our team offers:

- A long record of achieving successful environmental certifications and approvals;
- A commitment to customer service that begins with understanding the unique opportunities and constraints associated with your organization and your site;
- A unique ability to develop creative, cost-effective solutions that meet or exceed regulatory requirements; and
- Familiarity with the specific environmental and regulatory requirements associated with working on in remote locations and with First Nations.

We pride ourselves on beginning with the big picture so that we can provide you with strategic advice on the most cost-effective means to remediate a site to the relevant standards while also scoping all foreseeable impacts and costs. Because we are a small/medium-sized local company, this project will matter to us and so it will get resources and expertise it needs such as:

- A customized project to meet you requirements: you will get what you need, not some standard package;
- Direct communication with senior staff and principals of the firm, who have influence on the timing and cost of your project; and
- Explanation of the implications of our findings, so you will understand the project well enough to give us instructions and control our approach.

2.1 Our Technical Specialists

Our technical teams consist of highly experienced engineers, scientists, planners, and regulatory specialists. As individual consultants or a group they manage and advise on a variety of environmental and planning issues, big or small. This team has:

- A long record of achieving successful environmental approvals;
- Excellent working relationships with key regulators, First Nations, and other federal and provincial agencies, ensuring an efficient communication process and prompt service;
- Professional project budget analysis and management; and
- Experienced key stakeholder and public consultation strategists.

2.2 The PGL Advantage

Because of the way our company is built and the type of people that we are, we offer clients the following advantages:

1. **Responsiveness**: As one of few remaining employee-owned, independent and purely environmental consulting firms, we are suited to offer quick, informed and personal advice to clients from all personnel, even senior consultants.

2. **Value**: We offer a range and quality of services equivalent to that of larger companies but without the operational tendency to make projects larger, and costlier, than necessary.
3. **Flexibility**: We make our team and approach fit your project – not the other way around. We get better results for your project and reduce the time and money required to complete it by assigning only the right people to do the work and doing only the work that needs to be done.
4. **Completion**: Our technical and project management systems are designed to deliver excellent projects on task, on time, and on budget with good management of scope change, if necessary.

PGL has stood by this project approach and service style for 20 years and it has proven successful for a wide variety of clients.

2.3 A Strategic Alliance with NovaTox

PGL has purpose-built a team for this project that involves equal participation from a firm that we work well with: NovaTox.

NovaTox is a scientific consulting firm that specializes in providing risk assessment services to a variety of clients in both the public and private sectors. NovaTox has significant experience in understanding complex exposures involving chemicals found in air, soil, water, sediment and other potentially contaminated media (foods, cosmetics, pharmaceuticals, etc.). Senior scientists at NovaTox have backgrounds in human toxicology, industrial hygiene, environmental sciences, statistical analysis, and risk assessment. All principal staff members hold professional designations through the American Board of Toxicology (ABT).

NovaTox professionals utilize scientifically valid, state-of-the-art toxicology and risk assessment approaches to complete routine evaluations, and those that are more complex or unique. NovaTox applies various sophisticated techniques to solve issues for its clients, including novel methods such as statistical approaches, probabilistic modelling, and chemical fate and transport modelling. NovaTox has also developed novel methods to assess exposure-related events including the application of bioavailability or physiological available chemical methods for developing benchmark concentrations for chemicals in soil.

NovaTox's toxicological evaluations and risk assessments have ranged from screening-level assessments and detailed risk assessments, to complicated multi-pathway, multi-chemical analyses at a variety of sites, including: industrial, manufacturing, treatment, storage, and military sites. From conducting risk evaluations for clients in government and industry to serving as expert witnesses in litigation cases for various parties, NovaTox has the knowledge and experience to address health risk concerns of its clients. Its key staff are certified and active in professional organizations (Society of Toxicology; Society of Environmental Toxicology and Chemistry; Air & Waste Management Association), publish in peer-reviewed scientific journals, and have been involved in presenting toxicological and risk assessment research at professional conferences.

3.0 SUMMARY OF PROJECT PHASE 2

Based on the results of the Human Health Risk Assessment, Phase 1 Report, identifying health concerns relating to oil and gas development in northeastern BC, seven distinct categories of respondents' concerns were noted including;

- Personal Health Issues;
- Environmental Pathways of Exposure;
- Related Environmental Issues;
- Changes to Community;
- Community Service Issues;
- Oil and Gas Operational Issues; and
- Institutional Framework Issues.

It is our understanding that of the seven identified categories, three are to be specifically addressed in Phase 2 of the Human Health Risk Assessment (HHRA) including;

- Environmental Pathways of Exposure;
- Other Environmental Issues and Events; and
- Institutional Framework Issues.

Each of these three categories to be addressed in the Phase 2 Human Health Risk Assessment is further discussed in the following sections.

3.1 Environmental Pathways of Exposure

The evaluation of environmental pathways of exposure includes the potential for environmental stressors to negatively impact;

- Air quality;
- Water quality and quantity; and
- Land and food quality.

3.1.1 Air Quality

Air quality may be impacted from oil and gas operations in northeastern BC through a number of chemical constituents that occur at all phases of an oil and gas project. Air quality from both transient as well as permanent and semi-permanent operations will be evaluated in the HHRA. In addition, both stationary operations, such as wells and extraction facilities, and mobile operations, including transportation and exploration activities, need to be considered. Atmospheric pollutants and airborne contaminants associated with oil and gas activities will be evaluated as to their potential to impact human health, taking into consideration the unique physiogeography and human receptors that are present in northeastern BC. The air quality HHRA will include an evaluation of gases (hydrogen sulphide, sulphur dioxide, etc.) and dusts (diesel smoke, total suspended particulate, particulate matter less than 10 microns in diameter, etc.) that are directly associated with the oil and gas development, but also other airborne impacts that might arise indirectly from activities such as increased nitrogen dioxide, polycyclic aromatic hydrocarbons (PAH), and aldehydes that are associated with increased traffic that may correspond with oil and gas development.

3.1.2 Water Quality and Quantity

Freshwater is a finite resource and needs to be preserved and managed as such. To this effect the evaluation of negative impacts on freshwater resources is to be included in the HHRA. Oil and gas industry operations have a wide variety of potential effluents from direct and indirect operations, which can impact the quality and quantity of water resources. It is noted that water quality and quantity are two distinctly different aspects of the resource, though one may impinge upon the other. Specifically, water quality is related to its physicochemical characteristics and whether the water can be used for a proposed use (i.e., water if free from contamination for drinking water or the appropriate hardness to use in a boiler system). Water quantity, on the other hand, is the amount of the water that may be available. The quantity of water available for an individual or community use can be impacted by oil and gas development directly, such as a depressed water table where large amounts of water are being used for hydraulic fracturing (fracking) or other process, or indirectly, such as the contamination of a freshwater system which makes it unavailable for use by the local community. Both water quality and quantity will be addressed in the HHRA.

3.1.3 Land and Food Quality

Impacts on land and food quality are associated with commercial crops, livestock, backyard gardens, as well as country foods that may be harvested locally by individuals and include plants, wildlife and fish. A number of exposure pathways potentially impacting land and food quality exist. The transfer of contaminants to soils and aquatic systems through airborne emissions, effluents or process wastes can contribute to decreased local food quality. This may occur directly, such as the contamination of soils with oil at a well installation, or indirectly such as the migration of contaminants through groundwater systems to a surface water system, or the deposition of dusts on edible plants. To this effect, the evaluation of land and food quality will evaluate the processes, products and by-products of oil and gas development operations to identify those contaminants that may decrease land and food quality. In particular, specific attention with regard to land and food quality should include an evaluation of the ability of the identified contaminants to bioaccumulate in foods such as may occur with some metals in plants or animals.

3.1.4 Other Environmental Issues and Events

Other environmental issues and events may occur which would impact human health. Many of these other issues can be classified as catastrophic events that are not expected to happen on a regular frequency but have the potential to have an immediate impact on human health. Included in this category for the HHRA is the potential associated with oil and gas development for explosions, spills and accidents. The potential for these events to impact human health is governed by the event frequency, oil and gas development distance, and density with respect to potentially impacted populations and communities and the potential severity of the impact. These will be examined in the HHRA using data specific for northeastern BC, when available.

A second set of other environmental issues was identified to be included in the HHRA; namely the potential for increased truck traffic to influence the risks associated with the air, water and food environmental exposure pathways noted above. In the review of the potential exposure pathways, the transported quantities and types of oil and other chemicals will be included in the exposure pathway evaluation. In addition, the effects of increased transportation on ambient noise and ambient air quality will be investigated.

3.1.5 Institutional Framework Issues

This component of the HHRA for oil and gas development in northeastern BC focuses on the province's institutional framework used to govern the operational issues associated with the oil and gas industry. This framework, in part, includes the province's current Acts and Regulations that dictate the oil and gas industry monitoring, compliance, and reporting requirements, but also the province's ability to enforce these requirements. The project description requires these components to be addressed, including the review of regulatory requirements and practices in other jurisdictions, to aid in the recommendations of the risk assessment. In addition, the current processes for communicating to the public regarding oil and gas operational issues as well as emergency response will also be addressed.

4.0 APPROACH AND SOLUTION

4.1 Key Objectives

It is understood that the Ministry of Health is committed to developing:

> *A transparent process that provides a thorough scientifically sound assessment of the potential health risks associated with a range of oil and gas activities and events, and effectively communicate the results so that future decisions (including policy related decisions) are expertly informed and valued.*

Based on this vision and the scope of work developed by the Ministry, our project team considers the overlying goals of the HHRA to be:

- Review the human health concerns identified in Phase 1 of the study that are associated with environmental pathways of exposure (air, water and food), other environmental issues including accidents/incidents (spills, explosions) and increased traffic, and review the province's institutional framework associated with respect to oil and gas activity in northeastern BC to determine whether risk assessment methods are available.
- Where appropriate and/or available, apply the risk assessment paradigm to quantify the risk associated with the identified human health concerns through the use of existing data and various models. Where data or models are not available, qualitative techniques will be used to identify and validate issues of concern.
- Improve public health outcomes through the development of reports and deliverables that include recommendations to manage the risks identified through the quantitative and qualitative assessment of the identified human health concerns.

4.1.1 Strategy

To successfully accomplish the goals identified above, the primary objectives of the HHRA are identified as:

- Determining the environmental pathways of exposure that are predominantly associated with oil and gas activities (i.e., source to receptor pathways related to various phases of oil and gas activity).
- Compiling existing data to evaluate levels of chemicals of concern (COCs) (related to the exposure scenarios) in various media (i.e., air, water, land (soil), and food) as well as other hazards (explosions) and other environmental stressors (noise) found in the study area that may be associated with oil and gas activities.
- Developing criteria and a decision process for identifying stressors (e.g., chemical COCs) for the HHRA component of the study.
- Identifying hazards associated with numerous environmental stressors, including chemical release incidents, fluid releases, and increased traffic, etc.
- Describing operable source-to-receptor pathways that are related to oil and gas activities, including activities associated with gas development, extraction and production methods, emergency events such as well blowouts and pipeline breaks, chemicals used in drilling and well stimulation techniques, chemicals in drilling waste, air quality issues related to flaring and

processing facilities, onsite and offsite waste management, transportation and disposal activities, and land reclamation activities.
- Developing criteria and a decision process for defining the study area (i.e., exposure scenario) for each stressor for the HHRA component of the study.
- Developing criteria and a decision process for identifying communities of interest that may have a direct and tangible interest in the outcome of the HHRA.
- Determining critical receptors for assessing risk to human health from source-related stressor exposure. Critical receptors for assessing human health include children and other sensitive subpopulations (the elderly, those that are considered to be more sensitive as a result of predispositions or their specific activity patterns such as hunters, anglers, etc.).
- Identifying and quantifying exposure and the degree of risk to human health for each stressor (i.e., a chemical COC) via each significant exposure pathway.
- Identifying and documenting areas of uncertainty and making recommendations for further investigations as appropriate.
- Assessing the current statutory, regulatory and policy frameworks that are designed to protect the northeastern BC population, and develop recommendations that are considered critical to better understanding and quantifying human and ecological risk (i.e., policy regarding need for further enhanced sampling of environmental components).
- Identifying the types of GIS/spatially enabled data that would improve efforts to monitor and manage the potential heath risks of populations located in northeastern BC.

These objectives are to be realized recognizing the diversity of the population living in the study area, the wealth of knowledge that has been accumulated (by various government agencies) documenting the historical levels of various stressors in the study area, the types of operations specific to this region, and considerable expertise that resides in the local communities including, but not limited to, the local health unit and local organizations.

4.1.2 Challenges

The challenges of the study are many and need to be fully appreciated to be dealt with successfully. These challenges include:

- The study area covers approximately 205,000 square kilometres (21% of the land area of BC) and encompasses areas with a wide variety of soil types, air sheds, flora, and fauna, in addition to different oil and gas activities. As a result, the risk assessment may need to be tailored to suit local geographical areas (i.e., local air shed, catchment basins of a surface water system, etc.).
- The area is characterized by diverse topography and a variety of biogeoclimatic zones and includes a wide variety of soil types and geological formations. The landscape changes from Rocky Mountains (and many other areas having very little soil) and foothills with aspen, spruce and pine forests to flat ground and muskeg. The area is generally renowned for its pristine wilderness, biological diversity and intact predator-prey ecosystem.
- Oil and gas operations began in the area in the 1950s and continue (in some cases) to be a mainstay of the local economy. The study area also includes First Nations lands. Both of these issues have implications in how socioeconomic and societal values are reflected and incorporated in the HHRA (i.e., need for assessment of sustenance users, etc.).
- The task of identifying and characterizing stressor levels impacting the study area will be complicated by the history of the area. The area has current emission sources and a number

of historical emission sources. A number of old and current oil and gas development facilities are located within the study area. Historical activities, in addition to natural background sources (i.e., oil seeping from the banks of the Peace River, etc,) may complicate the task of determining the origin of certain stressors (e.g., chemicals) present in soils and other media, as well as establishing typical background levels.

- Communication with identified (limited) stakeholders will be complicated by the geographical extent of the study area and the diverse make-up of the population. While English is the primary spoken language throughout the study area, the Study Area also includes several First Nation reserves. Societal values reflecting the diverse make-up of the study population will need to be considered (and likely incorporated) and reflected in the design and execution of the HHRA (e.g., consideration of consumption of wild game by native populations, etc.).

PGL, and our project partner NovaTox Inc., are confident that the work program we have developed for conducting a comprehensive HHRA for the study area can address these challenges and others as they arise.

4.1.3 Approach

The PGL-NovaTox team is sincerely committed to meeting the goals and needs of this project. Our overall approach to this project is to:

- Apply a risk-based decision process to maximize use of existing data;
- Work within standard guidance and protocol for the risk assessments, but apply the guidance and protocol as appropriate to site-specific, regional, study area conditions;
- Apply our scientific expertise in toxicology, exposure assessment, risk analysis, air monitoring, geology, hydrogeology, engineering, geomatics, and communications to expediently resolve technical issues without unnecessary recommendations for additional data collection programs (i.e., use of models and other sophisticated approaches including probabilistic approaches, etc.);
- Enhance productive relations with involved parties to achieve successful project completion and adoption of results. These include regulatory agencies, the oil and gas industry, First Nations, and the broader community of stakeholders;
- Meet aggressive schedules while maintaining high-quality professional performance; and
- Work in as transparent a manner as possible, so that credibility is established early and is maintained throughout the project.

Our proposed approach incorporates the following key commitments:

- **A thorough initial review of existing information.**
  PGL and NovaTox's key project team members are committed to an intense period of review of existing reports, studies and data, including all of the data categories and sources identified by the Ministry (refer to RFP Q&A#3). Team experts will thoroughly evaluate existing data and catalogue it into a usable database for use in supporting the key objectives and associated decisions to the extent needed to develop a sound HHRA and to adequately address current and future decisions and Ministry policies.

- **We will ensure that data assessment activities are focused and support the risk assessment goals, the key objectives, and the identified decision needs.**
  The PGL-NovaTox team recommends employing a structured decision process throughout the course of this project to ensure that project objectives are identified and clearly understood by all prior to embarking on analysis activities. The use of a structured decision process is a cost-effective strategy because it eliminates unnecessary delays and increases efficiency by ensuring that the appropriate data analyses are completed to meet the specific objectives of the study. A structured decision process will provide a scientifically sound and defensible basis for defining the type, quantity, and quality of data that is assessed to support risk assessment decisions, and to provide a documented link between the stated risk assessment goals, key objectives, and related decisions that need to be made. The PGL-NovaTox team will provide site-specific decision criteria for any recommended future data gathering needs, so that future programs are consistent and appropriate for their identified use.

- **We will identify data gaps consistent with the key objectives and decisions.**
  In preparing this proposal, PGL and NovaTox has considered that there are likely to be potential data gaps in addition to discrepancies in policy or regulatory oversight that might need to be researched or looked into further to meet the overall key objectives of the study. We understand that the scope of the project explicitly excludes further field investigations. We have not scoped fieldwork into the proposal but will note where fieldwork could, in future, reduce uncertainty in order to bound the definition of risk and uncertainty. When explaining data gaps (and their effect on uncertainties in the risk assessment process), any recommendations for future monitoring will adhere to a defined decision-based framework. This will involve a thorough evaluation of existing data in the context of overall estimation of risk and the level of uncertainty in the assessment. Data gaps will be triggered when the level of risk is at or near a level considered unacceptable and/or when the level of uncertainty in the assessment is considered unreasonable for informed decision making.

4.2 Project Execution

4.2.1 Project Management

PGL has formed a project management team of senior specialists in the key areas of human health risk assessment, regulatory review, geomatics, and communications planning and liaison to ensure that a technically competent project with Ministry and stakeholder acceptance is delivered within a defined budget, schedule and overall process. This team has been assembled in response to the following challenges:

- The technical challenge requiring coordination of the efforts of senior technical specialists to satisfy the technical and schedule objectives of the Ministry.
- The challenge related to a diverse stakeholder group/audience representing a variety of perspectives on the technical and scientific issues.
- The challenge of communicating complex and potentially emotionally charged technical issues (this is clearly evident in the Phase 1 report) in a diverse and geographically dispersed community/study area.

A single point of contact for the Ministry has been established through the designation of an overall project manager. The technical manager and senior leads will work as a team under the project manager's direction, with each member bringing to the table a particular area of expertise required for the successful completion of the project. This approach ensures that the Ministry of Health has one point of contact with the project team, the project team remains focused on their individual tasks, and at the same time ensures that the appropriate expertise is included in project management and is available at the management level to the Project Manager and the Ministry of Health. The organization of the management team is presented in Figure 1.

Dr. Simone Mol, Ph.D., PChem, CSAP, will serve as Project Manager. She will have overall responsibility to the Ministry of Health Project Manager for delivery of the project within the budget and schedule. Simone will focus on the logistical/delivery aspects of the project including management of financial performance, schedule performance, and contract administration with the client Project Manager in addition to sub-consultants (i.e., NovaTox, and GIS-Monitoring Group). She will work closely with the client Project Manager to manage potential changes to the scope of work, budget and schedule (if deemed to be necessary). PGL's project management system uses a variety of techniques to ensure on time, on budget project delivery. Technical leads for the regulatory/jurisdictional scan will report to Simone.

Mark Chappel, MSc., DABT, will be the HHRA Lead. He will have overall responsibility for the technical aspects of all components of the HHRA project. He will oversee and coordinate the execution of the HHRA, including exposure modelling studies/assessments and will be the principal spokesperson on risk communication issues. In addition to his overall technical supervisory role, Mark will be the technical lead on the HHRA. Mark will be supported by a team of HHRA specialists composed of **Derek Hillis**, Ph.D., **Hugh Scobie**, M.Sc., DABT, and **Dino Manca**, Ph.D., DABT. All senior staff involved in any component of the HHRA will report to Mark. Mark will report to Simone, as noted above.

Will Gaherty is a founder and principal of PGL, with 25 years of contaminated sites consulting experience. Will is also a founding director of the Science Advisory Board for Contaminated Sites in BC. He will be responsible for providing senior-level peer review and will act as the PGL's Project Sponsor. In addition to providing review at the most senior, strategic level, Will has been involved in many multi-stakeholder projects and is a regulatory expert. He will contribute an open, personal style and orientation to the communications effort, developing creative win-win solutions and will contribute his experience with strategic advice to regulatory review.

Leslie Beckmann, B.Sc., M.A., will manage the communications activities. Under the direction of the Project Manager, Leslie will work to identify and reconnect with First Nations and stakeholders involved in Phase 1 of the project, will propose a meeting strategy for informing stakeholders on the process, "reality checking" the results, and identifying appropriate communications tools for sharing the final findings. Leslie will also work closely with the Ministry's Communications staff to develop an appropriate media strategy and clear media messages.

Duncan MacDonald, B.Sc., P.Eng., CSAP, will act as the team lead for the Regulatory/Information Review to identify all relevant health standards. He will oversee a regulation/information review team composed of **Emma O'Neill** (B.A.Sc., P.Eng.), **Stephanie Louie** (B.Sc., R.P. Bio.), and **Carla Shaw** (Env. Sci. Dipl.) that will review Phase 1

findings and identify key contaminants and pathways. Duncan will report to Simone, as noted above.

Stewart Brown, M.Sc., P.Ag., R.P.Bio. will lead review of air contaminants data and, where appropriate, will provide expertise concerning regional air modelling for specific airsheds and/or pollutants for the purpose of refining the exposure assessment components of the risk assessment. Stewart has extensive experience on air monitoring and modelling projects in northern BC and Yukon.

Ian Blandford will provide IT and GIS support to review and manage data and develop appropriate systems for data presentation and sharing. Ian will be responsible for completing data reviews, assessing archived soil data and converting it to a useful format that can be input into the risk assessment process, contaminant and other applicable stressor mapping (i.e., noise, air impacts), compiling any needed satellite imagery, etc. The effective utilization of this resource will streamline data collection and will ensure that data is compiled into a format useful for the needs of the study and the long-term needs of the Project Sponsor.

4.2.2 Enhanced Systematic Planning (ESP)

The Enhanced Systematic Planning (ESP) system is a unique, high-level planning process in which PGL's experienced facilitator focuses and integrates the total technical skills, relevant knowledge and social experience of a team of key project participants and limited stakeholders. It is a user-friendly, owner-oriented process. The deliverable is a coherent plan to achieve specific technical results while concurrently satisfying the requirements of a spectrum of stakeholders.

PGL believes that ESP is critical to:

- Confirming key objective and goals that will form the unifying principles for the project;
- Providing a focused and common vision; and
- Establishing strong working relationships early in the project.

The end-product of a focused team working to achieve a tightly defined plan will improve the effectiveness of the project by avoiding ill-defined objectives, unnecessary delays as a result of data quality or uncertainties in assessment techniques, or ambiguity in the decisions that will need to be made throughout the course of the project. The net impact of the use of the ESP process is a reduction in the cost of the study.

4.2.2.1 Application of ESP to this Project

The key objectives, approach, execution plan and schedule outlined in PGL-NovaTox's proposal, in conjunction with the scope of work, will form the foundation of the process.

PGL propose a two-day ESP session to be scheduled early in the project schedule – either during final negotiation prior to finalizing the scope, budget and contract, or after project team members have had an opportunity to review any data not available to them during the bidding process. The advantage of conducting the ESP at the negotiation stage is that the project execution will begin

with consensus on the scope of work, budget, schedule, and project plan. The advantage of the later date is that the project team would have a better understanding of the available data and potential data gaps, and this may facilitate developing consensus on the scope of work and schedule.

The two-day ESP session will develop an action plan that will be technically appropriate and will integrate the needs of the stakeholders. We consider that both needs will have to be satisfied to ensure a project of this nature can be successful.

The objective will be to develop a study design and work plan to execute the project, with a vital underlying objective to develop a plan that will be based on consensus and alignment among all participants in the exercise.

In technical terms, the ESP process is based on the methodical development of a high-level precedence network that identifies the key tasks of a project and establishes their logic-based relationships. The facilitator leads eight to ten key members of the project team (the “Planners”), plus senior members of stakeholder organizations (the “Sponsors”), plus a number of technical support personnel and other people with a vested interest in the project (the “Limited Observers/ Stakeholders”) into the development of “their” plan to satisfy the project objectives. In this case, it is anticipated that the participants would be drawn from Victoria, the PGL-NovaTox team, and others who may be designated by the Ministry (i.e., the limited stakeholders).

Together, they will be lead into development of an integrated, consensus-based plan that will address relevant project areas, such as:

- Confirming key objectives and project goals, and how project risks will be eliminated;
- Establishing criteria and decision processes for determining relevant oil and gas activities that impact upon exposure, relevant stressors that need to be assessed in the risk assessment investigation;
- HHRA methodology (and triggers for recommendations for further studies to address any identified data gaps);
- Communications strategy and approach;
- Reporting lines and frameworks; and
- Any other relevant areas of the project.

In the context of an environmental program of this magnitude and importance, the elements of systemic planning will include:

- Description of the project goals, objectives, and questions and issues to be addressed;
- Identification of project schedule, resources (including budget), milestones, and any applicable requirements [e.g., logistical requirements (time involved in collecting applicable data from regulatory agencies), contractual requirements];
- Identification of the type of data needed and how the data will be used to support the project's objectives;
- Determination of the quantity of data needed and specification of performance criteria for measuring quality;

- Description of how and where the data will be obtained (including existing data) and identification of any constraints on data collection;
- Specification of quality assurance and quality control activities to assess the quality performance criteria (e.g., quality control samples for both the field and laboratory, audits, technical assessments, performance evaluations etc.); and
- Description of how the acquired data will be analyzed, evaluated (i.e., quality assurance review, verification, validation), and assessed against its intended use and the quality performance criteria.

The ESP process (details of the key ESP parameters are provided in Appendix B) will deliver three products that will form the basis for the study design and work plan:

- **Master Project Schedule:** a schedule with 100 to 120 work packages or activities that graphically documents the project plan and establishes the schedule baseline for the project.
- **Action Plan:** a report (typically in a one-inch binder) that records the details of the ESP session. It documents the objectives, and the products of key discussions, and the content and context of each planned work package (HHRA, Jurisdictional Scan report, Review of Statutory Framework, etc.). The descriptions are coded to the schedule items, and they can also form the basis for development and management of associated budget items.
- **Focused Project Team:** this is the most important deliverable. The group of Planners, Sponsors and Observers will have been guided into consensus-based development of an action plan in which they will have a shared understanding and a shared commitment to success.

4.2.3 Identification of Key Tasks

Key tasks to be completed as part of this study include:

1. Review existing reports, data and resources available from the Ministry for the human health concerns to be evaluated in Phase 2 including:

- Human health exposure pathways (air, water and food);
- Other environmental issues including accidents/incidents (spills, explosions) and increased traffic; and
  - The province's institutional framework with respect to oil and gas activity.

2. Complete a jurisdictional review and report.

3. Determine the feasibility and applicability of the available information to complete a HHRA and the best methodology for each concern including:

- Deterministic quantitative risk assessment;
- Probabilistic quantitative risk assessment;
- Qualitative risk assessment; and
  - Other approach.

4. Complete the HHRA for each of the concerns identified (exposure pathways, other environmental issues and institutional framework) with a full report detailing the problem formulation, exposure assessment, hazard assessment and risk characterization of each concern. This section is more fully described below in Section 4.2.4

5. Review the BC statutory, regulatory and policy framework to:

- Identify where current statutes, regulations and policies are sufficient or exceed a level to effectively manage and minimize human health risks;
- Identify gaps in the current statues, regulations and policies necessary to effectively manage and minimize human health risks; and
    - Identify where current statutes, regulations and policies would benefit from a change to improve the ability to manage and minimize human health risks.

6. Develop a report that includes recommendations to manage the human health risks identified through the use of spatially enabled data.

7. Engage key stakeholders in a limited manner to reality check both process and interim results and prepare a report on the nature and extent of the engagements.

A Project Risk Management Strategy is presented in Section 5.0. The communications objectives, approach, and preliminary work plan are presented in Section 6.0. Projects milestones are summarized in Section 7.0. Further details on the process and methodologies to be applied to the HHRA are presented in Section 8.0. The Team is presented in Section 10.

4.2.4 Human Health Risk Assessment

The purpose of a HHRA is to quantify the potential health risks associated with exposure to chemicals (or other stressors) that may be found in various environmental components or media that may be potentially impacted as a result of oil and gas activities. In doing so, the risk assessment takes into account the concentrations of the chemicals to be evaluated, the manner in which people may be exposed, and the toxicity associated with each chemical. This information is compiled and risks are quantified using two different approaches depending on whether one is assessing potential cancer or non-cancer risks. Typically, for non-cancer endpoints, the predicted exposures (expressed as an average daily dose with units of mg/kg-day) are compared to “safe” levels of exposure. If the ratio of the two is less than one, (i.e., the estimate exposure is less than the “safe” level), it is assumed that there are no health risks associated with that chemical. For cancer, potential health risks are expressed as an upper bound of the probability of an individual developing cancer over a lifetime as the result of exposure (expressed as an average daily dose over a lifetime) to a given chemical at a given concentration (US EPA, 1989). The incremental probability of developing cancer over a lifetime (i.e., the theoretical excess lifetime cancer risk) is the additional risk above and beyond the cancer risk an individual would face in the absence of the exposures characterized in the risk assessment. Potential excess lifetime cancer risks are expressed as unitless probabilities, with acceptable risks in the range of $1x10^{-6}$ (one in one million) to $1x10^{-4}$ (one in ten thousand).

For other environmental issues that may not be chemical-based, such as incidents/accidents and noise, other risk assessment frameworks will be applied including those used in risk-based land-use planning. Specifically, a risk-based framework produced by the Major Industrial Accidents Council of Canada (MIACC) relating to the manufacture, storage, distribution, transportation, handling, use, and disposal of hazardous materials from industrial establishments including the oil and gas industry is proposed for use to determine the risk from incidents/accidents. Resources and methodologies from other jurisdictions used in the risk management of the oil and gas industrial will also be applied where appropriate. For other environmental stressors, such as noise, methodologies for assessment, standards and guidance documents used by the province

as well as other provincial jurisdictions, the United States and Europe will be reviewed and employed as appropriate for the assessment of human health risk.

The risk assessment that the PGL-NovaTox team proposes for the study area will be performed in a manner consistent with the following risk assessment guidance:

- BC Ministry of Environment (MOE). *Supplemental Guidance For Risk Assessment.* Technical Guidance on Contaminated Sites 7, Version 2. July 2012.
- Health Canada. *Guidance on Human Health Detailed Quantitative Risk Assessment (DQRA)*, 2010.
- United States Environmental Protection Agency (US EPA). *Guidance for Exposure Assessment*. Federal Register 59(104) 22888-22936. March 29, 1992.
- United States Environmental Protection Agency (US EPA). *Risk Assessment Guidance for Superfund: Volume I – Human Health Evaluation Manual (Part A, Baseline Risk Assessment).* December 1989.
- United States Environmental Protection Agency (US EPA). *Exposure Factors Handbook*. 2010.
- Canadian Council of the Ministers of the Environment (CCME). *A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines*. 1996.
- Canadian Council of the Ministers of the Environment (CCME). *Guidance Manual for Developing Site-Specific Soil Quality Remediation Objectives for Contaminated Sites in Canada*. 1999.
- Major Industrial Accidents Council of Canada (MIACC). *Risk-based Land Use Planning Guidelines*. June 1995.

In accordance with the risk assessment guidance (BC MOE, Health Canada, US EPA; others), the HHRA for the study area will include the following four main components: hazard identification (problem formulation), exposure assessment, toxicity assessment, and risk characterization. An uncertainty section will also be included, as well as an executive summary, an introduction and conclusion sections. The major HHRA components (for chemical stressors) are described below.

4.2.4.1 Problem Formulation/Hazard Identification

This component will include a description of the criteria for determining potential hazards that contribute to COCs and other environmental issues as a result of various oil and gas activities and that are to be considered for assessing risk to human health, the criteria for identifying the populations within the study area that might be at higher risk from exposure, all applicable receptor populations to be included in the study, as well as potential exposure pathways for each (through all of the applicable exposure media including air, water, soil and food).

4.2.4.2 Review and Identification of Pathways of Concern

One of the first tasks to be undertaken will be to review and compile the historical sampling results into a unified format that facilitates understanding and informed decision-making. Described briefly below, this task is discussed in greater detail in Section 8.0 of the proposal.

We anticipate there to be numerous repositories for sampling results. As a result, PGL will work with our geomatics experts to develop GIS-based maps showing the spatial distribution of the stressors (i.e., COCs) in relation to major oil and gas sources. Depending on the particular issue being examined, maps of differing scales will be developed, each showing features relevant to understanding the relationship between source and exposure. As an example, for residential areas where the primary concern is human exposure, chemical contouring can be presented in relation to features such as schools, playgrounds, parks, homes, etc. It should be noted, however, that chemical contouring in urban areas can be suspect due to the disturbed nature of the soil in many of these areas. This issue will be examined when reviewing the sampling results to ensure that anomalies are appropriately recognized and dealt with.

4.2.4.3 Identifying Communities of Interest

Communities of interest were identified in the Phase 1 report (pg. 52–58). In conjunction with the development of a comprehensive communications strategy for the study, the PGL-NovaTox team will undertake a review of the communities of interest identified to date to identify those that might have a unique or significantly different exposure pattern than what is typically found in standard communities.

4.2.4.4 Identifying Chemicals of Concern

An initial list of COCs related to oil and gas exploration (i.e., hydrogen sulphide, polycyclic aromatic hydrocarbons, other chemical stressors, etc.) has been identified in the Phase 1 report (Fraser Basin Council, 2012). COCs and other stressors will be identified and refined on the basis of whether: 1) the COCs are potentially present [at potentially] elevated levels within the study area; 2) concentration in various media are potentially in excess of applicable standards or criteria (provincial, federal, compared to other regulatory agencies, i.e., WHO, US EPA etc.); and 3) the chemicals are emitted from the operations and activities related to oil and gas development in BC.

As an initial task, the PGL-NovaTox team will review the various environmental sampling programs (air, water, soil, food) to identify candidate stressors (i.e., COCs, noise, etc.) in addition to the ones listed in the background documentation.

In addition, NovaTox suggests reviewing the decision criteria used for selecting COCs to determine how appropriate they are for each aspect of the study. As an example, it may be advantageous to apply different screening criteria to the HHRA to develop a suite of COCs unique for each major aspect of the study based on human health endpoints (as opposed to ecological endpoints, which are not part of the scope of work).

4.2.4.5 Toxicity/Dose-Response Assessment

This section will include a description of sources of toxicity (chemical) or hazard (incidents/accidents and noise) criteria to be used in evaluating the relationship between the magnitude of exposure to the adverse health effects associated with the COCs.

4.2.4.6 Exposure Assessment

Topics to be addressed include establishing realistic potential receptor scenarios and the associated exposure factors (e.g., dermal contact rates, inhalation rates, ingestion rates, and exposure duration). A table depicting all of the potentially complete exposure pathways and receptors, and the corresponding reasons for their inclusion or exclusion in this HHRA will be developed. The exposure assessment will employ primarily deterministic but also potentially probabilistic approaches for estimating exposure.

4.2.4.7 Risk Characterization

This section will describe the relationship between estimated levels of exposure for each receptor population and the respective exposure limits for the individual COCs. The relative contribution of "area-specific" sources to total exposure and risk will be identified. In addition, the major areas of uncertainty will be identified and discussed in a meaningful manner.

4.2.5 Deliverables

The following tasks and deliverables have been identified by the PGL-NovaTox team to ensure the successful execution of the project:

- Project Award (kick-off meeting);
- Preliminary Data Review;
- Enhanced Systematic Planning (ESP);
- Jurisdictional Review;
- Intensive Data Review;
- Exposure Summary and Modelling;
- Human Health Risk Assessment;
- Statutory and Regulatory Review;
- Review of GIS methodologies; and
- Final Reporting.

Table 1 below illustrates the sequence of execution and identifies outputs and decision points for each component.

Table 1: Project Work Plan

Staff	Estimated Time (hours)								
	Project Kick-off meeting (ESP)	Jurisdictional Review and Report	Assess HHRA information and methodology	Complete Human Health Risk Assessment	Review BC Statutory, Regulatory and Policy Framework	Reporting	Limited Key Stakeholder Engagement	Bi-weekly Meeting	Monthly Meeting in Northern BC
Simone Mol, PhD., PChem, CSAP Project Manager	80	20	100	120	80	120	100	80	200
Will Gaherty, M.S., P.Eng. Technical Director/Senior Review	20	4	10	18	18	18	18	10	0
Mark Chappel, M.Sc., DABT HHRA and Exposure Assessment Lead	40	20	70	240	0	90	50	40	200
Derek Hillis, PhD Toxicological Assessment	40	0	140	350	20	160	0	0	0
Hugh Scobie, M.Sc., DABT Exposure Modelling	40	0	120	350	20	160	0	0	0
Dino Manca, Ph.D., DABT Senior Technical Review	10	0	25	80	0	80	0	0	0
Duncan MacDonald, B.Sc., P.Eng, CSAP Regulator Review Lead	30	40	0	0	50	60	0	10	0
Emma O'Neill, B.A.Sc., P.Eng Environmental Engineer	20	40	0	0	100	50	40	0	0
Stephanie Louie, M.Sc., R.P. Bio Environmental Scientist	20	40	0	0	50	50	40	0	0
Carla Shaw Phase 1 Manager	20	40	0	0	100	50	40	0	0
Stewart Brown, M.Sc., P.Ag, R.P. Bio Air Quality Specialist	20	0	20	10	4	60	0	0	0
Leslie Beckmann, B.Sc.H, M.A. Communications Coordinator	20	8	8	8	80	60	130	40	0
Ian Blandford, Dipl. Geomatics Specialist	20	0	20	90	20	40	10	0	0
Admin. Assistant	0	8	0	20	20	20	20	0	0

The communication plan will ensure that the key stakeholders (identified by the Ministry) will be kept aware of the progress of the project with accurate information in a timely manner. PGL proposes that communications outputs will be delivered through a communications expert for review and approval in conjunction with the Ministry's communications groups prior to any releases. The preliminary communication plan is described in more detail in Section 6.0

Following the intensive review of existing data and consultation with the limited stakeholders to confirm key decisions and issues through the ESP process, the project team will conduct the jurisdictional, regulatory, statutory, and GIS methodology reviews and, based on the results of these reviews, will commence the human health risk assessment.

All technical outputs will be subject to senior review prior to submission to the Ministry.

The project team has identified the following key decision points where the Ministry's approval will be required to proceed:

- Study design and work plan;
- Confirmation of oil and gas activities that influence exposure to identified environmental stressors, pathways in various study area(s);
- Conceptual exposure models to be applied to exposure assessment, and the HHRA;
- Confirmation of data gaps assessment and limitations imposed as a result of the available data (with subsequent identification of data needs); and
- Confirmation of risk assessment findings.

We have identified Enhanced Systematic Planning (ESP) and project management as critical to the successful execution of the project. Further details on these elements are provided below.

5.0 PROJECT RISK MANAGEMENT STRATEGY

A number of risk factors exist that pose a threat to the success of Phase 2 of the project. Most of these are related to results and results perception. Management strategies for these are presented below (Table 2).

Table 2: Risk Management Strategy

Item No.	Identified Risk	Proposed Mitigation Measure
1	Lack of engagement or unreasonably high expectations from stakeholders	Create surrogates for them in the process, and don't give up on them if for no other reason than to establish a paper trail.
2	Exploit the Ministry: some stakeholders may either know or think they know how to exploit the Ministry of Health's plans/priorities and hence try to take advantage of the Ministry's available resources, perceived liability or timetable to leverage their own interests.	Neutralized by mapping the stakeholders and their interests, engaging (or trying to engage) them in dialogue, and identifying alternative ways of satisfying their aspirations if possible (whether related to the issues or not).
3	New stakeholders emerge during the project and request changes.	Complete a detailed review of stakeholders at project initiation. Release publications in local newspapers and set up an information website/hot-line for general inquires.
4	Political interference: given the attention to the Northern Gateway Pipeline Project, the HHRA project may be vulnerable to becoming a topic of political debate.	Include elected representatives as key external stakeholders, and engage them in a facilitated dialogue about the project.
5	Community opposition to Phase 1I	Re-iterate the purpose of Phase 2 during public consultation meetings to address concerns.
6	Repeat similar exercise/process (based on jurisdictional review) and yield similar outcomes.	Review lessons learned from previous work at project initiation. Incorporate those lessons in new approach going forward.
7	Media interference: stakeholder pushback or political interference might readily translate into media attention. Moreover, in the absence of information (an information vacuum), the media will fill that vacuum with information that may inflame the situational context.	Engage media representatives in a process that surfaces a different narrative than might otherwise be the case – a narrative that demonstrates how the Ministry is approaching Human Health Risks from oil and gas development in a progressive, collaborative fashion.

Item No.	Identified Risk	Proposed Mitigation Measure
8	Environmental regulations change, where applicable standards become more stringent.	Plan the investigation work to meet current and any draft regulations/ standards, therefore, if draft regulations/ standards are implemented during the project, they will have been met. Some changes may be unforeseeable. Engage regulators on this issue.
9	Previous environmental work is incomplete: data gaps identified, insufficient delineation.	Complete a comprehensive review of previous work once data is entered into a database. Establish methods to fill possible critical data gaps.
10	Loss of key personnel on the project team, workload for project team is overwhelming.	Provide for qualified alternatives of key personnel and supplement the project team, as needed, with qualified in-house personnel with experience that suits the project needs. Hire additional qualified personnel.
11	Scope creep: without clarity on scope, and situational context, the project can be pushed into areas of work that result in timing delays, increases in cost, and potential questions about mandate and/or fiduciary responsibility.	Managed by attaining and maintaining as much clarity as possible during the initial ESP process. Adhering to the ESP deliverable.

6.0 COMMUNICATIONS STRATEGY

Effective communications within the project team, between the team and the Ministry, and with external stakeholders underpin the on time, on budget success of this, or any, project. Appropriate communication – at the right times, with the right people, in the right language and format – is even more important to the present project: if the stakeholders of interest for which the risk assessment was conducted do not understand the process or if they believe their input was not reflected, they ultimately may not accept the results of the process. In that case, regardless of the "technical excellence" of the work, the exercise will have failed to reach its primary objective of completing a study that can be relied upon for making informed decisions in the community. Early, open, transparent, and creative communication will be essential to project success.

To this end, the project team has included a communications coordinator, Leslie Beckmann, to work with the Ministry. Leslie will work closely with the Ministry's communications team to build on the work begun in Phase 1 to develop and implement a three-pronged approach to project communications:

- Project team communications;
- Supporting targeted outreach; and
- Media support.

Specific elements of each component are discussed more fully below.

6.1 Objectives

The principal objectives of a comprehensive communications strategy include:

- Identifying and addressing key communications challenges in the community. These include the diversity of the population and the geographical extent of the study area;
- Developing a process to effectively engage key audiences in the study;
- Developing a process to critically evaluate all communications efforts with an aim of continually improving communications with target audiences;
- Developing a process to manage the media in a positive and proactive manner;
- Developing a process whereby all communications efforts concerning the study are effectively coordinated so that responses to questions can be dealt with effectively without the danger of providing "mixed messages," and
- Creating a process to recognize and deal with rumours and conflicting stories.

6.2 Approach

The communications team will be lead by Leslie Beckmann who will be assisted as needed by a webmaster and a communications specialist. Leslie will work closely with other members of the project management team to develop and implement the overall communications strategy for the project.

Key components of the communications strategy will include:

- Issuing plain language summaries at key project points;
- Regular website updates;
- Community consultation for identification of communities of interest;
- Community outreach initiatives and media campaigns at strategic project stages;
- Directed presentations to key target audiences; and
- Transparent mechanisms for responding to and documenting public inquires.

A preliminary identification of public output documents as identified in Table 2 includes:

- Phone-call outreach to key stakeholders prior to kick-off;
- Project kick-off press release;
- Project objectives and communication mechanism press release;
- Community consultation materials defining COCs, study area and soliciting input on communities of interest;
- Media release material summarizing outreach results, COCs, study area, communities of interest, project schedule, and communication mechanism update;
- HHRA status reports summarizing key project messages as identified in Table 2-1 for targeted audiences;
- Community update materials incorporating key HHRA messages for general public; and
- Community update material summarizing key study findings.

These preliminary deliverables and schedule will be modified based on the project launch analysis, which will be used to identify the strengths, weaknesses, opportunities and threats associated with the study. From this effort, additional opportunities for community outreach will be identified and the listing of potential target audiences will be confirmed.

Additionally, the communications team will develop a framework for managing internal communications, external communications and media relations. Each of these is discussed further below.

6.2.1 Project Team Communications

The coordination of communications efforts across the entire study team including the Ministry is an essential component of an effective communications strategy. This will ensure consistent messaging and will avoid difficult situations whereby members deliver conflicting information.

The communications plan will incorporate the following elements:

- Communication protocols will be developed to ensure all messages related to the study are consistent and presented in plain language.
- Mechanisms for ensuring that requests from politicians, the media, special interest groups, partners and the general public are responded to quickly and consistently with appropriate documentation.

This plan will be developed in close consultation with Ministry communications staff to ensure compliance with government communications procedures and access to information (see Section 5.2.3).

6.2.2 Supporting Targeted Outreach

Phase 2 requires that the approach and findings receive stakeholder/user group "buy in." This will require relationship-building (or strengthening, in the case of relationships built through Phase 1) with a targeted set of stakeholders who can critique the proposed approach and findings. This group will serve as the focus group for the broader community, providing early feedback on how the project and its results will be received.

Critical to the success of this effort are:

- **Plain language messages**: Recognizing the highly technical nature of the study and the extent of the study area, it is essential that communication efforts involve plain language summaries that are easily understood by all target audiences.
- **Media appropriate to the stakeholder group**: Recognizing that not all communities prefer to receive written information, other media need to be considered.
- **Appropriate communication**: Recognizing the timeframe of the study, communication efforts need to be appropriately scheduled to avoid over-saturation, at one extreme, or a perception of a "cone of silence" at the other. Preliminary communication messages are summarized in Table 3.

Tasks related to communications with external stakeholders can include:

- Building on the existing website to enhance its use an effective communications 'tool'. The website would be updated on regular basis with plain language project summaries, Q&As, interactive e-mail, and links to more technical information;
- Establishing a toll free number people can use to ask questions and obtain more information. This can be established in cooperation with any health information lines used at the District Health Unit;
- Hosting information sessions and open houses in various communities to discuss the project and present interim status reports. To enhance attendance, these could be coordinated and held in conjunction with key stakeholder groups (i.e., business development groups, community associations, Tribal councils, etc.);
- Developing presentation material that can be used at the local school level as an educational tool to raise awareness of the project in the community;
- Providing project updates at regularly scheduled meetings of local groups and organizations (e.g., Rotarians, Boards of Trade, local outdoors clubs, etc.);
- Developing a regular newsletter to be distributed to stakeholder groups; and
- Advertising in daily, weekly and community newspapers.

6.2.3 Media

Media relations is a specialized discipline; media relations on behalf of the Ministry will require that the project team develop a positive, proactive media relations campaign in concert with the media relations team at the Ministry. We recommend that the communications strategy include:

- Designating a single spokesperson for the project;
- Evaluating which media should be used to ensure we get our messages out to our key audiences. In some cases these may be non-traditional or creative media;
- Engaging the local media in assessment process by providing regular columns, spots on local talk radio and appearances on community cable stations. Exclusive interviews can be considered for reporters who know the “beat” and can be trusted;
- Anticipating the range of questions that might arise and developing appropriate media lines;
- Establish a media monitoring system to know what is being said by whom and to identify trends at an early stage;
- Monitoring the information being sent out by special interest groups;
- Quick follow-up on incorrect media coverage to actively correct misinformation and rumours; and
- Establishing a process for evaluating the effectiveness of the communications program and adapt to changing information needs to ensure continued efficacy.

As the study evolves, the dynamics in the community will change as people become more aware of the study and its implications. By developing a comprehensive and proactive communications strategy, PGL is confident the study team can effectively anticipate and respond to these changes in a positive manner.

Table 3: Overview of External Communication Activities

Item	Audience	Objective	Vehicle	Responsible	Timing
Project Initiation	Targeted First Nations and stakeholder groups	• Provide initial project overview • Establish communication mechanisms • Confirm intent open and transparent process	Telephone and email outreach	Communications Coordinator	2 weeks project launch
Project Objectives	Targeted First Nations and stakeholder groups	• Summarizes project objectives • Summarize Phase 1 results • Identify criteria for determining COCs • Identify criteria for determining study area • Identify community outreach programs	Plain language summaries posted to website, media releases	Communications Coordinator	2 months from project start
Confirm COIs	Targeted First Nations and stakeholder groups	• Summarize critical studies conducted to date • Review criteria for determining and identify COCs and Study Ares • Identify criteria for determining communities of interest • Review community outreach programs and communication mechanisms	Plain language summaries posted to website, presentations to strategic stakeholders; event-based Open House	Communications Coordinator	3 months from project start
Overall Model for Study Design	Targeted First Nations and stakeholder groups	• Identifies project schedule, communications vehicles, milestones and opportunities for public input	Plain language summaries posted to website, community meetings	Communications Coordinator	4 months from project start

Item	Audience	Objective	Vehicle	Responsible	Timing
HHRA – Toxicological Assessment	Targeted First Nations and stakeholder groups	• Identities and discusses in a meaningful manner what is know about the toxicity of each of the contaminants of concern • Identifies what toxicity benchmarks are available for assessing exposure • Discuss and seek input on the criteria used for selecting toxic benchmarks and endpoints	Plain language summaries posted to website, presentations to targeted stakeholders HHRA Status Public Outreach	Communications Coordinator	5-6 months from project start 9-10 months from project start
HHRA – Exposure Assessment	Targeted First Nations and stakeholder groups	• Identify exposure pathways and assumptions that may be used for sensitive subpopulations • Identify assumptions used for quantifying exposure • Identify key issues and data gaps as well as approaches that will be used to obtain site specific data	Plain language summaries posted to website, presentations to targeted stakeholders HHRA Status Public Outreach	Communications Coordinator	9-10 months from project start 9-10 months from project start
HHRA – Risk Characterization	Targeted First Nations and stakeholder groups	• Discuss in a meaningful way the results of the risk characterization for various subgroups of the population • Identify how the estimates of risk were arrived at • Discuss/demonstrate the relative contribution to risk from of each exposure pathway • Discuss the areas of uncertainty and how they relate to the estimates of risk • Identify possible risk reduction measures as warranted.	Plain language summaries posted to website, presentations to targeted stakeholders Project Results Public Outreach	Communications Coordinator	16-18 months from project start

7.0 PROJECT MILESTONES

7.1 Bi-weekly Status Updates

On a bi-weekly basis, team conference calls and e-mail updates will be provided to the Ministry by the project manager.

E-mails will be provided in advance of the conference call and will include information on progress, timelines, new development, potential challenges, concerns, and risks.

7.2 Monthly Status Reports

On a monthly basis, status reports will be provided to the Ministry by the project manager. The status reports will contain a concise summary of:

- Project status with respect to key milestones;
- Identification of any obstacles encountered;
- Identification of how each obstacle will be overcome;
- Schedule for the coming month; and
- Status of communications including public communication efforts and media summaries.

The status reports will be provided in written and/or electronic format one week prior to each monthly Ministry meeting. The Project Manager or a suitable alternate will attend meetings as deemed necessary. More frequent meetings may be scheduled as the need arises.

7.3 Interim Reports (IR)

While interim reports provide an opportunity to review the progress of the study, they also serve as a means to document key milestones and obtain input from the public and other stakeholders on key decision points in the HHRA. The PGL-NovaTox team proposes completing a series of "technical" interim reports that describe the technical aspects of study. These will be coupled with a series of plain language summaries designed to facilitate understanding and input into key aspects of the study.

Overall Study Design and Work Plan (IR1)

This initial report will be used as a "blueprint" to describe project objectives, overall approach, specific tasks and activities, key milestones, decision points, and opportunities for public input. The report will include the project outline developed in the ESP for the HHRA and jurisdictional scan and regulatory policy review components of the study. As this interim report establishes the project schedule and milestones, it is critical that the schedule be realistic in accounting for any contingencies that may arise.

Background Data Summary (IR2)

This report will summarize and present in a manner that promotes understanding, the results of the environmental monitoring programs, as well as the historical sampling efforts for other media/ stressors (e.g., noise, increased traffic, etc.). The report will document the criteria and decision

processes used for identifying stressors (i.e., chemical COCs, noise) and study areas. The report will identify natural background concentrations of COCs in selected media and document methodologies applied in determining these values.

HHRA Toxicological Assessment and Exposure Pathways Analysis (IR3)

This report will summarize the toxicity of the various COCs and provide recommendations on what exposure limits are considered the most appropriate for assessing potential human health risk in the study area. The exposure pathways analysis will identify the critical receptors that will be considered in the risk assessment, the pathways by which they might be exposed, and the assumptions used for modelling exposure.

HHRA – Risk Characterization and Uncertainty Analysis (IR4)

This report presents the results of the HHRA and non-chemical stressor evaluation. The level of risk attributable to the presence of COCs or hazard as a result of a non-chemical stressor in the community will be presented in a manner that facilitates understanding and informed decision-making. Included will be an assessment of the major areas of uncertainty and their consequence in understanding the risks and their sources.

7.4 Final Report

The final report will consist of the three principal volumes described in the scope of work, each with a series of technical appendices. A fourth volume documenting options will be produced only if the conclusions of the study warrant consideration of mitigative measures.

The HHRA will include the following main headings:

1. Executive Summary
2. Introduction
3. Problem Formulation
4. Toxicological Assessment
5. Exposure Assessment
6. Risk Characterization
7. Conclusions and Recommendations

The reports will be completed as PDF files and supplied on CD-ROM to facilitate electronic publishing. All photographs collected during the course of the study will be scanned and included in a standard digital format on CD-ROM.

8.0 DESCRIPTION OF APPLICABLE HHRA METHODOLOGIES AND PROPOSAL FOR THE MOST TECHNICALLY SOUND AND COST-EFFECTIVE METHODOLOGIES TO BE USED

This section describes the methodologies proposed for the HHRA, as well as the approach that the PGL-NovaTox team will use to meet the key objectives and address the key issues identified in the scope of work.

The HHRA proposed by the PGL-NovaTox team related to oil and gas activities will identify the COCs for human health, determine critical receptors and exposure pathways operational in the study area,[1] and quantify exposure and risk associated with exposure to the COCs for each type of receptor considered. Throughout the process, we will rely to the greatest extent possible on existing information available from government agency reports, the published literature, provincial, federal or other agencies' reports, and other types of grey literature. Where there are identified information gaps, these will be identified. The major steps for conducting the HHRA are outlined below.

8.1 Introduction and Problem Formulation

The purpose of a HHRA is to quantify within reasonable bounds of uncertainty the potential health risks associated with exposure to chemicals and other stressors (e.g., noise, vibration, etc.) that are related to oil and gas activities that might be found in the study area. In doing so, the risk assessment takes into account the types of stressors, or in the case of chemicals, the concentrations of the chemicals in various environmental media, and the manner in which people may be exposed to the stressor or the chemical and the toxicity associated with the chemical.

A critical initial step of any risk assessment is the "problem formulation" step that defines the scope of the assessment. This is dependent on the types of stressors or the type of chemical COCs, the characteristics of the study area and associated receptor populations, potential exposure pathways, and the extent of information that may be available regarding the stressors or the level of COCs found in various media. As information is gathered and analyzed, a need for additional data or a more sophisticated analysis may be identified. This need becomes critical where initial assessments indicate estimated exposures (to the stressor or the chemical COC) are at or near a level that would be considered unacceptable.

The problem formulation step will identify:

- Criteria and decision process for determining stressors and identifying chemical COCs for assessing risk to human health;
- Criteria and decision processes for identifying populations within the study area that might be at higher risk from exposure to the stressor or chemical COCs;
- The receptor populations to be evaluated in the study, including sensitive sub-populations such as infants and children (others that are predisposed to health effect); and
- Potential exposure pathways for each receptor population identified.

[1] The study area is limited to the geographical area within the administrative boundaries of LHA's 81, 60, and 59 of the Northeast Delivery Area of Northern Health Authority. RfP HL173 (pg. 11)

While several of these elements have been discussed elsewhere in this proposal, we would like to emphasize that the PGL-NovaTox team considers the problem formulation step to be a critical point at which to communicate with the Ministry, as this identifies exactly how the study is going to be conducted. Perhaps more importantly, it also identifies the criteria and the rationale used for excluding certain areas, certain activities that contribute as a potential stressor, chemicals or exposure pathways from consideration. Providing opportunity for the Ministry (and any of its designated (i.e., limited) stakeholders) to provide input at this early stage in the study will help to ensure that issues critical to scoping the HHRA are not overlooked in the planning stage. Details of the communications strategy are discussed elsewhere in this proposal.

8.2 Data Analysis and Historical Review

One of the first tasks of the HHRA will be to review the available data pertaining to various media (i.e., air, groundwater, surface water, soil and food) to identify stressors and COCs and associated communities/receptor populations that may be at higher risk from exposure. Criteria will be needed to identify stressors and COCs (i.e., MOE's health-based criteria as an initial screening tool to identify areas where people may be at higher risk from exposure to COCs). In addition, the assessment will be scaled to identify the major locations/activities/situations where the health-based criteria are potentially exceeded under the rationale, as this is where people spend most of their time and therefore receive the majority of their exposure. Rural areas, which may have unique exposure patterns (especially for First Nation populations, etc.), will also be included as warranted by the sampling data and decision needs.

In developing an approach to understand the spatial distribution of stressors or COCs within the study area, the data will be analyzed to determine and confirm likely "hot spots," or areas where COC levels are unusually high compared to the rest of the study area (e.g., areas around a point source emission, etc.). An evaluation of current land use will be used to determine if it is logical to break the sampled area into sub-areas. However, caution will be exercised to ensure that such an approach does not unduly stigmatize communities in areas identified as potential "hot spots."

8.3 Hazard Identification/Toxicity Assessment

In evaluating the potential health risks associated with exposure to a stressor or in the case of a chemical, the hazard associated with that stressor (or the toxicity associated with each COC) must be considered. For chemicals, both non-cancer and cancer endpoints will be evaluated, as appropriate. A variety of authoritative sources of toxicity information is available and will be used in the toxicity assessment. The following is a list of the various organizations that have developed chemical-specific toxicity criteria for use in risk assessments:

- Health Canada;
- US Environmental Protection Agency (US EPA);
- Agency for Toxic Substances Disease Registry (ATSDR);
- National Institute of Public Health and the Environment (RIVM), The Netherlands;
- The World Health Organization; and
- Other data repositories where needed (i.e., ITER database).

For chemical stressors, the toxicity criteria selected for each COC will be obtained from one or more of the above sources, after a thorough evaluation of the basis for each criterion. In general, the non-cancer reference doses (RfDs) and cancer potency factors developed by the US EPA and presented on the Integrated Risk Information System (IRIS) are recognized as the most authoritative. For some presumed COCs or non-chemical stressors, neither the US EPA via IRIS or Health Canada have developed specific toxicity data or criteria. Thus, the toxicity criteria developed by RIVM, ATSDR or other agencies may be used.

In addition to the sources of information identified above, local health databases will be reviewed to assess their utility in meeting the objectives of the HHRA. While no epidemiological studies have been identified in the RFP, local health units may maintain a database of key health indicators and risk behaviours for the area. While it is unclear at this time whether the information contained within these databases will provide any insight on the potential health effects directly attributable to COCs or other stressors, this information will be reviewed in consultation with staff of the health unit as part of the toxicological assessment.

8.3.1 Sensitive Life Stages

As part of the scope of work, information on how all life stages will be addressed when assessing health risk will be considered. While organizations like the US EPA and Health Canada are beginning to examine how the protocols used for developing allowable exposure limits relate to exposure during sensitive life stages including exposures received in utero, the concepts for addressing these life stages have not been well developed (see for example, *A Review Of The Reference Dose And Reference Concentration Processes*, US EPA External Review Draft, May 2002). For some compounds (like lead, as an example) where there is toxicological evidence for a differential response during specific life stages, the exposure limits and risk assessment protocols developed for these chemicals reflect these sensitivities (US EPA 2000). For most other compounds however, the exposure limit is defined as one that is protective of sensitive subpopulations including children. The US EPA defines the RfC/RfD as:

> *"A quantitative estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of non-carcinogenic, deleterious effects during a lifetime." (Emphasis added)*

The PGL-NovaTox team believes that with regard to sensitive life stages, the non-cancer reference doses developed by the organizations listed above are protective of all sensitive life stages. The reference doses are derived in a fashion that typically provides an extra measure of conservatism (i.e., uncertainty factor (UF_H)) to account for sensitive sub-populations, including children and those with altered health status. For example, the reference doses for some chemicals include a UF_H of 10 and 3. Recently, Dourson et al.[2] summarized the literature surrounding the use of the UF_H with regards to its ability to protect children. The authors concluded that virtually all studies available suggest that using the UF_H protects a high percentage of the human population, including children. Based on specific comparisons for newborns, infants, children, adults, and those with severe disease, the population protected is between 60% and 100%, with the studies of larger populations that include sensitive individuals suggesting that the value is closer to 100%.

[2] *Differential Sensitivity of Children and Adults to Chemical Toxicity: II Risk and Regulation*, May, 2002. www.tera.org.

Sensitive life stages are also considered during the exposure assessment through the development of specific exposure scenarios tailored to the behaviour of different groups. As an example, estimated soil ingestion rates for children and toddlers are typically higher than other age groups, leading to higher levels of exposure.

8.3.2 Bioavailability

Bioavailability is a critical factor in assessing risk from exposure to some COCs because most of the toxicity criteria are based on direct dosing of the chemical compound and some of the toxicity criteria are based on human drinking water studies. Significant differences in bioavailability of a COC in soil compared to water have been observed and need to be accounted for in the risk estimates. In general, bioavailability of inorganics from soil is much less than in drinking water. The PGL-NovaTox team's approach to addressing the issues regarding bioavailability/ bioaccessibility for the study area is included in the discussions of individual exposure pathways.

8.4 Exposure Assessment

Assessing the potential occurrence of adverse effects resulting from chemical exposure is based on the fundamental principal of dose (of the stressor or COC) and response, that is, the probability of an adverse effect increases with increasing exposure. The objective of the exposure assessment is therefore to predict the extent to which receptors are exposed to the stressor or the COCs via various pathways such as direct inhalation or ingestion of soil. The exposure assessment takes into consideration the concentration of COCs in various media, the physical-chemical form of COCs and how that may affect uptake and toxicity, as well as the degree to which receptors are exposed to that particular pathway.

The types of receptors considered in a risk assessment need to be representative of the study population being studied. That is, for a study population in northeastern BC, the receptors considered will include infants, toddlers, school-age children, teenagers, adults, and sub-populations, who because of their occupation or personal habits may be at higher risk of exposure (e.g., farmers, hunters and anglers, First Nations peoples). A description of all receptors to be considered, as well as their physical characteristics duly referenced, will be summarized in a series of tables. As discussed below, preference will be given to BC and/or Canadian-specific sources when determining receptor characteristics for the study population.

8.4.1 Probabilistic vs. Deterministic Modelling

Generally two forms of exposure modelling are used in HHRAs, deterministic and probabilistic. Deterministic approaches tend to model what would be considered reasonable upper bound estimates of exposure (RME) – what is often referred to as "worst case." As the exposure assumptions used in a deterministic approach tend to be conservative, this type of analysis typically results in an overestimate of exposure and potential risk rather than an underestimate.

In developing deterministic exposure estimates, the PGL-NovaTox team will develop exposure point concentrations where the data allow. The exposure point concentration (EPC) is a conservative estimate of the average chemical concentration in an environmental medium, and is determined for each individual exposure unit within a site. Estimating a representative exposure concentration is critical in the exposure assessment of the various routes and pathways. Typically, 95% of the upper confidence limit of the arithmetic mean is used to represent the EPC

(US EPA, 1992). The US EPA guidance on making this calculation primarily addresses only two data distributions, normal and lognormal, thereby hindering the evaluation of many environmental data sets that are neither normal or lognormal, resulting in illogical estimates of the EPC. We propose to evaluate each EPC in accordance with the US EPA guidance entitled *Guidance on the Calculation of Upper Confidence Levels for Superfund Sites*, May 2002. This guidance provides for various methodologies to assist in evaluation of non-normal datasets such as Central Theorem (Adjusted), Boot Strapping, Jackknife Procedure, etc.

Deterministic approaches, by providing a single estimate of exposure and risk for each critical receptor, can be easier for stakeholders to understand as individuals can more easily compare their individual behaviour patterns to the assumptions used in generating the exposure estimates. However, as deterministic approaches only provide a single estimate of risk, they provide little insight on the distribution of exposures and potential risk within a community or study population, which can become important when developing risk management strategies.

Probabilistic modelling, by examining the range of the values for different variables affecting exposure, provides direct insight into how risks are distributed across a population in terms of intensity, duration and frequency. In addition, by providing a means of examining how the exposure models are affected by changing variables (i.e., sensitivity), probabilistic modelling allows one to focus on key assumptions and data to develop more realistic estimates of risk.

In developing a cost-effective approach for conducting the HHRA, the PGL-NovaTox team proposes to take a tiered approach to conducting the exposure assessment. The initial tier will include both deterministic and probabilistic approaches to exposure modeling. While a deterministic approach may well demonstrate that the risks for various populations in the study area are acceptable, the PGL-NovaTox team is of the opinion that a probabilistic approach will provide useful information on how exposure and risk is distributed throughout the study population. This will, in turn, allow interested parties to focus on mitigative efforts (where identified as being necessary) that have the greatest benefit. At the very least, probabilistic modelling will include an assessment of both high end (i.e., 95th percentile) and central (median) tendencies for exposure. These will be compared to the “worst-case” value derived from the deterministic assessment. Other approaches that can be applied to refine exposure estimates include micro-exposure event analysis and community-based surveys, which are discussed briefly below. These approaches would only be recommended where the results of deterministic and probabilistic modelling indicate that risks exceed a level defined as acceptable.

8.4.2 Micro-exposure Event Analysis and Community-based Surveys

An advanced form of probabilistic risk assessment, known as Micro-exposure Event (MEE) analysis, also uses the Monte Carlo technique, but modifies the exposure equation to better integrate spatial and temporal variations in exposure parameters and to explicitly address correlations between parameters. This approach avoids the difficulty inherent in conventional Monte Carlo modelling where unrealistic exposures may be projected due to coincidental selection of the upper percentiles of two or more input distributions.

Central to the MEE analysis is a shift in emphasis from generalizing about a whole population’s exposure to applying relevant information to estimate the exposures of individuals within that population. In brief, an individual’s total exposure to a contaminant is calculated by summing the

doses received during many individual exposure events. Each event is simulated using information specific to the time and location of the exposure event. The number of events and sequence in which they occur in the person's life can be simulated based on demographic data and information on an individual's short- and long-term behaviour. The PGL-NovaTox team has access to a model which allows for the MEE analyses.

As an example, MEE analysis is an effective tool to use when evaluating exposures associated with fish consumption. The model determines the age, body weight, and fish consumption rate of each angler during each year of exposure, as well as each angler's exposure duration. The model also determines the characteristics of each fish meal. These characteristics include the fish species consumed, the contaminant concentration in the fish, the method used to prepare the fish, and the level of contaminant loss resulting from the cooking practices used. In the end, the total dose received by each angler is the sum of the discrete exposures received by that angler as a result of all of the specific fish meals consumed. Correlations between exposure parameters can be easily modelled and limitations in datasets can be incorporated into the model.

As the extent to which individuals are exposed to COCs via different pathways is dictated by personal habits (e.g., consumption of garden vegetables, consumption of game, amount of time spent outdoors), the uncertainty of any assessment can be reduced by community-based surveys that are designed to solicit information from members in a household on habits and consumption patterns. As surveys can provide valuable information on habits within a community, they can be used to replace or supplement conservative assumptions regarding exposure. Household surveys have been used to obtain information on personal habits in community-based risk assessments conducted in other areas in Canada, and it might be possible that federal agencies have collected data in the current study area.

Depending on the size of the study area and the diversity of the population, however, household surveys may need to be quite extensive in order to derive a statistically valid and meaningful dataset that can be applied to the community. Therefore, while surveys can be an invaluable tool for validating exposure assumptions, their use in a HHRA needs to be evaluated in the context of the risk estimates derived using conservative default assumptions. That is, if the conclusions of a risk assessment conducted using conservative default assumptions are that the level of risk is acceptable, there may be little benefit in conducting community-based surveys to refine the exposure estimates.

8.4.3 Exposure Parameters

Information on the physical characteristics and time-activity patterns (e.g., dermal contact rates, inhalation rates, ingestion rates, intake rates of locally grown produce, bioavailability, and exposure duration, etc.) used for estimating exposure will be obtained from standard reference sources, which include:

- Health Canada and BC Ministry of the Environment;
- *Compendium of Canadian Human Exposure Factors for Risk Assessmen*t (O'Connor, 1997);
- *Exposure Factors Hand Book* (US EPA, 2010);
- *Risk Assessment Guidance for Superfund*, (US EPA 1989-2001);
- *Child-specific Exposure Factors Handbook* (US EPA, 2000); and
- Canadian Council of the Ministers of the Environment (CCME, 1996; 2000).

While the *Compendium of Canadian Human Exposure Factors for Risk Assessment* is specific for the Canadian population, information from this source will be supplemented as necessary from sources such as the *Exposure Factors Handbook* and the *Child-specific Exposure Factors Handbook* (US EPA 2010, US EPA 2000). In all cases, assumptions used for describing the physical characteristics of a receptor population, as well as the intake variables used will be fully documented and justified. Where there are differences in values recommended between jurisdictions (e.g., soil ingestion rates in children), original references will be reviewed to examine the source of the discrepancy and recommendations will be developed on what value to use. Where there is no clear scientific rationale for using one exposure variable over another, either the more conservative value will be used or a sensitivity analysis will be conducted to examine the consequence of this uncertainty in understanding overall exposure. This will ensure that defensible exposure assumptions (i.e., transparency) are used throughout the assessment.

The algorithms used for modelling exposure will be the standard equations as recommended and used by the US EPA (Risk Assessment Guidance for Superfund, 1989–2001), the Canadian Council of Ministers of the Environment (CCME, 1996, CCME, 2000) and Health Canada (2010). The algorithms will be tailored, however, to suit local climatic conditions as appropriate. Calculation of non-carcinogenic average daily doses and carcinogenic lifetime average daily doses will be presented. For other stressors (i.e., non-chemical), exposure will be determined based on similar frameworks.

The approach the PGL-NovaTox team proposes to use to assess exposure via each major pathway and to address the critical issues identified in the scope of work is described more fully below.

8.4.3.1 Exposure via Ingestion

Exposure via Direct Ingestion of Soil and Dust

Issue

Quantifying COCs exposure from direct ingestion of soil and dust.

Background

For certain receptor populations such as children, direct ingestion of soil can represent a significant exposure pathway. Children are frequently exposed to soil as part of their normal play activities while certain age groups such as toddlers engage in frequent hand-to-mouth activities. Even during times when soil is seasonally inaccessible, children can be exposed to soil-borne contaminants via dust in the home and residual dirt that may accumulate on toys that have been used in outdoor play areas.

In modelling potential exposure via direct ingestion of soil and dust, it is important to understand ingestion patterns of soil in the various receptor groups. There are values recommended by CCME (CCME, 1996), Health Canada and other regulatory jurisdictions (e.g., US EPA) Obviously, different soil intake rates have a large bearing on understanding exposure via this pathway. Fundamental to understanding exposure via soil ingestion is consideration of the relative availability of the COCs in the particular matrix under study. While a conservative assumption would be to assume all of the chemical present in the soil particles is available to be

taken up in the digestive tract (i.e., 100% bioavailability), a number of studies that have examined the issue of bioavailability from soil indicate that it is much less than 100%. This is especially true for the less soluble inorganics (ATSDR, 1997).

Approach

To assess COCs exposure from the ingestion of soil the PGL-NovaTox Team will:

- Review available literature concerning daily intake rates for soil and dust for children and adults. Summarize the intake rates to use for various age groups on the basis of the review.
- Develop preliminary exposure estimates based on the levels of COCs detected in surface soil (from monitoring studies performed in the Study Area, as supplied by various sources). As discussed above, depending on how representative the soil sampling results are for different communities, or study areas, exposure will be modeled using the exposure point concentration, which represents the 95% of the UCL of the mean. Exposure to soil and dust will be evaluated separately based on the estimated time spent indoors and out. Levels of COCs in dust will be estimated using a soil-to-dust transfer coefficient. Several house studies have been conducted (Calabrese et al, 1989, Calabrese and Stanek, 1992 and Camman and Lewis, 1993) from which the PGL-NovaTox Team can develop data distributions based on soil-based transfers to estimate a mean soil-to-air dust transfer (typically 0.44).
- Conduct a review of the literature on bioavailability of various COCs from soil to identify appropriate bioavailability factors to use. Should the review be inconclusive, exposure will be modeled assuming 100% bioavailability from soil.
- Examine the uncertainties associated with understanding this exposure pathway and assess their significance.

Exposure via Drinking Water

Issue

Quantifying exposure to COCs from drinking water.

Background

In certain cases, drinking water can be a significant source of exposure.

Drinking water in the study area might in some cases be supplied principally by municipal sources that rely on both surface water and drilled wells as sources of raw water. In addition, a number of communal supplies also likely operate within the study area supplying small groups of users.

The PGL-NovaTox team will consult data generated from various surveillance programs (e.g., provincial and federal sources) to obtain reports summarizing the results of drinking water quality in the study area. Municipal records will also be obtained and reviewed.

In addition to municipal supplies, permanent and seasonal residents in the study area rely on drilled wells, point wells and surface water as a source of potable water. While the First Nations reserves likely supply their own potable water, information regarding the levels of COCs is not available for many of these sources.

Approach

Historical results from the provincial/federal/municipal drinking water surveillance programs should provide a comprehensive picture of the level of exposure to the COCs from drinking water for the majority of residents in the study area. This information will be supplemented with any other available information related to levels of certain COCs for water.

Information on the extent of exposure for private well users and potential users of surface water is lacking. To address this issue the PGL-NovaTox team will:

- Identify the extent of well use in the area using sources such as local knowledge of the area and the provincial water well records database. Efforts will concentrate on those areas where levels of COCs in soil exceed the health-based criteria, as well as those areas where drinking water supplies have historically been affected by COCs attributable to atmospheric deposition.
- Identify and compile information from local sources, such as company records, on the levels of COCs in drinking water supplies not covered by provincial or municipal monitoring programs. This information will be used to identify locations with a history of elevated contaminant levels in groundwater and/or areas influenced by elevated levels of contaminants in soil.
- Identify locations where existing water quality information may be insufficient to characterize exposure from these sources. We anticipate that in some locations where private wells and the municipal wells draw water from a common aquifer, water quality will be comparable. Where this is not the case, sampling may be required to assess the degree of exposure to the COCs.
- Ensure, through the use of an information circular, that residents in the homes identified for sampling are fully informed of the purpose of the sampling program. The results of water quality testing for individual residences will be provided to each home at the completion of the sampling program. Analytical results will be compared to relevant health-based and aesthetic benchmarks.
- Estimate potential exposure to any private residences that rely on surface water based on the levels of COCs in nearby surface water bodies.
- Examine the uncertainties associated with understanding this exposure pathway and assess their significance.

The potential contribution of ingestion of surface water during recreational activities will also be examined in the context of understanding exposure via other ingestion pathways. Based on the relative levels of COCs in surface water and municipally supplied drinking water, it is anticipated that this pathway will have only a minor contribution to total exposure.

Exposure via Normal Food Basket

Issue

Quantifying exposure to COCs via normal food basket.

Identifying any unique consumption habits that would result in higher exposure for certain sub-populations (e.g., infants, ethnic groups, First Nations peoples).

Quantifying exposure via ingestions of COCs from a typical good basket by identifying the relative contribution of locally grown supermarket foods to the diet.

Background

Food can be a significant exposure pathway for many elements.

The approach taken to quantifying exposure via food relies on statistics regarding “typical” consumption patterns of different foodstuffs for different age groups, as well as their respective level of COCs. For example, while Health Canada acknowledges that people living near a point source may be exposed to higher levels of nickel due to consumption of locally grown produce, the available data on nickel levels in different types of locally grown produce was considered insufficient to model exposure via this pathway. In assessing exposure to people living near a point source, Health Canada has therefore assumed that the intake from a typical food basket is no different than the general population (CEPA, 1994).

Approach

To assess COC exposure from the normal food basket, the PGL-NovaTox team will:

- Conduct a literature review to identify information regarding the level of COCs in various food types, as well as the dietary intake for various age groups and receptor populations.
- Identify those components of the food basket that have the highest relative contribution to dietary intakes of the COCs.
- Identify any unique consumption patterns of particular foods or dietary supplements that might be expected to lead to higher than average intakes for each COCs.
- From a typical food basket, estimate the maximum contribution to total diet from locally grown produce such as potatoes.
- Model the relative contribution to total daily COCs intake from locally grown produce.
- Local livestock may supply a moderate fraction of local meat supply, potential exposure via consumption of local livestock will be modelled to account for those individuals who may rely on a local source to supply their needs.
- Conduct a literature review to assess the bioavailability of COCs from food intake. Recommend appropriate bioavailability factors for each of the COCs as appropriate.
- Examine the uncertainties associated with understanding this exposure pathway and assess their significance.

Exposure via Consumption of Backyard Vegetables

Issue

Quantifying COC exposure via the consumption of backyard vegetables grown in soils with elevated levels of COCs.

Background

Where plants can take up contaminants present in soil, consumption of produce grown in backyard gardens represents a potential exposure pathway. Total exposure is dependent on the concentration in the plant tissue, the degree of consumption, and the extent to which soil is washed from the plants prior to consumption.

When assessing potential exposure via consumption of backyard vegetables, the approach is to typically assume a garden of approximately 30m^2 producing ~40kg of vegetables (average yield of 1.4kg/m^2). For a family of four, this will represent approximately 7% of the annual consumption of fruits and vegetables. These assumptions regarding the extent to which a family consumes backyard vegetables have been used to model exposure via backyard vegetable consumption in recent risk assessments conducted for Canadian communities.

Recognizing the differences in size of many of the gardens in the area and the apparent popularity of “pick-your-own” gardens, when modelling to assess potential exposure via this route it would be prudent to include what would be considered high-end consumers (e.g., as high as 100% consumption).

Approach

To assess potential COC exposure via consumption of fruits and vegetables grown in home gardens, the PGL-NovaTox team will:

- Conduct a thorough review of data regarding plant uptake available as part of any applicable soil studies for the study area. It is assumed data for various plant types, as well as data for washed and unwashed samples might be available. The data will be compared to other studies that have examined plant uptake from aerial deposition and soil.
- Identify and validate critical assumptions regarding garden size, the types of vegetables grown, the extent of consumption in the study Area and reliance on “pick-your-own” farms. This will be based on local knowledge.
- Quantify COCs exposure under varying assumptions regarding consumption (e.g., 100% consumption during the harvest season; 100% consumption throughout the year, partial consumption during harvest, and partial consumption throughout the year). The bioavailability factors used to model COC uptake from food will be the same as those recommended under the general food basket.
- Examine the uncertainties associated with understanding this exposure pathway and assess their significance.

Exposure via Consumption of Local Fruits, Plants, Fungi

Issue

Quantifying exposure to the COCs from the consumption of locally grown fruit and fungi.

Background

Locally grown low-bush berries, which thrive on acidic soils are a source for local consumption. In addition, locally grown strawberries are available from home gardens and pick-your-own farms. The extent to which locally harvested fungi such as wild mushrooms contribute to diets and potential exposure to the COCs is unknown at this time.

Approach

To assess potential exposure to COCs via consumption of wild berries and other wild plants, the PGL-NovaTox team will:

- Review the available literature, the results of recent sampling study and any unpublished reports documenting the concentration of COCs in wild fruit and fungi such as blueberries, strawberries and mushrooms. Where suitable information may not be available for quantifying exposure, the consequences to understanding exposure via this pathway will be examined. Options and recommendations for addressing these data gaps will be developed. These may include recommendations for additional sampling.
- Identify through literature reviews, local knowledge and/or public forums, consumption patterns that may result in higher than expected consumption of wild fruits and fungi such as mushrooms.
- Quantify reasonable maximum exposures from the consumption of locally grown fruit such as berries and fungi. As with backyard vegetable consumption, exposure will be modelled for high-end consumption patterns (i.e., seasonal daily consumption), as well as average or occasional consumption.
- The issue of bioavailability via dietary intake will be handled in a comparable fashion to the normal food basket as discussed above.
- Examine the uncertainties associated with understanding this exposure pathway and assess their significance.

Exposure via Consumption of Local Fish and Game

Issue

Quantifying exposure to COCs from consumption of locally caught fish and game.

Background

Little information is available on the levels of COCs in tissues of game animals such as deer and moose. Where suitable information on tissue levels of COCs from game obtained from the study is not available, these can be estimated using the food web model. Considering the diet of small species undoubtedly found in the study area, their tissue concentration may provide some insight on the levels that might be expected in larger wild game animals in the area.

First Nations peoples and avid hunters and anglers may be at higher risk from exposure from consumption of wild game and fish. The *Compendium of Canadian Human Exposure Factors for Risk Assessment* (O'Connor 1997) contains information on fish and game consumption by First Nations people. These data, which were obtained largely from surveys conducted for Health Canada, also includes probability density functions that can be used for probabilistic modelling.

Approach

To assess potential COC exposure via consumption of wild fish and game, the PGL-NovaTox team will:

- Conduct a thorough review of the literature to identify reliable information sources on the tissue levels of COCs in fish, wild game and livestock obtained from the study area (and possibly a background area).
- Where suitable information is not available, estimates of the tissue levels of COCs using food web uptake models will be used. Should these models result in an unacceptable level of uncertainty, recommendations for collecting and analyzing suitable samples of game will be provided.
- Model reasonable maximum exposures from the consumption of local wild game and fish using data on consumption patters from sources such as *Compendium of Canadian Human Exposure Factors for Risk Assessment* (O'Connor, 1997) and other source of dietary information for the region.
- The issue of bioavailability via dietary intake will be handled in a comparable fashion to the normal food basket as discussed above.
- Examine the uncertainties associated with understanding this exposure pathway and assess their significance.

8.4.3.2 Exposure via Inhalation

Exposure to Ambient Air

Issue

Quantifying COC exposure via inhalation of ambient air and developing recommendations for additional ambient air monitoring as appropriate.

Background

The inhalation of contaminants present on particulate matter also contributes to exposure via ingestion as particulate matter is cleared from the lung by mucocilliary transport. While the contribution to exposure via ingestion for the COCs is minor via this mechanism, it is important to understand the particles the COCs are associated with as this affects bioavailability for both direct inhalation and ingestion.

Approach

To assess potential COCs exposure via inhalation of ambient air, the PGL-NovaTox team will:

- Obtain and compile ambient air monitoring data for the various COCs available sources.
- Identify and assess the spatial distribution of available ambient air monitoring data in relation to potential receptors in the study area, available toxicity benchmarks for assessing exposure via inhalation, as well as the extent to which inhalation contributes to overall exposure. On the basis of this review, the need for additional monitoring for each of the COCs will be identified as appropriate.
- Assess potential risk via direct inhalation of COCs. Exposure via inhalation will be assessed against benchmarks appropriate for evaluating inhalation toxicity (e.g., reference levels, inhalation unit risk values).
- Assess the extent to which inhalation contributes to exposure via ingestion through mucocilliary transport.
- Examine the uncertainties associated with understanding this exposure pathway and assess their significance.

Inhalation of Indoor Air/Dust

Issue

Quantifying COC exposure from indoor air and developing recommendations for an indoor air monitoring program.

Background

As time/activity studies show that non-worker individuals spend the majority of their time indoors, contaminants present in indoor air can be an important source of exposure. While concerns have been raised regarding exposure to contaminant-bearing dust tracked indoors by residents and pets, the concern tends to focus more on the potential for increased oral exposure in toddlers due to the frequent hand-to-mouth activity in this age group.

In the absence of direct measurement of the concentrations of COCs in indoor air, “worst-case” levels can be approximated from the level of particulate.

Approach

To assess potential exposure to COCs via inhalation of indoor air and develop recommendations regarding the need for an indoor air sampling program, the PGL-NovaTox team will:

- Determine the significance of indoor air/dust as an exposure pathway by assessing worst-case conditions via this pathway.
- Conduct a literature search to identify the levels and characteristics of particulate matter in typical residential settings within the northeastern BC area. Assuming the contaminant-bearing particulate originates principally from re-suspended soil and dust, the concentration of chemical of concern resulting from dust in indoor air will be estimated based on their respective concentrations in surface soil. As discussed in earlier sections, a soil-to-dust transfer coefficient of 0.44 will be used.

- Depending on the potential for exposure via this pathway, recommendations will be provided on the need for an indoor air sampling program for the individual COCs to better refine exposure estimates and the degree of risk.

8.4.3.3 Exposure via Dermal Contact

Issue

Quantifying exposure to the COCs from dermal contact with soil and sediment.

Background

Dermal absorption can be a significant source of exposure to environmental contaminants for those individuals in frequent contact with soil and sediments. Gardeners, children who play in soil, construction workers and swimmers who frequent areas with impacted sediments can all be at greater risk from exposure via dermal contact.

The extent of exposure via this pathway is dependent on the frequency of skin contact, the amount of skin available for exposure, the amount of soil/sediment adhered to the skin, the frequency of washing and extent to which the contaminants present in the soil/sediment are absorbed by the skin. For example, while the rate of dermal uptake by most metals is low, some elements like nickel can cause contact dermatitis in sensitive individuals. As such, when examining dermal contact as an exposure pathway for a particular contaminant, consideration needs to given to its contribution to total exposure, as well as local, point-of-contact effects.

Limited information on the bioavailability of many of the COCs from dermal uptake is available from the literature. In addition, information on skin surface area for different age groups is available from sources such as the *Compendium of Canadian Human Exposure Factors for Risk Assessment* (O'Connor, 1997).

Approach

To assess potential risks via dermal exposure, the PGL-NovaTox team will:

- Identify reasonable receptor characteristics for quantifying dermal exposure in various age groups. This will include an assessment of skin surface area, contact rates for soil and sediment and dermal adherence factors.
- Review the available literature on factors affecting bioavailability and dermal uptake of the COCs. On the basis of this review, dermal uptake coefficients will be recommended for each of the COCs.
- Quantify total exposure to COCs on the basis of casual and intense exposure to soils and sediments.
- Review the available literature on contact dermatitis and sensitization in sensitive individuals. Where the data permits, identify a minimum elicitation threshold below which sensitization is not likely to occur.
- Examine the uncertainties associated with understanding this exposure pathway and assess their significance.

8.4.3.4 Assessment of Non-chemical Stressors

Noise

Noise is defined as unwanted sound. Noise exposure criteria and acceptable sound levels will be assessed using the guidance provided in the British Columbia Noise Control Best Practices Guideline published by the BC Oil & Commission in March 2009. In addition, other regulatory requirements and standards of best practice from BC and other provincial jurisdictions may be reviewed to evaluate noise emissions from stationary and transportation noise sources. Other aspects, which influence the perception of sound as noise, including tonality or impact and impulse noise will also be considered.

In principle, noise is problematic when it is heard over and above the level of the "background" or surrounding environmental noise. The impact of noise is therefore expressed as the difference between noise from the source and the background environmental noise. This is often referred to as the relative assessment method. The relative assessment method is more directly related to human annoyance and takes into account that developed areas and urban centres are associated with a “hum” which elevates background noise levels and may temper the perception of noise from an oil and gas source compared to rural or semi-rural areas. The relative assessment method will be incorporated into the evaluation of noise emissions from the oil and gas industry.

Stationary Noise Sources

A stationary noise source is a fixed facility, which may emit sound or a combination of sounds from the operations that normally would occur within the property lines of the facility. The impact assessment of noise produced by stationary sources is performed either by prediction or by measurement. Where noise measurements are available for existing facilities, these will be used to evaluate the potential for noise exposure criteria exceedences. Where noise measurements have been collected, distance attenuation calculations can be performed to estimate noise exposures at a variety of receptor locations. In the absence of noise measurements, stationary noise source modelling can be performed based on the type of facility and the anticipated processes, equipment and operations associated with that facility through noise power calculations and distance attenuation calculations and modelling.

Transportation Noise Study

Active traffic is associated with the oil and gas industry operations and may include both truck and rail noise. Existing transportation noise studies will be reviewed and evaluated as to the potential impact of noise from these sources on applicable points of reception. In the absence of noise measurements, road and rail traffic noise levels can be estimated at points of human reception using computerized versions of ORNAMENT and STEAM, which are also incorporated into the STAMSON noise modelling program. Modelling can also be used to estimate noise emissions from transportation corridors based on anticipated future traffic or rail patterns.

Light and Other Stressors

The PGL-NovaTox team will assess all other applicable stressors deemed to be of significance using recognized assessment framework.

Incidents

The PGL-NovaTox team will assess incidents (e.g., accidents, malfunctions) using recognized assessment framework.

8.5 Risk Characterization

The risk characterization component of the HHRA directly compares the predicted COC exposure via different routes of intake to the toxicological criteria that define an "allowable," "acceptable" or "safe" level of exposure. For chemicals that operate via a threshold-type of dose response, the comparison most often used is termed a hazard quotient (HQ) or exposure ratio (ER). This simply is the ratio between total exposure adjusted for bioavailability divided by the exposure limit as shown in the following equation:

$$ER = \frac{\text{Total Exposure (adjusted for bioavailability)}}{\text{Allowable Exposure Limit}}$$

Where predicted levels of exposure are less than the allowable limit (i.e., ER<1) no adverse health outcomes would be expected in the study population. The converse is not automatically true, however. That is, when levels of exposure exceed the allowable exposure limit (i.e., ER>1), adverse health outcomes are not necessarily expected. Rather, there is erosion in the margin of safety between the level of exposure and that known to cause adverse effects. Under such a situation, it is prudent to re-examine the basis of all of the assumptions used to generate the estimates of risk and exposure prior to identifying possible risk management measures. This analysis could conclude that given the conservatism of the assessment, no adverse health outcomes are expected or alternatively, that some form of follow-up action is required.

When assessing simultaneous exposure to more than one chemical, in the absence of toxicological information regarding possible synergistic or antagonistic effects of the combined chemicals, the exposure ratios for common end-points (e.g., liver toxicity) are summed. This assumes that the receptor is exposed to the COCs simultaneously and that the COCs operate independent of each other in exerting their toxic effect on the target organ (US EPA 1989).

For carcinogens that are assumed to operate via a non-threshold mechanism of action, the risk characterization identifies the incremental cancer risk associated with a particular exposure pathway. Incremental lifetime cancer risks are a unitless value that expresses the probability of developing cancer for a specified level of exposure averaged over a lifetime (assumed to be 70–75 years). Typically, incremental cancer risks of one in a million (10^{-6}) are considered *de minimus*, which means they are below a level that would be of concern. Incremental lifetime cancer risks of between one in ten thousand (10^{-4}) and one in a million can be considered acceptable on a case-by-case basis depending on the nature of the exposure and the number of people exposed (US EPA, 1991).

For assessing exposure, there is increasing use of a Margin of Exposure approach for assessing the level of risk in a population. Analogous to the exposure ratio discussed above, this describes the ratio between estimated levels of exposure and the lower level at which effects can actually be anticipated in a population. The effects can either be tumour response (e.g., the TD05/TC05 developed by Health Canada for assessing carcinogens) or a No Observed Adverse Effect Level

or Lowest Observed Adverse Effect Level estimated for a human population. This approach avoids the controversies often associated with the use of large safety factors in developing allowable exposure limits or the low-dose extrapolation methods to derive unit risk values.

Finally, in presenting the results of the risk characterization, it is essential that the individual contribution of each exposure medium is quantified and presented in a manner that is meaningful for making rational and cost-effective risk management decisions. This is especially important for those chemicals in which the majority of exposure can result from sources like food that are unrelated to industrial emissions. In cases such as this, the cost and benefits of controlling industrial-related exposures such as air and soil can be evaluated against the overall impact at the receptor level.

For the risk characterization, the PGL-NovaTox team will:

- Present separately, the levels of exposure and risk for each critical receptor. As discussed above, these are defined by age group or behaviours that may result in an increased potential for exposure.
- The contribution to total exposure and risk will be presented separately for each major pathway. This will be done using suitable graphics (i.e., histograms or pie charts) so that the contribution of “study area-specific“ sources to risk can be readily distinguished from those common to the general population.
- For the deterministic approach, the risk for the maximum exposed individual for each receptor group will be presented.
- In presenting the results of the probabilistic assessment, exposures and risk representing the 50^{th} (median) and 95^{th} percentile of the population will be presented. The entire distribution across the population may also be presented depending on the need.
- For COCs that affect a common organ system, for assessing the risk potential risk resulting from threshold effects, the hazard quotients or exposure ratios will be summed to approximate the combined effects of the individual COCs. The consequence of taking this approach will be discussed in the context of what is known about the individual and combined effects of COCs in experimental systems.
- For carcinogens, the incremental lifetime risk for each major exposure pathway will be presented. As above, the contribution of “study-area-specific“ sources will be clearly distinguished from sources common to the general population.
- The overall risk or hazard will be discussed in the context of exposure and risk to the general population. This will facilitate informed decision-making by identifying those sources and exposure pathways where risk reduction activities will have the greatest benefit.

8.6 Uncertainty Analysis

An uncertainty analysis will identify and discuss the principal areas of uncertainty associated with understanding the individual elements of exposure, toxicity and risk. The major sources of uncertainty for each of these elements will be discussed separately so that any risk management decisions developed as a result of the risk assessment are made with a full understanding of the sources of uncertainty and their magnitude, both of which have implications in evaluating the success of any risk reduction efforts that are contemplated for the community.

9.0 PRELIMINARY PROJECT SCHEDULE

It is understood that the anticipated starting date for the study is October 1, 2012 with an anticipated completion date of March 31, 2014.

Recognizing this and the scope of work described above, the preliminary schedule developed for the project is presented in Table 4. The preliminary project schedule is based on the assumption that the PGL-NovaTox team will deliver a draft final report for all components by March 31, 2014.

While it is recognized the interim reports will be reviewed and receive comment, is it is assumed the formal peer review will be conducted once the draft reports have been completed and submitted to the Ministry. The schedule and pricing does not include allowances for addressing peer review comments received after submission of the draft final report.

Table 4: Project Schedule

Tasks/ Deliverable	Project Schedule
Project award (kick-off meeting)	October 1, 2012
Preliminary data review	November 1, 2012
Enhanced Systematic Planning	December 1, 2012
Jurisdictional review	March 1, 2013
Exposure summary and modelling	June 1, 2013
Statutory and regulatory review	December 1, 2013
Human Health Risk Assessment	January 10, 2013
Review of advanced techniques to refine/assist risk assessment (i.e., GIS, geomatics)	January 15, 2013
Final reporting	March 31, 2014

10.0 PERSONNEL QUALIFICATIONS AND PAST EXPERIENCE IN CONDUCTING SIMILAR RISK ASSESSMENTS

10.1 Project Personnel

PGL has assembled a team of highly qualified professionals to lead this project. Each team member is a recognized expert in their field bringing years of experience to the project in disciplines such as human health risk assessment, exposure modeling, human toxicology applied human health risk assessment (HHRA), geomatics, air monitoring (and dispersion and depositional modeling) as well as risk communication.

Highlights of the qualifications of key members of the project team are provided below. An Organization Chart the relationship between the team members is shown in Figure 1 while resumes are included in Appendix C.

Proposed Core Team Member:	**Will Gaherty, M.S., P.Eng.**	**Years of Experience**	**27**
Project Title	**Technical Director/Senior Reviewer**		
Role & Responsibility of Proposed Core Team Member:	Will Gaherty will provide Senior Review for the project and focus on quality assurance and quality control.		
Area of Specialization and Credentials:	• Human health and ecological risk assessment • Migration of contamination • Environmental and analytical chemistry • BC environmental legislation and policy		
Education/ Affiliations:	• M.S. – Environmental Engineering and Science, Stanford University, Stanford, CA, 1985 • S.B. – Civil Engineering, S.B. – Chemical Engineering, Massachusetts Institute of Technology, Cambridge, MA, 1984 • PEng: British Columbia, Alberta, Ontario, Yukon, NWT • BC Science Advisory Board on Contaminated Sites – founding board member 2003–present • BC Roster of Professional Experts, BC Ministry of Environment 2000–2007 • Canadian Environmental Auditors Association – Certified Environmental Auditor 1997–2005 • TEC Member since 2007 • Fellow, Engineers Canada		
Summary of Core Team Member Experience Related to Services:	Will Gaherty is a founder and principal of PGL, with 25 years of contaminated sites consulting experience. Will is a founding director of the Science Advisory Board for Contaminated Sites in BC.		




Proposed Core Team Member:	**Simone Mol, Ph.D., PChem (BC), CSAP**	**Years of Experience**	**11 years**
Project Title:	**Project Manager**		
Role & Responsibility of Proposed Core Team Member:	• Project management • Data interpretation • Risk estimation • Report writing		
Area of Specialization and Credentials:	• Human Health and Ecological Risk Assessment • Regulatory compliance and reporting		
Education/ Affiliations:	• Ph.D.(Applied Science), Melbourne University, Australia • B.Sc.Hons., (Environmental Management), Victoria University, Australia • Professional Chemist (PChem) – Association of Chemical Profession of BC • Roster of BC Contaminated Sites Approved Professionals (CSAP)		
Summary of Core Team Member Experience Related to Services:	Simone Mol is an environmental scientist and project manager with over 12 years of experience, specialising in environmental investigation, remediation and risk assessment of contaminated sites in Australia and Canada. She was appointed to the Roster of Approved Professionals for Contaminated Sites in British Columbia, as a Standards Assessor in 2011. Based on Simone's project experience and clients, she is familiar with both the federal and provincial regulations. Simone has managed multi-disciplinary complex projects for various phases of contaminated site assessment, remediation and risk assessment. Her project management experience includes coordinating staff, contractors and schedules; providing ongoing project updates; tracking and maintaining budgets; managing contracts; and providing successful liaison with client, municipal, public and regulatory stakeholders. Simone has been actively involved in human health and ecological risk assessment for over 8 years. Simone has conducted more than 15 site-specific human and/or ecological risk assessments under provincial and federal regulation for a range of facilities including industrial, commercial, petroleum, transportation and first nations. Some of these risk assessments have led to the development and implementation of risk management strategies.		




Proposed Core Team Member:	**Mark Chappel. M.Sc., DABT**	**Years of Experience**	**14 years**
Project Title	**HHRA Technical Manager**		
Role & Responsibility of Proposed Core Team Member:	Technical Expert – Human Health Risk Assessment (HHRA) Risk Communication		
Area of Specialization and Credentials:	• Toxicology • Risk Assessment • Board Certified Toxicologist (through the American Board of Toxicology, Raleigh, North Carolina) • Board certified in 2008 • Has consulted for Health Canada, in addition to Ontario Ministry of the Environment		
Education/ Affiliations:	• MSc. (Toxicology), University of Guelph, Guelph, Ontario, Canada • ABT (Board-certified Toxicologist), American Board of Toxicology Inc., Raleigh, North Carolina, USA • Qualified Person (Risk Assessment), Ontario Ministry of the Environment (MOE), Toronto, Ontario, Canada • American College of Toxicology, Full Member, Bethesda, Maryland, USA • Society of Toxicology of Canada, Montreal, Quebec, Canada		
Summary of Core Team Member Experience Related to Services:	As head of the risk assessment group in NovaTox's Guelph office Mark will be the overall project lead for the human health risk assessment and will coordinate the efforts of the HHRA team members. This will include liaison with the Project Manager, as well as members of the project teams to ensure the design of the HHRAs for each activity and source-to-receptor pathway is scientifically robust is included for comprehensive assessment. Mark is a Board-certified toxicologist (DABT) through the American Board of Toxicology and has 14 years of experience in conducting environmental and human health risk assessment, modelling, contaminated sites risk assessment, mining site-related risk assessments, and development of regulatory guidance limits for chemicals in soil, air, water, food, and other media. He has significant experience in conducting probabilistic exposure assessment, multi-media risk assessment, and has been called on to provide peer review services for both the provincial and federal governments. On environmental projects, he is co-responsible for managing projects involving human health and the environment, including: human health risk assessment (HHRA), development of property specific standards, development and defence of human health toxicity reference values, design and oversight of sampling programs, including indoor air and soil vapour sampling. His clients have include industrial commercial clients, government agency's (Health Canada), and other organizations. He is a former staff member of MOE's Standards Development Branch (SDB), and participated in the development of the Community-Based Risk Assessment for Port Colborne. Prior to forming NovaTox Inc., Mark was consulted on by the Ministry of the Environment under their Vendor of Record Contract from 2004-2009. Mark's previous risk assessment activities with a large engineering firm included the preparation of contaminated sites risk assessments for a wide range of industrial, commercial, and federal clients, including the comprehensive Sydney Tar Ponds human health risk assessment and incinerator HHRA, a large-scale, multi-media, multi-pathway risk assessment completed in Sydney, Nova Scotia. He has contributed to the development of regulatory guidance documents including the CCME's Regulatory Guidance including the Scientific Criteria Documents related to polycyclic aromatic hydrocarbons, and the revised Soil Quality Guidelines for ethy benzene and thallium. In total, Mark has personally completed over 60 large-scale risk assessments including more than 20 comprehensive risk assessments for provincially regulated sites within the province of Ontario, and more than 40 federally owned properties (DND, PWGSC, DFO, other agencies of the Crown) throughout Canada. Mark continues to contribute to the peer reviewed body of literature and is considered an expert with respect to the toxicology of naphthalene, mixtures toxicology and probabilistic risk assessment techniques. Mark has successfully managed large, multi-year interdisciplinary projects with budgets in excess of $1.5 million.		




Proposed Core Team Member:	**Derek Hillis, Ph.D.**	**Years of Experience**	**14 years**
Project Title	**HHRA – Toxicological Assessment**		
Role & Responsibility of Proposed Core Team Member:	• Human health RA component • Exposure assessment modeling • Data interpretation • Risk estimation • Report writing		
Area of Specialization and Credentials:	• Toxicology • Risk Assessment • Industrial Toxicology • Industrial Hygiene • Noise Assessment		
Education/ Affiliations:	• Ph.D. (Environmental Biology/Toxicology), University of Guelph • B.Sc. (Biology), University of Western Ontario • B.Sc. (Environmental Science), University of Western Ontario • Diploma (Industrial Hygiene Technology), Lambton College of Applied Arts and Technology • Society of Environmental Toxicology and Chemistry (Member, 2004 to current) • Occupational Hygiene Association of Ontario (1999 to 2004, 2011 to current)		
Summary of Core Team Member Experience Related to Services:	Dr. Hillis has 14 years of environmental and industrial health consulting experience in the fields of industrial hygiene, human exposure assessment, risk assessment and regulatory compliance. On behalf of his clients, Dr. Hillis has evaluated complex human health risk assessment issues (both occupational and environmental) to help develop realistic and health protective exposure goals. Dr. Hillis provides expertise on the toxicology and exposure characterization methodology of chemicals arising from industrial operations/processes, contaminated sites and commercial products. Dr. Hillis began his career in Sarnia's "Chemical Valley," resulting in a strong interest and familiarity with the processes, raw materials, intermediaries and finished mixtures of the petrochemical industry and their impacts on local communities. In addition, Dr. Hillis has significant experience providing exposure characterization and industrial toxicology advice to diverse range of clients in the manufacturing, agrochemical and pharmaceutical industries and provides specific expertise in air monitoring programs including indoor exposure assessments, fugitive emissions, point-of-impingement and perimeter air monitoring programs. Dr. Hillis has successfully completed exposure studies for submission to international regulatory agencies such as the Organization of Economic Co-operation and Development – Good Laboratory Practices and has completed reviews of carcinogenicity potential of active pesticide ingredients for agrochemical industry clients. Since completing his graduate degree in environmental toxicology, Dr. Hillis has focused on human health exposure modeling and toxicology for use in risk assessments under a variety of regulatory frameworks, including Ontario Regulation 153/04, federal guidance and the Canadian Council of Ministers of the Environment (CCME). Dr. Hillis appointment as a certified industrial hygienist (CIH) by the American Board of Industrial Hygiene is pending.		

Proposed Core Team Member:	**Hugh Scobie, M.Sc., DABT**	**Years of Experience**	**14 years**
Project Title	**HHRA – Senior toxicologist**		
Role & Responsibility of Proposed Core Team Member:	• Exposure modelling and toxicological assessment • Human health RA component • Exposure assessment modelling • Data interpretation • Risk estimation • Report writing		
Area of Specialization and Credentials:	Toxicology Risk Assessment		
Education/ Affiliations:	• MSc. (Pharmaceutical Sciences), University of Toronto, Toronto, Ontario, Canada • ABT (Board-certified Toxicologist), American Board of Toxicology Inc., Raleigh, North Carolina, USA • Qualified Person (Risk Assessment), Ontario Ministry of the Environment (MOE), Toronto, Ontario, Canada • Society of Toxicology, Associate Member, Reston, Virginia, USA • Society for Risk Analysis, Member, McLean, Virginia, USA		
Summary of Core Team Member Experience Related to Services:	Mr. Scobie is a board certified toxicologist with 12 years experience in conducting human health and environmental risk assessment and is a Supervising Health Scientist with ChemRisk. Mr. Scobie provides expert advice in the fields of human health risk assessment and toxicology, site-specific risk assessment, environmental toxicology, probabilistic exposure assessment, multi-media risk assessment, review of risk assessments and toxicology and development of regulatory standards for chemicals in soil and other media. He was previously employed with the Ontario Ministry of the Environment (MOE) as a Regulatory Toxicologist in the Human Toxicology and Air Standards section of the Standards Development Branch. In his previous work at the MOE, he provided expert advice in assessing the risk of adverse effects resulting from exposure to a wide range of hazardous chemicals. He has experience in the assessment of human health risks associated with contaminants in air, water and soil from numerous investigations conducted at various contaminated sites and exposure situations. With his years of experience and expertise in conducting risk assessments in Ontario, Mr. Scobie has been designated by the MOE as a Qualified Person (QP) for conducting risk assessments under Ontario Regulation 153/04.		

Proposed Core Team Member:	**Dino Manca, PhD, DABT**	**Years of Experience**	**20 years**
Project Title	**HHRA –Senior Technical Review**		
Role & Responsibility of Proposed Core Team Member:	Technical review		
Area of Specialization and Credentials:	Toxicology Risk Assessment		
Education/ Affiliations:	• PhD. (Toxicology) University of Quebec at Montreal, Canada • PhD. (Chemistry), University of Cagliari, Cagliari, Italy • MSc. (Bioanalytical Chemistry), University of Laval, Quebec City, Quebec, Canada • B.Sc. (Chemistry), University of Laval, Quebec City, Quebec, Canada • Member: ABT (Board-certified Toxicologist), American Board of Toxicology Inc., Raleigh, North Carolina, USA • American College of Toxicology, Full Member, Bethesda, Maryland, USA • Society of Toxicology of Canada, Montreal, Quebec, Canada • Canadian Association of Professionals in Regulatory Affairs (2010-present) • British Toxicology Society (2009-present) • Association of the Chartered Chemists of Ontario (2008-present) • Society of Toxicologic Pathology (2005-present) • Board Certified Toxicologist (through the American Board of Toxicology, Raleigh, North Carolina).		
Summary of Core Team Member Experience Related to Services:	Dr. Manca is a Board-certified toxicologist (DABT) through the American Board of Toxicology and has over 20 years of experience specialized in sophisticated human health toxicology and safety assessment strategies, chemical modelling, development of regulatory guidance limits for chemicals, and assessment of chemicals and food toxicants. Dr. Manca is primarily involved in performing high-level toxicity assessments, dose-response modelling, and characterization of individual and population exposure to environmental and occupational contaminants. He has significant expertise in the development of generic/multimedia/health-based toxicity reference values and health-based environmental standards/guidelines. Dino has authored numerous high-profile site-specific health risk assessment for chemicals found in contaminated soil and groundwater. He is a leader in the field for performing health risk assessment for industrial emissions, municipal waste management practices (e.g., land filling, incineration), and environmental impact assessments. Dr. Manca was the former Head of the Ontario Ministry of the Environment's Human Toxicology and Air Standards Section. He served as a key reviewer of numerous soil standards authored the Ministry's, including the soil standard for lead, one of the first multi-media assessments for a chemical in soil. Dr. Manca directs risk assessment projects for a wide range of industrial clients and provides senior technical review of projects in which the critical evaluation of toxicological and pharmacokinetic data are essential.		

Proposed Core Team Member:	**Duncan Macdonald, B.Sc., P.Eng, CSAP**	**Years of Experience**	**16**
Project Title	Regulatory/Information Review Lead		
Role & Responsibility of Proposed Core Team Member:	• Regulatory review • Team management • Data interpretation • Risk estimation • Report writing • Regulatory review		
Area of Specialization and Credentials:	• Regulatory Review and Reporting • Soil and groundwater remediation • Contaminated Sites Approved Professional, British Columbia		
Education/ Affiliations:	• B.Sc.H. (Civil Engineering/Environmental), Queen's University • Professional Engineer (P.Eng.) – Association of Professional Engineers and Geoscientists of BC • Roster of BC Contaminated Sites Approved Professionals (CSAP)		
Summary of Core Team Member Experience Related to Services:	Duncan MacDonald is an engineer and project manager, with over 16 years of experience, specialising in environmental investigation and remediation of contaminated sites throughout BC. He was appointed to the Roster of Approved Professionals for Contaminated Sites in British Columbia, as a Standards Assessor in 2007. As a Roster member, Duncan has made over 15 submissions to the Ministry of Environment. Duncan is familiar with both provincial and federal regulations. Duncan has a proven track recorded for developing and successfully implementing remedial action plans and obtaining regulatory instruments for complex remediation projects in BC. He has significant experience with the evaluation and modelling of contaminant migration and exposure pathways, and the selection and implementation of remediation system. While not a risk assessor, he is familiar with the problem formulation and has project managed risk-based remediation studies.		




Proposed Core Team Member:	**Emma O'Neill**	**Years of Experience**	**10 years**
Project Title	**Regulatory/Information Review Team**		
Role & Responsibility of Proposed Core Team Member:	• Regulatory review • Data interpretation • Risk estimation • Report writing		
Area of Specialization and Credentials:	• Regulatory reporting • Phase I, II, and II Environmental Site Assessments • Groundwater monitoring programs • Soil remediation		
Education/ Affiliations:	• B.A.Sc. (Bio-Resource Engineering), University of British Columbia • Professional Engineer (P.Eng.) – Association of Professional Engineers and Geoscientists of BC		
Summary of Core Team Member Experience Related to Services:	Emma O'Neill is an engineer and project manager with over 10 years of experience in environmental investigation and remediation of contaminated sites in BC. Emma has worked on a number of large projects both for the federal government and developers, requiring the review and interpretation of previous environmental investigation reports, management of large volume of data (soil, groundwater, sediment, soil vapour), and liaising with various parties and stakeholders (e.g., current/former land owner, tenants, adjacent property owners, communities, etc.).		

Proposed Core Team Member:	**Carla Shaw, Env. Studies. Dipl.**	**Years of Experience**	**10 years**
Project Title	**Regulatory/Information Review Team**		
Role & Responsibility of Proposed Core Team Member:	• Historical land use • Regulatory review • Data interpretation • Risk estimation • Report writing		
Area of Specialization and Credentials:	Phase I Site Investigations Historical Land Use and Potential Areas of Concern		
Education/ Affiliations:	• Environmental Studies Diploma, Langara College, BC		
Summary of Core Team Member Experience Related to Services:	Carla Shaw is an environmental scientist with over 10 years of experience in environmental consulting and is the Phase 1 specialist. In this role, Carla collects and reviews available documentation for sites. This documentation review and interpretation includes historical reports, aerial photographs, street directories, maps, water well database, BC Ministry Site Registry Search and other available databases. Carla, also regularly conducts interviews with knowledgeable persons to collect relevant information.		

Proposed Core Team Member:	**Stephanie Louie, B.Sc., R.P.Bio**	**Years of Experience**	**7 years**
Project Title	**Regulatory/Information Review Team**		
Role & Responsibility of Proposed Core Team Member:	• Regulatory review • Terrain and ecosystem mapping (TEM) • Species at Risk • report writing		
Area of Specialization and Credentials:	Wildlife Baseline Inventory and Assessment Vegetation Baseline Inventory and Assessment Environmental Impact Assessment		
Education/ Affiliations:	• B.Sc. (Animal Biology), University of British Columbia • Recreation, Fish, and Wildlife Management, Selkirk College, Castlegar, BC • Professional Biologist (R.P.Bio.), BC College of Applied Biology		
Summary of Core Team Member Experience Related to Services:	Stephanie is an environmental professional with more than seven years of experience in the environmental consulting industry. She has planned and conducted biological field surveys throughout British Columbia and is familiar with field conditions and ecosystems in northeastern BC. She has completed vegetation and wildlife inventories, fish habitat assessments and rare plant and wildlife species at risk surveys. Particularly relevant to the current project, she has performed technical review of terrestrial baseline studies, environmental management plans, and impact assessments.		

Proposed Core Team Member:	**Stewart Brown, M.Sc., P.Ag, R.P.Bio**	**Years of Experience**	**11 years**
Project Title	**Air Quality Specialist**		
Role & Responsibility of Proposed Core Team Member:	Air shed modelling Air quality monitoring Regulatory requirements Data review and analysis Reporting		
Area of Specialization and Credentials:	Climate studies, modelling and assessment Air quality monitoring and assessments Regulatory reporting		
Education/ Affiliations:	• M.Sc. (Earth and Atmospheric Sciences), University of Alberta • B.Sc. (Physical Geography), University of Alberta • Professional Agrologist (P.Ag.) – British Columbia Institute of Agrology • Professional Biologist (R.P.Bio) – Association of Professional Biologists of BC		
Summary of Core Team Member Experience Related to Services:	Mr. Brown is an environmental geoscientist with over 11 years of experience in environmental consulting. His experience includes: • Obtaining provincial and regional district air discharge permits for a variety of facilities including compost facilities, quarries and biogas/cogeneration facilities. • Conducting air emissions inventories. • Research and consultation on climate and air quality, managing air quality assessments including dispersion modelling to identify and mitigate fugitive dust and air pollution impacts of mining operations. • Developing and installing air monitoring networks and meteorological stations for numerous studies and projects, data analysis, regulatory and First Nations consultation, and report preparation for provincial and territorial regulatory submission. • Managing long-term climate studies in northern British Columbia and the Yukon. • Managing complex projects including coordinating multidisciplinary project staff and contractors, liaising with clients and regulators, tracking budgets, complying with federal, provincial and municipal regulatory requirements, data analysis and interpretation, and report preparation for client and ministry submission. Stewart has a thorough understanding of the federal regulatory framework, including Canadian Council of Ministers of the Environment guidelines and the Federal Contaminated Sites Action Plan. He is also well versed in the provincial regulatory framework.		




Proposed Core Team Member:	**Leslie Beckmann, B.Sc.H., M.A.**	**Years of Experience**	**20 years**
Project Title	**Communications Coordinator**		
Role & Responsibility of Proposed Core Team Member:	Communications coordination Project management Facilitation technical and popular press writing stakeholder relations		
Area of Specialization and Credentials:	Regulatory requirements Environmental Impact Assessment Consultation		
Education/ Affiliations:	• M.A. (Political Science and Environmental Studies), University of Toronto • B.Sc.H. (Biology/Physiology), Queen's University		
Summary of Core Team Member Experience Related to Services:	Leslie is a Senior Environmental Scientist with more than 20 years of experience working at the interface between science and policy. She has a passion for communicating science to non-scientists and for using scientific information to develop sound social policy. Leslie has led multi-stakeholder meetings on each of Canada's three costs with marine user groups to develop conservation policies for the federal government; has coordinated multi-jurisdictional review of development projects on the Fraser River, and, with PGL, has managed the technical research programs and communications requirements associated with provincial and federal Environmental Impact Assessments. Leslie is an award-winning author. Her non-fiction has appeared in academic journals and the popular press; her fiction has received national recognition.		

Proposed Core Team Member:	**Ian Blandford, Dipl.**	**Years of Experience**	**20**
Project Title	**Geomatics Specialist**		
Role & Responsibility of Proposed Core Team Member:	Information management and sharing strategies and systems Data processing GIS Mapping		
Area of Specialization and Credentials:	Forest inventory mapping Topographic mapping Terrain mapping GIS data processing		
Education/ Affiliations:	• Advanced Diploma Program, BCIT • Surveying and Mapping Technology, Algonquin College, Ottawa • Hydrographic Surveying, Humber College, Toronto		
Summary of Core Team Member Experience Related to Services:	Ian Blandford is trained in Geomatics/GIS with more than 20 years of experience. Over the 20 years, Ian's diverse experience includes photogrammetric operations mapping (i.e., forestry, mining), inventory mapping, development plans, volume calculations, spatial analysis for contaminated sites and environmental impact assessments, environmental constraints mapping, terrain stability mapping, soils mapping, vegetation mapping, revegetation plans, fish habitat mapping, municipal zoning, webGIS and database programming.		

10.2 Conflict of Interest Statement

The aforementioned individuals in declare jointly and severally that they have no conflict of interest, perceived or real related to this project. They currently do NOT consult for any oil and gas companies that are involved in any oil and gas development or exploration projects in BC.

Some of the team members have previously performed risk assessment work related to contaminated sites for an oil and gas proponent located in Ontario.

None of the aforementioned individuals is directly or indirectly affiliated with any individual or organization involved in oil and gas exploration, extraction, processing, advocacy or support in the Province of British Columbia.

11.0 RELATED PROJECT EXPERIENCE

The PGL-NovaTox team has conducted human health and ecological risk assessments throughout North America. These have included all of the major classes of chemicals and have ranged in complexity from screening-level assessments to multi-pathway, multi-chemical assessments. In addition, NovaTox has also been successful at introducing new techniques to human health risks assessments, which have helped avoid the use of overly conservative exposure assumptions. Examples of such techniques include the use of geostatistical methods to estimate exposure concentrations, the derivation of site-specific bioavailability factors and the development of micro-exposure event modelling to enhance the application of Monte Carlo analysis as a tool for characterizing exposure of individuals within a population.

The PGL-NovaTox team routinely undertakes ecological risk assessment for a variety of clients to provide a realistic assessment of the potential impacts that have resulted or might be expected to result from an undertaking.

Examples of risk assessment projects that included components similar to the present study are provided below.

Pages 496 through 498 redacted for the following reasons:
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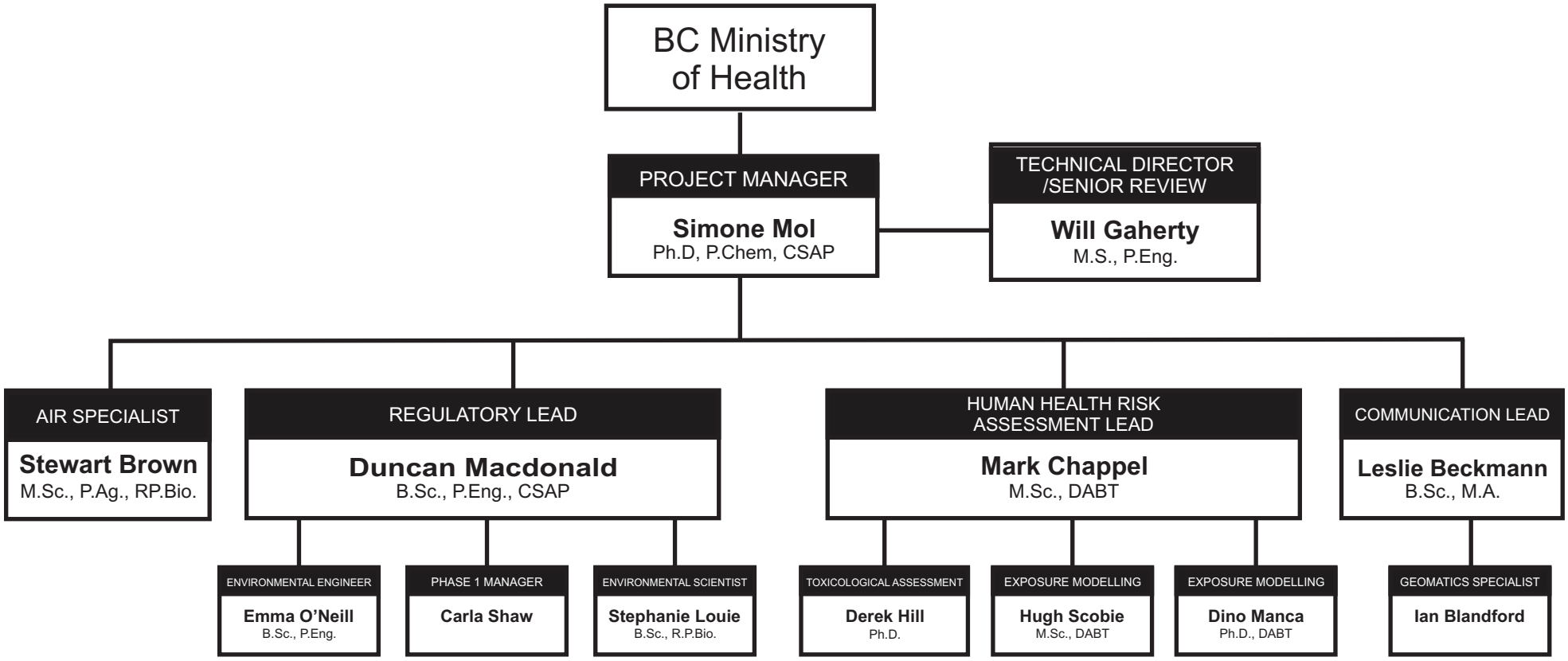
Figure

Pottinger Gaherty Organization Chart for BC Ministry of Health

Pottinger Gaherty ENVIRONMENTAL CONSULTANTS

Human Health Risk Assessment of Northeastern British Columbia Oil & Gas Activity Project



Appendix A

Bid Documents and Addenda

BRITISH COLUMBIA
The Best Place on Earth

Request for Proposals
Phase 2 – Human Health Risk Assessment of Northeastern British Columbia Oil and Gas Activity

Ministry of Health Request for Proposals Number: RFP HL173

Issue date: June 28, 2012

Closing Time: Proposal must be received **before** 2:00 PM Pacific Time on: Friday August 10, 2012

GOVERNMENT CONTACT PERSON: All enquiries related to this Request for Proposals (RFP), including any requests for information and clarification, are to be directed, in writing, to the following person who will respond if time permits. Information obtained from any other source is not official and should not be relied upon. Enquiries and any responses will be recorded and may be distributed to all Proponents at the Province's option.

<<Norman Helewa, Project Manager e-mail: norman.helewa@gov.bc.ca>>

DELIVERY OF PROPOSALS:

Proposals must not be sent by mail, facsimile or e-mail. Proposals are to be submitted to the closing location as follows:

A. (8) complete hard-copies(and 1 copy on CD) must be delivered by hand or courier to:

Purchasing Services Branch
c/o 2nd Floor 563 Superior Street
Victoria, B.C. V8V 1T7
Attention: Norman Helewa

Proposal envelopes should be clearly marked with the name and address of the Proponent, the Request for Proposals number, and the project or program title.

PROPONENTS' MEETING:

☐ A Proponents' meeting **will** be held at:

Auditorium A &B - Basement *1515 Blanshard Street,* *Victoria, BC* *V8W 3C8* *From 1:00 pm – 3:00 pm PST on Friday July 13, 2012.*	Note: A summary of questions and responses will be posted on the BC Bid Website. Attendance is optional. Oral questions will be allowed at the Proponents' meeting. However, questions of a complex nature, or questions where the Proponent requires anonymity, should be forwarded in writing (via email), prior to Noon PST Wednesday, July 11th, 2012, to the Government Contact person designated above. Please note There will be no video/teleconferencing for this meeting.

PROPONENT SECTION:

For hard-copy proposals, a person authorized to sign on behalf of the Proponent **must** complete and sign the Proponent Section (below), leaving the rest of this page otherwise unaltered, and include the originally-signed and completed page with the first copy of the proposal. **The enclosed proposal is submitted in response to the above-referenced Request for Proposals, including any addenda. Through submission of this proposal we agree to all of the terms and conditions of the Request for Proposals and agree that any inconsistent provisions in our proposal will be as if not written and do not exist. We have carefully read and examined the Request for Proposals, including the Administrative Section, and have conducted such other investigations as were prudent and reasonable in preparing the proposal. We agree to be bound by statements and representations made in our proposal.**

Signature of Authorized Representative:	***Legal Name of Proponent*** *(and Doing Business As Name, if applicable):* Pottinger Gaherty Environmental Consultants
Printed Name of Authorized Representative: Will Gaherty	*Address of Proponent:* 1200 – 1185 West Georgia Street Vancouver, BC V6E 4E6
Title: President	
Date: August 10, 2012	*Authorized Representative phone, fax or email address (if available):* 604-895-7601 wgaherty@pggroup.com

Declaration

General Service Agreement (GSA)

By submitting a proposal or other expression of interest to the Government of BC, PGL certifies that should its proposal or other supply offering be successful, PGL will enter into a Contract With the Province in accordance with the terms of the General Service Agreement and Attached Schedules as updated in 2010 and all amendments to the current date.

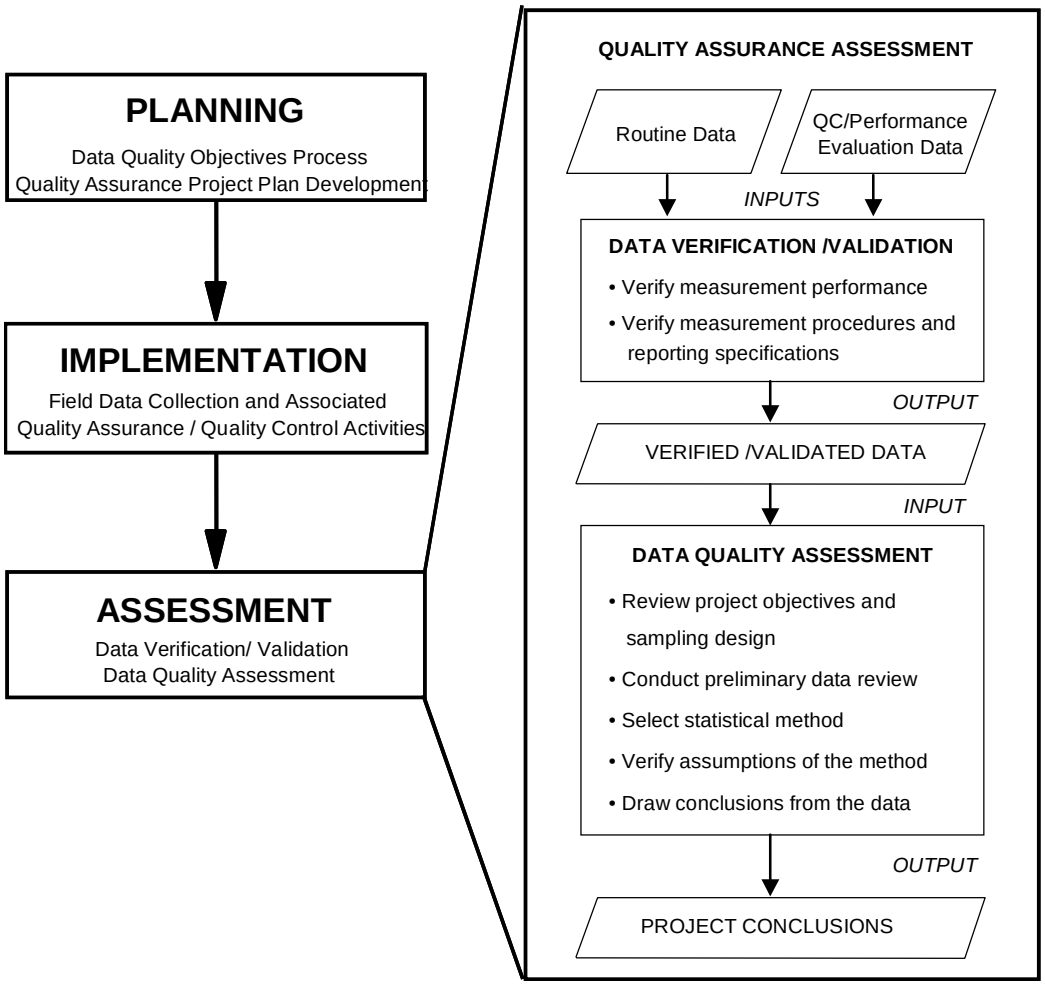
William Gaherty, M.S., P.Eng
President
Pottinger Gaherty Environmental Consultants Ltd.
604.682.3707
wgaherty@pggroup.com

AUGUST 10, 2017
Date

Appendix B

Enhanced Systematic Planning

Appendix B – Enhanced Systematic Planning



Elements of Enhanced Systematic Planning:

Identification and involvement of the project manager, sponsoring organization and project personnel, stakeholders, and experts. This element ensures that the study will be designed to address the needs of all vested parties (for example, data users, data generators, data analysts, and other stakeholders). Consulting cross-disciplinary experts familiar with the different technical aspects of the problem ensures that important details of the study are not overlooked or ignored and technical challenges will be addressed appropriately. It is also important to assign responsibilities for the project so that conflicts can be resolved and progress is tracked. For some projects, it may be most effective to create a formal "planning team," while for others, one individual may be responsible for the project and involve other individuals when necessary.

Description of the project goals, objectives, and questions and issues to be addressed. This element ensures that the participants formulate a clear statement of the project's goals and objectives and therefore understand the purpose of the project and expected results. The objectives reflect a general statement of the intent of a project and how that project is linked to addressing the issue of concern (or contributing to understanding the issue of concern). The project's questions will define what data or information is needed to address the project's goals and objectives. The transition from the project goals, to statement of objectives, to specific and appropriate questions are some of the most important steps in systematic planning.
Identification of project schedule, resources (including budget), milestones, and any applicable requirements (e.g. regulatory requirements, contractual requirements). Identifying the available resources and deadlines at the beginning of a project helps ensure the project is feasible and timely. A clear statement of the project's resources, constraints, and deadlines helps prevent potential issues and/or conflicts by determining practical bounds on the project as early as possible. Regulatory, statutory, contractual and other constraints should be considered that might affect the project schedule.
Identification of the type of data needed and how the data will be used to support the project's objectives. This element focuses on identifying the specific type of data or information needed to complete the project. Types of, sources for, and how to obtain information needed to address the study questions should be listed. Sources may include literature, existing databases, and/or new data collection. By developing a list of the information needed to address the project questions, the project requirements will be clearly defined. In addition, the list may identify other information that will be helpful, or that can be economically collected to facilitate the use of the project results for other purposes.
Determination of the quantity of data and specification of performance criteria for measuring quality. This element focuses on establishing criteria to ensure that the information and products generated meet the objectives of the project. These quality specifications are established at both the product level and at the level of components of that product, such as the quality of individual measurements. Examples of product-level criteria include EPA's information quality guidelines components -- objectivity, utility, integrity, and reproducibility. Examples of component-level criteria are quality criteria for individual measurements (for example, criteria for precision, bias, accuracy, representativeness, comparability, completeness, and sensitivity) and criteria for decisions or estimates [for example, a stated desired confidence that results will fall within a specified window such as Type I and Type II error rates (false rejection and acceptance error rates), uncertainty intervals, etc.] After the information, data, or product is generated, these criteria are used to determine if they met the project's objectives.
Description of how and where the data will be obtained (i.e., existing data) and identification of any constraints on data collection. This element focuses on how to amass the data or information needed for a project by collecting data, using existing data, citing information from other resources, etc. When collecting data or information, consider sampling design, data that represents the variable of interest within the sampling unit, questionnaires and survey instruments, sampling technologies, analytical methods, representativeness, etc. When existing data or information (i.e., from models, databases, literature, etc.) is used, consider sources and methods for assembling it. Also consider how the data will be inspected to ensure compatibility with the project's goals and the handling of information/data either through physical custody of samples or the entering of specific information into a database or spreadsheet.

Specification of QA and QC activities to assess the quality performance criteria (e.g., QC samples for data, audits, technical assessments, performance evaluations etc.). It is often necessary to plan ahead for QA and QC activities to ensure that a process, item, or service is of the type and quality needed and expected by the customer. QA and QC activities measure the attributes and performance of a process, item, or service against defined standards to verify that it meets the stated requirements. Example of these activities include assessments/audits of field sampling and laboratory activities, QC samples (blanks, duplicates, etc), project reports, and inspections/testing/maintenance of equipment, supplies and consumables, etc.
Description of how the acquired data will be analyzed (either in the field or the laboratory), evaluated (i.e., QA review, verification, validation), and assessed against its intended use and the quality performance criteria. This element focuses on the reviews of both the information (such as verification and validation) and the project (peer reviews, clearance procedures, etc.). It is important to determine up front how data and information will be summarized, displayed, and communicated; how uncertainty in the information will be determined and accounted for in the final product; and how the information will be used to achieve the project's goals.

Appendix C

Curricula Vitae

Pages 511 through 544 redacted for the following reasons:
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