

PROGRESS REPORT: JUNE 2016

**RECOMMENDATIONS IN THE HUMAN HEALTH
RISK ASSESSMENT OF OIL AND GAS ACTIVITIES IN
NORTHEASTERN BRITISH COLUMBIA**

**HEALTH PROTECTION BRANCH
MINISTRY OF HEALTH**



MESSAGE FROM HONOURABLE TERRY LAKE, MINISTER OF HEALTH

As Minister of Health, it is my pleasure to provide you with the first progress report on the Recommendations in the *Human Health Risk Assessment of Oil and Gas Activities in Northeastern British Columbia*.

The Ministry of Health has been collaborating with many agencies to implement the recommendations set out in the report, including the BC Oil and Gas Commission; Ministry of Environment; Ministry of Forests, Lands and Natural Resource Operations; Ministry of Natural Gas Development; Ministry of Community, Sport and Cultural Development; and Northern Health Authority.

In recent years, the B.C. government has taken significant steps in addressing the issues identified in the recommendations report. For example:

- The BC Oil and Gas Commission, working with the Ministry of Environment, now has two mobile air-monitoring units. These are being used to ensure that air quality in areas where oil and gas activities are taking place is protected.
- The Ministry of Environment has undertaken a number of projects to help characterize groundwater resources in the Northeast, and has expanded groundwater and air quality monitoring networks in the area.
- The Ministry of Forests, Lands and Natural Resource Operations has begun a number of projects to better understand the potential contaminant fate and migration in groundwater and surface water interactions.
- The Ministry of Health has begun conducting preliminary analysis of the relationship between air quality measurements and health outcomes in British Columbia.

Our government is working to implement the recommendations by developing policies and practices that ensure B.C.'s oil and natural gas resources continue to be developed safely and responsibly.

INTRODUCTION

The **Human Health Risk Assessment of Oil and Gas Activities in Northeastern British Columbia** was a three-phase project led by the Ministry of Health to identify, explore and assess concerns about human health risks relating to oil and gas activities in the Northeast. The project began in 2012. All phases of the project have been completed:

- **Phase 1:** Identified concerns raised by the public and stakeholders in the region related to oil and gas development.
- **Phase 2:** Evaluated potential human health concerns related to oil and gas activities.
- **Phase 3:** Reported on findings to the Province, stakeholders and the public.

The overall findings of this detailed human health risk assessment (HHRA) suggest that, while there is some possibility for elevated air concentrations to occur at some locations, there is a low probability that health impacts would occur in association with continuous air emission exposures. The elevated air concentrations were rare or occurred in remote locations, and given the margin of safety built into the HHRA, are not expected to result in negative health effects.

The final reports are available on the Ministry of Health website at:

<http://www2.gov.bc.ca/gov/content/health/keeping-bc-healthy-safe/oil-and-gas-activities>.

At the public release of the Phase 2 findings and recommendations for the Human Health Risk Assessment of Oil and Gas Activities in Northeastern British Columbia, the Minister of Health announced that the ministry would follow up with the ministries and agencies responsible to ensure the study recommendations were followed. The minister also committed to an annual public progress report on the implementation of the recommendations.

This public progress report outlines the steps the Ministry of Health (MOH) and Northern Health Authority (NHA), Ministry of Environment (MOE), Ministry of Forests, Lands and Natural Resource Operations (FLNRO), Ministry of Natural Gas Development (MNGD), BC Oil and Gas Commission (OGC), Ministry of Community, Sport and Cultural Development (CSCD) and their partners are taking to address the HHRA recommendations.

PROGRESS REPORT CARD

RECOMMENDATION		STATUS	TO BE COMPLETED
1	Update emergency planning zones (EPZs). <ul style="list-style-type: none"> • HPZ Consultation 		2017
2	Update land use and setback provisions. <ul style="list-style-type: none"> • Setbacks 		Completed
3	The B.C. Ambient Air Quality Objectives: guide development of regulations. <ul style="list-style-type: none"> • B.C. Ambient Air Quality Objectives • Air Quality Dispersion Modelling Guidance Update 		2016
4	Implement baseline, pre-drilling groundwater-testing requirements for oil and gas activity. <ul style="list-style-type: none"> • Collection of baseline groundwater data • Observation wells • OGC groundwater monitoring and protection program 		Ongoing
5	Refine fracturing fluid disclosure process. <ul style="list-style-type: none"> • Assessment of hydraulic fracturing fluids • Provision of contact information 		2017
6	Use site classification tool and framework to manage legacy and contaminated sites. <ul style="list-style-type: none"> • Legacy Site Identification and Management • Liability Management Rating Program 		Completed
			Ongoing
			Ongoing

RECOMMENDATION	STATUS	TO BE COMPLETED
7	Make databases that manage permits, facility information, and well and flare data more accessible and user friendly.	
	<ul style="list-style-type: none"> • Online Permit Data 	Completed
	<ul style="list-style-type: none"> • Improvements to B.C. Government Data Warehouse • Enhancements to WELLS Database 	
8	Ensure the Province's air monitoring program in the Northeast follows the principles outlined in MOE's Framework for the British Columbia Air Monitoring Network.	
	<ul style="list-style-type: none"> • Northeast Air Quality Monitoring Project (Phase 2) 	2016
	<ul style="list-style-type: none"> • Northeast Air Monitoring Project (Phase 3) 	
9	Revise the air quality predictions and human health risks estimates from the detailed HHRA when additional data for the Northeast are available.	
10	Expand aquifer mapping (and vulnerability mapping) to enhance groundwater protection with respect to oil and gas development.	
	<ul style="list-style-type: none"> • Airborne electromagnetic data collection 	2016
	<ul style="list-style-type: none"> • Overburden depth to bedrock mapping 	
	<ul style="list-style-type: none"> • Private well water chemistry sampling 	
	<ul style="list-style-type: none"> • Core drilling of aquifers 	
	<ul style="list-style-type: none"> • Develop groundwater vulnerability model of northeast B.C. 	
11	Complete additional study of groundwater and surface water interactions in shallow aquifers and local groundwater flow conditions.	
	<ul style="list-style-type: none"> • Private Well Sampling Program 	2016
	<ul style="list-style-type: none"> • Site C Aquifer Characterization 	

RECOMMENDATION	STATUS	TO BE COMPLETED	
12	<p>Consider overall goals of the environmental monitoring programs for soil, water and biota, along with the presentation and quality of data.</p> <ul style="list-style-type: none"> • Northeast Water Strategy: Enhance information to support decision making • Northeast Water Strategy: Improved Surface Water Quantity Monitoring • Northeast Water Strategy: Improved Surface Water Quality Monitoring 		Ongoing
	<ul style="list-style-type: none"> • Northeast Water Strategy: Groundwater Knowledge Project • Northeast Water Strategy: Disturbance Sensitivity Approach to Identifying Enhanced Water Monitoring Priorities in northeast B.C. • Collaboration between responsible ministries • Northeast B.C. Permafrost Project • Murray River Cumulative Effects Monitoring Framework 		Ongoing
			Completed
			Ongoing
			2018
			2016
13	<p>Tailor health surveillance system to determine if there are differences in disease rates in areas identified in the HHRA.</p> <ul style="list-style-type: none"> • Preliminary Analyses on Air Quality and Respiratory Disease in northeastern B.C. 		Ongoing
14	<p>Review and update the B.C. Ambient Air Quality Objectives based on the existing provincial framework for developing air quality objectives.</p> <ul style="list-style-type: none"> • Review of Interim Ambient Air Quality Objectives 		2017

 In progress¹
 Ongoing²
 Completed

1. In progress: projects “in progress” have defined completion dates.

2. Ongoing: projects that are “ongoing” are activities conducted regularly to meet government business requirements.

RECOMMENDATION 1

The tools applied to the calculation of emergency planning zones (EPZs) representing the range of hazards associated with oil and gas infrastructure and activities should be updated and use scientifically supportable methods and emergency-based consequence endpoints.

PROGRESS AND NEXT STEPS

HPZ CONSULTATION

The OGC is working with the Canadian Association of Petroleum Producers (CAPP) and the Canadian Energy Pipeline Association (CEPA) to thoroughly address risks associated with potential releases from the oil and gas industry. These agencies are considering the concept of using common modelling tools with consistent calculation methodologies and data formats that may be adopted across provinces and federally.

Indications are this tool would include all environmental releases to encompass an “all hazards” approach indicated by the *Oil and Gas Activities Act’s Emergency Management Regulation* (http://www.bclaws.ca/civix/document/id/loo96/loo96/204_2013).

For air releases, atmospheric dispersion plume modelling is used to mathematically describe the transport of air contaminants from point of release to the surrounding environment. Results from air modelling help provide a cause-effect link between releases and resulting concentration on ambient air. Model outputs are useful for making land use and hazard planning decisions. Draft recommendations on the development of an “all hazards” assessment model are under development.

Target completion date for this work is spring 2017.

RECOMMENDATION 2

Land use and setback provisions applied in B.C. should be updated and use scientifically supportable methods, along with individual and societal risk-based endpoints, consistent with accepted risk norms, guidelines and standards applied in other developed, industrialized countries. Further, it is recommended that these land use and setback provisions be applied equally to both oil-and-gas and land-development activities.

PROGRESS AND NEXT STEPS

SETBACKS

A setback is the minimum distance that must be maintained between an oil and gas activity, such as a drilling or producing well, and a residential dwelling, urban centre or public facility (such as a school).

The purpose of setbacks is to provide a buffer between the public and oil and gas activities in the event of an emergency.

In June 2014, the Province announced the OGC had completed an exclusion-zone policy that prohibits drilling within one kilometre of schools in B.C.

For setbacks to be fair and effective, they must apply to both oil and gas, and other land use activities (such as subdivision for residential purposes). While oil and gas setbacks are regulated by the OGC, other land uses are the responsibility of municipal or regional governments. Local governments are responsible for making decisions they believe are in the best interests of their communities and ensuring their bylaws and processes conform both to principles of good practice and to all legal requirements, including any applicable bylaws and regulations.

RECOMMENDATION 3

The B.C. Ambient Air Quality Objectives should guide the development of regulations, directives and policies pertaining to venting, fugitive emissions, flaring limits, flaring notification and reporting, and flaring performance requirements. This should be done in a transparent manner that demonstrates how the objectives are considered.

PROGRESS AND NEXT STEPS

CONSIDERATION OF B.C. AMBIENT AIR QUALITY OBJECTIVES

All oil and gas activities are regulated to minimize impacts on air quality. The OGC considers the B.C. Ambient Air Quality Objectives when making decisions to authorize oil and gas activities. Air quality objectives are specific pollutants levels that are determined to be necessary to protect human health and/or the environment. They usually include a numeric pollutant concentration, averaging time, rules or guidance on sampling methodology, and how the objectives are to be applied.

The OGC and MOE continue to collaborate to ensure the B.C. Ambient Air Quality Objectives are applied consistently throughout the province.

The BC Oil and Gas Commission *Flaring and Venting Reduction Guideline* includes a section on ambient air quality evaluation for permit holders and operations covered by the Oil and Gas Waste Regulation. This guideline is in the process of being updated. As part of the update, consideration will be made to provide greater clarity for considering B.C. Ambient Air Quality Objectives in relation to flaring and venting.

Target completion date for the update to the OGC *Flaring and Venting Reduction Guideline* is summer 2016.

AIR QUALITY DISPERSION MODELLING GUIDANCE UPDATE

An air quality dispersion model is a series of equations that mathematically describe air quality dispersion and the behaviour of pollutants in the air. It provides a cause-effect link between the emissions into the air and the resulting air pollution concentrations. Computer air quality dispersion models are a cost-effective method to understand the interaction between existing or future sources, meteorology, topography and existing air quality. However, there are dozens of dispersion models available.

The purpose of the *B.C. Air Quality Dispersion Modelling Guideline* is to ensure dispersion modelling done for air quality assessments as part of a regulatory process is appropriate, applied correctly and consistently using accepted scientific techniques, and used to reliably inform air quality decisions. The guideline is periodically updated to reflect changes in modelling practice and progress in science.

MOE is updating the flaring component of the *B.C. Air Quality Dispersion Modelling Guideline* in light of the Interim Ambient Air Quality Objectives for sulphur dioxide (SO_2) and nitrogen dioxide (NO_2), adopted by the Province in September 2014. SO_2 and NO_2 are two of the chemicals of potential concern identified in the HHRA.

Target completion date for this work is fall 2016.

RECOMMENDATION 4

The implementation of baseline, pre-drilling groundwater testing requirements for oil and gas activity in B.C. should be considered. Whenever possible, the process for collecting the information should be transparent and the results publicly available, and reviewed on a regular basis. To facilitate the interpretation of results, it may also be beneficial to encourage the collection and reporting of well information in addition to sample data.

PROGRESS AND NEXT STEPS

NORTHEAST WATER STRATEGY – MONTNEY AQUIFER CHARACTERIZATION PROJECT

The Montney Aquifer Characterization Project is a collaborative inter-agency multi-disciplinary project co-ordinated by FLNRO to characterize aquifers and groundwater chemistry in the Groundbirch/Dawson Creek area. The project began in 2011 and has three major components:

1. Geophysical investigation and core drilling of the Groundbirch paleovalley (ancient valley).
2. Drilling and testing of new groundwater observation wells (seven new observation wells).
3. Private water wells survey, including water chemistry sampling and analysis, groundwater level measurement and GPS location of water wells.

This project is part of ongoing initiatives in northeastern B.C. that will contribute to the implementation of the Northeast Water Strategy. The strategy is a proactive, long-term approach for the sustainable use and management of water resources in northeast B.C.

Project partners include the provincial government, OGC, Simon Fraser University and Peace River Regional District. MOH has contributed to the funding for the characterization of baseline drinking water quality. FLNRO is collecting additional baseline groundwater information through a program to sample domestic water wells.

This work is ongoing.

NORTHEAST WATER STRATEGY – MONTNEY AQUIFER CHARACTERIZATION PROJECT: OBSERVATION WELLS

As part of the Montney Aquifer Characterization project, MOE installed seven observation wells near Dawson Creek in 2011/12. These wells are tested for groundwater chemistry on an annual basis. Dissolved methane, oil and grease, and volatile organic compounds (VOCs) are tested in addition to the standard provincial observation well water chemistry package.

Monitoring work is ongoing.

OGC GROUNDWATER MONITORING AND PROTECTION PROGRAM

The OGC continues to consider an approach for a groundwater monitoring and protection program, and has been exploring requirements in other jurisdictions. The OGC specifies requirements for groundwater sampling on a case-by-case basis to support requirements of the Environmental Protection and Management Regulation.

This work is ongoing.

RECOMMENDATION 5

The Province should consider refining its fracturing fluid disclosure process so that designated authorities and health professionals can gain access to needed information about fluid ingredients, without compromising confidential business information.

PROGRESS AND NEXT STEPS

REVIEW OF FRACTURING FLUID DISCLOSURE PROCESSES – ASSESSMENT OF ADDITIVES

All chemicals within a fracture fluid system are reported to the OGC under section 37 of the Drilling Production Regulation. The generic chemical family name is required for each additive, while the specific Chemical Abstract Service # (CAS#) may be withheld if a valid trade secret claim has been submitted to the Hazardous Material Information Review Committee (a federal branch of Health Canada). Despite

this, all details must be disclosed to a physician or medical professional in an emergency, as required under section 46 (3) of the *Hazardous Material Information Review Act* (HMIRA).

All details must be submitted to the provincial government for administration or enforcement of any law relating to occupational safety and health, as per HMIRA section 46 (2) (e). The Province is committed to the disclosure of hydraulic fracture fluid ingredients. All companies must report their hydraulic fracturing fluid ingredients on FracFocus.ca, the Chemical Disclosure Registry.

The OGC is working with University of British Columbia (UBC) Okanagan and CAPP to put in place an assessment method to determine the toxicity of additives to hydraulic fracturing fluids. The OGC is drafting a proposal for funding this work.

Target completion date for Phase 1 of this work is spring 2017.

REVIEW OF FRACTURING FLUID DISCLOSURE PROCESSES – PROVISION OF CONTACT INFORMATION

In November 2014, all fracture fluid service companies agreed to provide the OGC with their contact details through an updated online tracking database. Collecting the direct contact information of all hydraulic fracturing service companies operating in B.C. is improving health professionals' access to information in the event of an emergency.

This work was completed in fall 2015.

RECOMMENDATION 6

When possible, the site classification tool and the existing framework for managing contaminated sites should be used together in the assessment and management of legacy sites in northeastern B.C.

PROGRESS AND NEXT STEPS

LEGACY SITE IDENTIFICATION AND MANAGEMENT

The provincial regulatory framework provides the tools necessary for managing contaminated sites.

Legacy sites are well sites that were decommissioned and remediated before the establishment of the Crown Land Restoration Branch in 2004. The OGC addresses legacy sites identified to have residual contamination that may pose a risk to human health or the environment, using the site classification tool and the existing framework for managing contaminated sites. A working group of subject-matter experts from the OGC and MOE will be established to review how these tools are currently applied and identify opportunities for improvement.

One contaminated legacy site was identified in 2014. The OGC issued an order on November 5, 2014 requiring the operator to investigate and remediate the site. The operator investigated and remediated as requested. No other legacy sites were identified or reported in this period.

The OGC continues to work with MOE to ensure sites are appropriately classified and are under the oversight of the appropriate regulator.

Legacy site identification, management and monitoring are ongoing.

LIABILITY MANAGEMENT RATING PROGRAM

The OGC's Liability Management Rating (LMR) program is used as a tool, within the provincial regulatory framework under the OGC and MOE. The objective of the OGC's LMR program is to manage public liability exposure related to oil and gas activities by ensuring permit holders carry the financial risks and regulatory responsibility of their operations through to their closure. The LMR was developed by the OGC to assist in the determination of security deposits for permit holders under Section 30 of the *Oil and Gas Activities Act*.

This work is ongoing.

RECOMMENDATION 7

The overall objectives and efficient use of the various databases that manage permits, facility information, and well and flare data should be reviewed, with the aim of identifying means to make the systems more accessible and user friendly.

PROGRESS AND NEXT STEPS

ONLINE PERMIT, AND OIL AND GAS WASTE REGULATION DATA

The *Environmental Management Act* (EMA) authorizes the introduction of waste into the environment. Site specific EMA Permits for large oil and gas facilities are issued either by the OGC or MOE. The Oil and Gas Waste Regulation (OGWR) places requirements on facilities that do not meet thresholds for site specific permits under EMA. Exemption requirements are also specified in this regulation for small facilities.

In July 2011, the Province committed to the release of open datasets. Premier Clark noted: "We are changing our approach to governing by putting citizens at the centre of our web services and making government data and information more freely available". In response, MOE developed and launched a project to develop a website tool to allow user access to EMA permit and registration data.

All permits issued under EMA and registrations for facilities covered under code of practice or regulation can be accessed at: <https://j200.gov.bc.ca/pub/ams/default.aspx?possepresentation=documentsearch>.

To obtain EMA permits the OGC administers, select the following information:

- Authorization Type > Permit
- Waste Type > Air
- Region > Oil and Gas Commission

Before a search can be completed, a date range of a year or less is required.

Oil and gas permits administered by MOE are also available by selecting the appropriate region in the search criteria.

B.C.'s OGWR, administered by the OGC, places conditions on oil and gas operations that are smaller in size relative to facilities permitted under EMA. These registrations are also available online at:

<https://j200.gov.bc.ca/pub/ams/default.aspx?possepresentation=documentsearch>.

To access air registrations, enter the following after opening the EMA Permit Site:

- Authorization site > Oil & Gas Waste Regulation (Facility Registration)
- Waste Type > Air
- Region > Oil and Gas Commission

MOE does not issue registrations under the OGWR.

The OGC Air Summary report provides information on air quality and related initiatives for oil and gas activities regulated by the OGC in the 2014 calendar year. The public can access the information from the 2014 Air Summary at: <https://www.bcogc.ca/node/12928/download>.

This work has been completed.

ONGOING IMPROVEMENTS TO B.C. GOVERNMENT DATA WAREHOUSE

The OGC is in the process of making data more accessible to stakeholders and the public. It is anticipated specific initiatives around data sharing and accessibility will be launched in the coming year. The OGC has been improving the usability of its databases in recent years. Examples of completed improvements include:

- Making publicly available more than 60 new oil- and gas-related data sets through the B.C. Government Data Warehouse / GeoBC, and the public-land database.
- Initiation and expansion of FracFocus.ca, tracking the use of hydraulic fracturing fluids.
- Business Transition Strategy, making decision making more efficient and transparent.
- Area-based analysis tool, managing the impact of oil and gas activities within acceptable levels in the broader context of all development.
- The OGC Incident Map, showing pipeline incidents from 2000 to the present.
- Major Projects Centre, tracking proposals that require a high degree of internal and external co-ordination.
- Water information tools, including the Water Portal, NorthEast Water Tool (NEWT) and NorthWest Water Tool (NWWT).

Improvements to the B.C. Government Data Warehouse include an updated data model with more comprehensive and intuitive representation of all oil and gas permit data. The new model is a result of streamlined business processes as part of the Commission's Business Transition Strategy. New systems will ensure data are validated, and as a result, will be more accurate before entering OGC systems.

The new data model will be available through the following sites:

- B.C. Government Warehouse:
https://catalogue.data.gov.bc.ca/dataset?download_audience=Public
- OGC website: <http://www.bcofc.ca/online-services/geospatial-services>
- Public-land database: <http://geobc.gov.bc.ca/rrr/ilrr/>

The OGC is continuing its efforts to make data and information available to the public.

Target completion date for the new data model, and improved representation of oil and gas permit data, is summer 2016.

IMPROVEMENT OF THE WELLS DATABASE

WELLS is the provincial database of water well data – including well location, depth, diameter, lithology and productivity. This initiative involves ongoing improvements to WELLS to make data more accessible. For example, MOE is updating the WELLS database to include standardized well lithology, GPS location data and hyperlinks to scanned well logs.

WELLS reports can be accessed at: <https://a100.gov.bc.ca/pub/wells/public/indexreports.jsp>.

Information on classified aquifers is on the Aquifer Classification Database at:

https://a100.gov.bc.ca/pub/wells/public/common/aquifer_report.jsp.

Enhancements to WELLS are ongoing.

RECOMMENDATION 8

The Province's ongoing air monitoring program in northeast B.C. should continue to follow the principles outlined in MOE's *Framework for the British Columbia Air Monitoring Network*. Consideration should be given to the air quality contour maps provided in the detailed HHRA in the placement of future air quality monitors. As well, the identification of specific air contaminants for inclusion in the air monitoring program should consider the findings of the detailed HHRA.

PROGRESS AND NEXT STEPS

NORTHEAST AIR QUALITY MONITORING PROJECT

The Northeast Air Quality Monitoring project is a multi-phase project to:

- Monitor, report and assess air quality in northeast B.C.

- Reach out to the local community in this process.
- Establish a long-term air monitoring network with a sustainable funding mechanism.

The project is led by MOE and includes partners from CAPP, MOH, MNGD, OGC and Spectra Energy.

In Phase 1 of the project, MOE installed three portable air monitoring stations in small communities near oil and gas development in northeastern B.C. These stations were deployed for approximately two years at Farmington, Tomslake and Doig River. They measured compounds released through oil and gas activity – such as hydrogen sulfide (H_2S) and total reduced sulfur (TRS). Only low levels of these compounds were observed during the measurement period.

In Phase 2, after a scientific review using a process consistent with the *Framework for the British Columbia Air Monitoring Network* and drawing on the HHRA contour maps, the Northeast Air Monitoring Technical Advisory Group (TAG) provided advice to the Northeast Air Monitoring Project Steering Committee on priority locations for the three moveable monitoring stations and pollutants that should be monitored at each site.

TAG's recommendations were accepted. Three monitoring stations are being redeployed to new communities in winter and spring 2016 with an expanded set of pollutants being monitored as follows:

Taylor

- Existing: sulphur dioxide (SO_2), total reduced sulphur (TRS).
- Added: nitrogen oxides (NOx), ozone (O_3), fine particulates ($PM_{2.5}$), volatile organic compounds /non-methane hydrocarbons (VOCs – methane (CH_4)/NMHCs).
- Blueberry #205 – Indian Reserve or Buick Creek.
- Existing: sulphur dioxide (SO_2), total reduced sulphur (TRS).
- Added: nitrogen oxides (NOx), ozone (O_3), volatile organic compounds (VOCs) (optional).

Rolla

- Existing: sulphur dioxide (SO_2), total reduced sulphur (TRS).
- Add: nitrogen oxides (NOx), ozone (O_3), volatile organic compounds (VOCs) (optional).

A core air monitoring station, measuring NOx, O_3 , $PM_{2.5}$ and SO_2 , was established in Fort St. John in 2015 to provide a regional picture of air quality for the national Air Quality Management System (AQMS), and to support Air Quality Health Index (AQHI) reporting in that community. All air quality data generated by the three portable stations and the core air monitoring station are available in near real-time at:

<http://www.bcairquality.ca/readings/northeast.html>.

OGC operates two mobile air monitors for compliance and emergency monitoring: Commission Air Monitoring Environmental Laboratory (CAMEL) trailer unit and the new Roaming Air Monitor (RAM) van unit (for rapid deployment). More information can be found on the OGC website at:
<http://www.bcogc.ca/public-zone/air-quality>. Project partners are presently evaluating long-term governance options for ambient air quality monitoring in northeast B.C.

The target completion date for Phase 2 is June 2016. Phase 3 will use information gathered in previous phases to refine and improve the monitoring project.

RECOMMENDATION 9

Once additional data for the northeastern B.C. region are available from new monitoring stations or are made available from regulatory submissions, the air quality predictions and human health risk estimates from the detailed HHRA should be revisited.

PROGRESS AND NEXT STEPS

NORTHEAST AIR QUALITY MONITORING PROJECT

Phase 3 of this project is the implementation of a sustainable air quality monitoring network in the Northeast. The data collected by this network will determine the need for a future re-evaluation of the HHRA risk estimates by MOE and MOH.

Phase 3 of the Northeast Air Quality Monitoring Project (implementation) is anticipated to launch in July 2016. Air quality predictions and human health risks may be updated in 2017 as indicated by monitoring results.

This work is ongoing.

RECOMMENDATION 10

While some aquifer mapping has been completed in northeastern B.C., it is recommended that the existing aquifer mapping (and vulnerability mapping) be expanded for the region to help enhance protection of groundwater resources in relation to oil and gas development. This information would aid in regional and site-specific assessments of potential risks to groundwater. One of the limitations with the current aquifer mapping relates to an overall absence of subsurface data; it is suggested that surficial geology mapping (on an appropriate scale) for the region be completed as well.

PROGRESS AND NEXT STEPS

AIRBORNE ELECTROMAGNETIC (EM) SURVEY

The Geoscience BC Airborne EM project is a collaborative effort that will generate new information about the distribution of shallow aquifers in the Peace region, and their groundwater quantity and quality.

Airborne EM project partners include the provincial government (FLNRO, MOE, MOH, and MNGD), OGC and Geoscience BC. Partner support to Geoscience BC comes from CAPP through the OGC Research and Innovation Society (formerly the Science and Community Environmental Knowledge fund), ConocoPhillips Canada; Progress Energy Canada Ltd. and the Northern Development Initiative Trust.

The project includes two main components: collecting airborne electromagnetic data and mapping the overburden depth to bedrock.

Airborne Electromagnetic Data Collection

Airborne electromagnetic geophysics data has been collected for the Montney North Region. The electromagnetic images help identify buried sand and gravel layers that host groundwater aquifers.

Data collection and data interpretation have been completed. The report can be found at:

<http://www.geosciencebc.com/s/DataReleases.asp>. The next step is data analysis in select areas.

The target completion date for data analysis is December 2016.

Overburden Depth to Bedrock Mapping

This Geoscience BC project involves experimental use of gamma ray logging on wells to determine the depth of overburden (soil, gravel or rock) to bedrock. A gamma log is a geophysical tool used in petroleum exploration to measure naturally occurring gamma radiation to characterize the rock or sediment in a borehole or drill hole.

For this project, past depth-to-bedrock measurements were re-examined and re-interpreted to help determine over burden depth to bedrock. 3-D seismic data was used to calibrate the electromagnetic data to the seismic data, producing a better estimate of bedrock depth.

This work has been completed, along with a project report and map. It can be found online at:

<http://www.geosciencebc.com/s/DataReleases.asp>.

MONTNEY AQUIFER CHARACTERIZATION PROJECT

Private Well Sampling

Individual wells have been sampled as part of this project and analyses have been completed. Data has been compiled on well location, water depth and chemistry including some isotope data for private domestic wells in the Peace River area.

Water well sampling, analyses and reporting are ongoing.

Core Drilling of Paleovalley Aquifers

In addition to the sampling of private wells, this project includes core drilling of ancient valley or paleovalley aquifers. Buried valley systems can exist where the valleys have been filled with sediment and have no surface expression. These systems sometimes host large aquifers of fresh water. This component was undertaken to provide information on the geology of these aquifers. Remote sensing and geophysical data are used to detect paleovalley aquifers and ground truth data (such as core drilling) improves detection of these aquifers.

Five wells were drilled in the Dawson Creek area and the physical characteristics of the lithology (surrounding rock formations) were mapped, providing a better understanding of the area's geology.

This work has been completed.

Developing Groundwater Vulnerability Model of Northeastern British Columbia

The DRASTIC method is used to determine how vulnerable groundwater systems are to surface water contamination. It is a method of assessing groundwater vulnerability in an area and considers: D – Depth to Water; R – Net Recharge; A – Aquifer Media; S – Soil Media; T – Topography; I – Impact of Vadose Zone Media; and C – Hydraulic Conductivity of Aquifer. Each of these parameters is mapped individually and rated from 1 to 10 (lowest to highest vulnerability) and they are combined using a geographical information system (GIS), to create the final vulnerability map.

These maps are a regional screening tool that can be used as part of: groundwater quality risk assessment; managing groundwater protection areas; guiding development and land use planning; and prioritizing areas for contaminated sites cleanup and groundwater monitoring.

DRASTIC mapping has been completed through a Simon Fraser University Project. The final report is available at: https://www.sfu.ca/personal/dallen/NEBC%20DRASTIC%20Report_Final.pdf.

In addition to the above initiatives, the Peace River Regional District (PRRD) has commissioned a Groundwater Baseline Project. The purpose of the project is to establish a comprehensive understanding of regional groundwater resources and share that information with PRRD residents.

PRRD is using the WELLS database and aquifer chemistry data to help visualize and characterize groundwater. MOE, FLNRO and OGC peer reviewed information presented on behalf of PRRD to the public in a series of information sessions. Final results are expected to be presented to the public in fall 2016.

RECOMMENDATION 11

Additional study of groundwater and surface water interactions within shallow aquifers and local groundwater flow conditions in the northeastern B.C. region should be completed. This information could contribute to a better understanding of potential contaminant fate and migration. As well, studies could be carried out to investigate the location and sources of groundwater recharges.

PROGRESS AND NEXT STEPS

MONTNEY AQUIFER CHARACTERIZATION PROJECT

As part of the Montney Aquifer Characterization Project, the Private Well Sampling Program is a multi-partner effort to characterize aquifers and groundwater chemistry in the Groundbirch/Dawson Creek area. Private water wells have been sampled and well water sampling analyses have been completed. In addition to the water sample analysis, groundwater level and well head elevation have been measured for each individual well.

Water well sampling, analyses and reporting are ongoing. The target date for completion of the final report is fall 2016.

SITE C AQUIFER CHARACTERIZATION

Scientific studies in advance of the development of the Site C dam have evaluated the potential impact of water level rise on two aquifers in the area. The reports were sponsored by BC Hydro and completed by independent consultants. **This work is complete and available at:**

https://www.ceaa-acee.gc.ca/050/documents_staticpost/63919/85328/Vol2_Appendix_F.pdf.

RECOMMENDATION 12

Consideration should be given to the overall goals of the existing environmental monitoring programs for soil, water and biota, along with the presentation and quality of these data within the existing databases, specifically as these relate to the value that these data could provide with respect to human and environmental health.

PROGRESS AND NEXT STEPS

NORTHEAST WATER STRATEGY – ENHANCE INFORMATION TO SUPPORT DECISION MAKING

This strategy addresses the presentation and quality of data as they relate to the value they could provide with respect to protecting human and environmental health.

In March 2015, the Northeast Water Strategy document was released to the general public. The multi-partner Water Working Group was struck to identify priorities and develop an implementation plan. An inter-agency steering committee is also under development. It will help the provincial government (FLNRO, MOE, MOH and MNGD) function with greater unity on water-related issues and provide a unified voice in the Water Working Group.

This work is ongoing.

NORTHEAST WATER STRATEGY – IMPROVED SURFACE WATER QUANTITY MONITORING

A multi-partner group has been created to support surface-water-quantity monitoring initiatives across the Northeast. Partners include the OGC, Geoscience BC, City of Dawson Creek and Progress Energy. Long-term support of the Geoscience BC/Horn River Producers Group, Horn River Basin hydrometric stations is under discussion. The hydrometric stations were created to Provincial Hydrometric Standards for a Geoscience BC project.

This work has just started and is ongoing.

NORTHEAST WATER STRATEGY – IMPROVED SURFACE WATER QUALITY MONITORING

A multi-partner group has been formed to establish a monitoring program for northeastern B.C. watersheds to characterize and identify trends in water quality. The intent of this initiative is to

characterize the known ambient water quality in basins in the Northeast, and identify partners to help implement the monitoring program and ensure its long-term success.

This work has just started and is ongoing.

NORTHEAST WATER STRATEGY – GROUNDWATER KNOWLEDGE PROJECT

A multi-partner group has been formed to guide development of sufficient and appropriate groundwater knowledge for the sustainable management of groundwater resources in northeastern B.C. Objectives include improved groundwater knowledge collection and dissemination, regional hydrogeological research, and enhanced aquifer characterization and monitoring. Partners initially include the OGC, Geoscience BC, Peace River Regional District, Canadian Association of Petroleum Producers and Simon Fraser University, with hopes of broadening the participating community.

This work has just started and is ongoing.

NORTHEAST WATER STRATEGY – DISTURBANCE SENSITIVITY APPROACH TO IDENTIFYING ENHANCED WATER MONITORING PRIORITIES IN NORTHEAST B.C.

This tool is intended to guide the establishment of water monitoring priorities for surface water and groundwater under the Northeast Water Strategy. The approach has been developed by FLNRO in collaboration with First Nations, communities and industry.

The model considers stressors on the landscape and areas of concern that may not be well addressed at present. Factors were combined and weighted using a geographic information system to find areas with the greatest requirement for monitoring water quality and quantity. A risk-based model was developed to identify where monitoring resources should be placed. It is available to B.C. government staff.

A project metadata report was also completed. Metadata explain which data were used in generating the model, and supports model reproducibility and transparency. By providing the means for examination and reproduction, the model can be validated and improved.

This work has been completed.

The next step in this project is to produce a methods report and a website. The methods report (planned to be a scientific peer-reviewed article) will provide the rationale for the project, data choices and discuss the utility of the model. The website will be made available to the public in 2016. It will allow decision makers and work groups under the Northeast Water Strategy to focus on watersheds or groundwater areas that need more monitoring, and help members prioritize areas.

COLLABORATION AMONG RESPONSIBLE MINISTRIES

B.C.'s natural resource sector will continue to improve access to existing and historical monitoring data, and provide opportunities for expanding the existing data.

The OGC's use of area-based analysis (ABA) in decision making helps to manage the impact of oil and gas activities within acceptable levels. ABA provides area-specific maps of all industrial activity and sets triggers to protect identified values, including environmental, to reduce the overall impact.

OGC staff recently attended inter-ministry technical and implementation meetings pertaining to new groundwater regulation and licensing requirements under the *Water Sustainability Act* (WSA). The OGC will participate in future inter-ministry, groundwater technical discussion meetings.

Collaboration among ministries is ongoing.

NORTHEAST B.C. PERMAFROST PROJECT

This is a three-year project led by the Consortium for Permafrost Ecosystems in Transition, a university-industry-government research consortium on permafrost in peat land. Information from the study will be used to estimate future quantities of runoff from surface water storage within boreal and subarctic landscapes with discontinuous permafrost under possible scenarios of climate warming and human disturbance.

The first six months of the project have been completed. FLNRO has assisted with mapping the changing spatial distribution of permafrost, wetland and forest coverage over the past 60 years using aerial photography, satellite images and LiDAR. FLNRO is also providing a support role for annual meetings and information exchange.

The target completion date for this work is March 2018.

MURRAY RIVER WATER QUALITY CUMULATIVE EFFECTS MONITORING FRAMEWORK

This framework will assess and better understand the aquatic ecosystem of the Murray River watershed and cumulative effects of development. It will also inform the management actions needed to improve the watershed's sustainability to guide cumulative effects monitoring. Cumulative effects are changes to the environment caused by action in combination with other past, present and future human actions.

The Murray River Water Quality Cumulative Effects Monitoring Framework is a multi-partner initiative that includes industry, municipal, regional and provincial government and First Nations. This project is a model being designed and tested with the intent to apply to other high priority watersheds dealing with water quality issues in the Northeast.

A key step towards completion of a cumulative effects assessment is the compilation and interpretation of existing water quality data as well as observations of aquatic life such as distribution, abundance, composition and habitat suitability. The group is currently working on collating and interpreting the available water quality data for the Murray River to identify data gaps, develop water quality objectives under the new *Water Sustainability Act* and ensure a robust water quality monitoring program is established for evaluating cumulative effects in the future.

Installation of a federal-provincial trend water quality monitoring station in the lower Murray River will be completed by June 2016.

RECOMMENDATION 13

The Province should explore tailoring its health surveillance to determine whether or not there are any differences in disease rates in those areas identified in the HHRA with the highest predicted air concentrations. If possible, such future health surveillance would help verify the conclusions of the HHRA.

PROGRESS AND NEXT STEPS

PRELIMINARY ANALYSES ON AIR QUALITY AND RESPIRATORY DISEASE IN NORTHEAST B.C.

Health surveillance is the ongoing collection, analysis and interpretation of health-related data. It can track estimates of disease (e.g., asthma) in a population and other information related to the risk of disease, or other outcomes that may indicate disease is present in a population. Such information includes risk factors (e.g., smoking rates), use of health services (e.g., hospitalizations), and interventions to manage disease when it occurs or worsens (e.g., the number of prescriptions for asthma medication).

MOH and NHA, with support from the Public Health Agency of Canada (PHAC), have been conducting preliminary analyses of the relationship between air quality measurements and select health outcomes in the Northeast. A review was undertaken of administrative health data sets to examine the degree of variability and utility of the data.

These analyses revealed a number of challenges in undertaking health surveillance using existing data sets and tools, including:

- Difficulty linking health data to environmental data (e.g., air quality readings). This occurs when community populations are small and catchment areas for analyses are larger than areas where air pollutant concentrations are predicted to be the highest. In addition, the health effects recorded in small populations may be over- or under-represented, making estimates of their occurrence unstable.
- Difficulty associating respiratory health outcomes with specific industrial exposures. Reasons for this include:
 - Multiple types and sources of air pollutants occurring together.
 - Small areas in which exposures are most likely to occur, as well as transient exposures.
 - A long latency period for disease development, particularly chronic diseases and cancer.
 - Multiple determinants of health. The physical environment is only one factor associated with disease. Other factors include health behaviours (e.g., smoking), access to medical care, socioeconomic status and marginalization.
 - Geographic scale. Analyses of Medical Services Plan data were carried out based on postal codes. In northeastern B.C., one postal code can cover over 100 kilometres and include people who do not live in areas of concern for air quality. As a result, meaningful information, with respect to air pollutant exposure, may be difficult to identify.

MOH is working with MOE and NHA, with support from PHAC, to explore ways of developing a better surveillance system by:

- Developing methods of linking air quality and health data at the local health area level.
- Exploring the establishment of a spatially based, consistent methodology that could be used across the province.
- Incorporating other determinants of health (e.g., smoking status) in the analyses, to find out what contribution air quality alone makes to poor health.

Work on this project is ongoing. Control for other health determinants during analysis will be required to provide a better understanding of the patterns emerging from the preliminary analysis of the health data.

RECOMMENDATION 14

The B.C. ambient air quality objectives should be reviewed and updated based on the existing provincial framework for developing air quality objectives.

PROGRESS AND NEXT STEPS

REVIEW OF INTERIM AMBIENT AIR QUALITY OBJECTIVES

The Interim Ambient Air Quality Objectives for SO₂ and NO₂ adopted by the province in 2014 will be reviewed when the new Canadian Ambient Air Quality Standards (CAAQS) for SO₂ and NO₂ are adopted.

The target completion date is spring or summer 2017, depending on pace of the CAAQS process.