Oil and Gas Land Use in Northeast British Columbia

2014 | BC Oil and Gas Commission





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About the BC Oil and Gas Commission

he BC Oil and Gas Commission (Commission) is the single window regulatory agency with responsibilities for regulating oil and gas activities in British Columbia, including exploration, development, pipeline transportation and reclamation.

The Commission's core services include reviewing and assessing applications for industry activity, consulting with First Nations, cooperating with partner agencies, and ensuring industry complies with provincial legislation and all regulatory requirements. The public interest is protected by ensuring public safety, respecting those affected by oil and gas activities, conserving the environment and ensuring equitable participation in production.

For general information about the Commission, please visit www.bcogc.ca or phone 250-794-5200.



Mission

We regulate oil and gas activities for the benefit of British Columbians.

We achieve this by:

- Protecting public safety,
- Respecting those affected by oil and gas activities,
- Conserving the environment, and
- Supporting resource development.

Through the active engagement of our stakeholders and partners, we provide fair and timely decisions within our regulatory framework.

We support opportunities for employee growth, recognize individual and group contributions, demonstrate accountability at all levels, and instill pride and confidence in our organization.

We serve with a passion for excellence.

Vision

To provide oil and gas regulatory excellence for British Columbia's changing energy future.

Values Respectful Accountable Effective Efficient Responsive Transparent

Purpose of Report Oil and Gas Land Use

This is the second report produced by the Commission to provide government, industry, First Nations and stakeholders with an understanding of the surface area used by oil and gas activities in Northeast British Columbia. The report also detaills the methodology used to calculate the areas by activity.

The Commission identified a need for a standardized methodology for the measurement of surface disturbances caused by oil and gas activity, and produced the Oil and Gas Land Use in Northeast British Columbia report in Aug. 2013. Similarly to the 2013 report, this report focuses on two aspects of oil and gas activity in northeast B.C:

- The type of surface activity.
- The surface area used by each activity.

This report provides an overview of surface land use by wellsites, pipelines, roads, geophysical exploration programs, facilities and associated oil and gas activities up to Dec. 31, 2014 - marking an additional 23 months of activity since the previous report. It explains the methodology used to collect data, identifies data sources, reviews changes in assumptions and limitations, and demonstrates how the Commission is working to improve future statistical reporting.

Area-based Analysis (ABA) was implemented at the Commission during this period and used methodologies similar to those in the 2013 report. In turm, the changes outlined in this report will be incorporated into new releases of ABA.

Information concerning ABA is available on the Commission website.



What Does the Commission Regulate?

The Commission's core services and related processes are legislated by the Oil and Gas Activities Act (OGAA). OGAA provides statutory authority to the Commission to permit oil and gas activities. Under OGAA, the Commissioner is the statutory decision maker and has authority to make or delegate decisions enabled by specified enactments.

OGAA enables regulation of surface land use primarily through the Environmental Protection and Management Regulation (EPMR). The EPMR regulates actions a permit holder and a person carrying out an oil and gas activity must take, or refrain from taking, to protect and/or effectively manage the environment. The regulation also outlines procedures for site restoration and reclamation by permit holders when the site is no longer required for oil and gas activities. Authority for certain activities related to other provincial acts has been given to the Commission through specified enactments (see Appendix I for a list of the OGAA specified enactments and provisions).

These enactments also establish compliance and enforcement oversight. Memoranda of Understanding (MOUs) and other agreements also provide the Commission with regulatory guidance. As a result, the Commission acts as a single-window agency with responsibility for regulating nearly all aspects of oil and gas activities.

What Is Not Regulated By The Commission?

Certain activities associated with oil and gas development are not regulated by the Commission as other agencies are involved in their regulation in British Columbia.

These include:

- The Ministry of Energy and Mines for associated activities falling under the Mines Act (such as large quarries).
- The National Energy Board (NEB) for the regulation of interprovincial pipelines and cross border permits.
- The Ministry of Environment for wildlife, waste management and long term water licences not used by the oil and gas sector.
- Environmental Assessment Office for environmental certificates for 'reviewable projects' related to oil and gas.

For the purposes of this report the Commission has calculated results based on the use of land to support oil and gas activities, regardless of the responsible regulatory agency. Data has been supplied by other regulatory agencies, however the Commission does not manage this data. The calculations will reflect any potential error in this data, but this represents a very small proportion of total activities.

Why Measure Oil and Gas Activity?

he continuing shift from conventional to unconventional gas development is creating opportunities to better understand the interplay between surface use and subsurface resource development, and assess the surface area used by oil and gas activities. The Commission and the provincial government are working together to enhance resource stewardship by collaborating with industry, First Nations and other stakeholders to increase land, water, wildlife and forest conservation.

The Commission released Area-based Analysis in Jan. 2015 as an enhanced approach to managing resource stewardship and reducing the impact of oil and gas acitivity. The Commission uses ABA to address the long-term effects of oil and gas activity in its decision making. Various decisions involving roads, water, geophysical exploration, well and facility locations, and pipeline corridors can cause cumulative effects to both environmental and social values. ABA allows the Commission to manage industry activity comprehensively for ecological, social and cultural heritage values. Proposed activities are assessed considering the combined footprint of industrial development on the selected values. For the Commission, that means decisions about oil and gas activities will be made with all industrial development in mind.

The Commission recognized that ABA required a baseline calculation of the surface area used to support oil and gas development and identified a standardized

methodology for the measurement of surface area disturbances. The 2013 report summarized that initiative. Modifications have been made as ABA has been developed, and the strengths and weaknesses of historical information were better understood. This report presents an updated and revised assessment.

The measurements and processes used here serve as a template for future reporting of oil and gas land use. For this report, the Commission chose to concentrate on northeast British Columbia (Figure 1). Several smaller subunits are also summarized: the Fort Nelson Land and Resource Management Plan Area (FNLRMP); the Fort St. John Land and Resource Management Plan area (FSJLRMP); the Dawson Creek Land and Resource Management Plan area (DCLRMP); the Western Canada Sedimentary Basin (WCSB); the Liard Basin; the Horn River Basin; the Cordova Embayment and the Montney Play Trend.

Figure 1

Northeast British Columbia encompasses approximately 17.5 million hectares of Crown land and is represented by the olive shaded area.



What and Where is Oil and Gas Activity?

Oil and gas exploration and development is concentrated in northeast British Columbia, particularly in the Montney and Horn River basins. As the resource potential of these areas continues to grow and industry shifts from land acquisition to gas extraction, expanded infrastructure will be required for development, production, processing and transportation of gas. Directional and horizontal drilling used in unconventional technologies is reducing the effects of new development on plants and wildlife since companies can locate operations where there is less impact. To provide some context, total natural gas production in B.C. in 2013 was 1.5 trillion cubic feet (Tcf), the majority of which was produced in the province's two most active basins – the Montney (46 per cent) and the Horn River Basin (12.7 per cent). Of the 590 wells drilled in B.C. in 2013, 500 (85 per cent) targeted unconventional sources, and 90 (15 per cent) targeted conventional. Of the 500 wells targetting unconventional sources - 447 were drilled in the Montney, 41 in the Horn River Basin, six in the Cordova Embayment, four in the Liard Basin, and two in the Deep Basin Cadomin. For more information on oil and gas activity, see the Commission's Hydrocarbon and By-Product Reserves in British Columbia report.



Patterns of Oil and Gas Development

Vil and gas development in British Columbia is referred to as either conventional or unconventional. Conventional oil and gas exploration refers to the exploration and development of porous and permeable rock formations in the subsurface. These types of reservoirs are typically less than 20 metres in thickness and have well defined and limited areal extent. By comparison, unconventional reservoirs such as fine grained sandstones, siltstones and shales are widespread. They occur over large areas and individual formations can reach thicknesses in excess of 300 metres. During both conventional and unconventional drilling operations, sumps or tanks are used to contain drilling and waste fluids. Pipelines connect all producing gas wells to markets and most oil wells will have pipeline infrastructure in place to transfer the oil to a facility. Wellpads are accessed by a combination of all-season and/or winter access roads, and occasionally by air.

Figure 2: Conventional and Unconventional Development Patterns

Conventional Development

Conventional development targets porous formations where oil and gas will flow to the surface from a large area surrounding the wellbore. Conventional gas plays are called "pools" and are typically limited in extent and have discrete boundaries. When developing conventional oil and gas pools, drilling and production operations typically require wellpads separated by 500 to 1,500 metres (photo top left) with one vertical well per pad. Land use patterns associated with single pool oil and gas development have changed little over the years.



Unconventional Development

Unconventional gas resources cover vast subsurface areas and are often referred to as "shale basins" or simply "basins". Unconventional development in British Columbia primarily focuses on gas held in formations with less porosity that cannot be extracted using conventional drilling and completion methods. These "tight" formations must be fractured to allow the gas to be extracted. The technology used to extract gas by unconventional means is evolving rapidly and surface development patterns are changing with the advancements.

A typical unconventional development model is to space drill pads relatively uniformly across the basin on the premise gas is evenly distributed and equally accessible throughout the targeted area (photo bottom right). Drilling is typically continued horizontally when the target formation is reached, extending 2,500 metres or more from the surface location. Unconventional wellpads can be widely spaced several kilometres apart and one pad can accommodate 16 wells or more. As a result, less total surface area and fewer wellpads are required to access a greater subsurface volume as conventional development.

Oil and Gas Activities

Seismic Lines

Oil and gas companies use geophysical exploration to indicate the location and characteristics of subsurface formations. The surveys send mechanical energy into the ground and record reflected or refracted energy waves. This activity requires linear clearings called seismic lines to allow the use of sounding equipment.

The Commission issues permits for geophysical exploration and regulates the activity. Geophysical exploration programs can be conducted by any qualified contractor without the need to hold a subsurface tenure.

Historically, seismic lines were cleared with a bulldozer (cat-cut) and the wide clearings disturbed mineral soils which were slower to regenerate. Over the past 10-15 years, low impact seismic techniques have been developed. Seismic lines are now often cleared manually or using a mulching machine and meander to avoid important ecological features such as wildlife trees. This results in significantly less surface disturbance (Figures 3 and 4) and a much faster return to a natural state.

Figures 3 and 4: Seismic Line Cleared with a Bulldozer and Cleared with a Mulching Machine



Figure 5: Road



Roads

Roads are constructed and maintained by industry operators to facilitate exploration and production of oil and gas. Special terms and conditions may be applied to any road permit.

Centralized facilities and multi-well pads reduce the number of roads needed and focus truck traffic on trunk roads, since multi-well pads can house equipment for multiple wells at one location. Existing roads such as highways and forestry roads are used where possible and in some areas snow or ice roads may be constructed during the winter. If there is significant projected activity for an area, a winter road may be upgraded, or an all season road built, to allow year round access. The Commission provides approvals for roads directly associated with oil and gas development.

Pipelines

Pipelines are constructed to transport oil and gas products from operations. Flowlines connect most producing wells to larger trunk lines to take the oil or gas to processing facilities or directly to market. The majority of pipelines in British Columbia are buried and are regulated by the Commission.

Figure 6: Example of a Multi -Well Pad



Facilities

Facilities (Figure 7) are defined as systems of vessels, piping, valves and other equipment used to gather, process, measure, store and/or dispose of petroleum, gas, water and waste. Oil and gas are processed at these facilities for transport to market. Oil and gas facilities also include batteries (for storage of crude oil and other liquids), compressors, dehydrators, flare sites and metering sites. The Commission permits and regulates the majority of oil and gas facilities in the province.

Other Oil and Gas Infrastructure

Other oil and gas activities that do not fit into the above categories include borrow pits (to obtain fill material), above-ground water lines, flare stacks (to burn gas for flow testing or to reduce pressure), helipads, airstrips, power lines and campsites. The Commission regulates the majority of these activities where they are directly related to oil and gas operations.

Wells

Oil and gas companies drill wells to extract oil and gas. Wells are also drilled to produce or dispose of water used in exploration and development. To drill a well, operators must hold subsurface tenure and obtain a permit to build a wellpad. The wellpad houses the equipment required to drill and complete one or more wells (Figure 6). If the well proves successful, the wellpad will also be used for the production wellhead and the necessary equipment to produce oil or gas.

Unconventional technology has allowed for more wells on a single wellpad, creating a larger footprint in one area, but reducing the overall number of wellpads in a given area.

Figure 7: Example of a Facility



Progress since the 2013 Report

he 2013 report identified five next steps, and the Commission's actions are summarized below.

| 2013 Next Step | Action/Result |
|---|---|
| Periodically updating the analysis to reflect future oil and gas activities and to report on outcomes. | This 2014 report is the first update of the 2013 surface land use analysis, includes changes to analysis methods and captures additional activity. |
| Investigating knowledge gaps to improve the data. The Commission recognizes the limitations with the data used for these calculations and the methodology errs on the side of a higher number of surface disturbances than may actually exist. | A significant effort was placed on better understanding the limitations of historical oil and gas surface land use data, and as a result new categories of data have been identified and incorporated into this update. |
| Reviewing and improving the data assumptions providing the framework for analysis. For example, vegetation regrowth and potential surface recovery have not been factored into any of the calculations presented. Future reporting may incorporate calculations of vegetation regrowth and other relevant parameters. | In conjunction with the Ministry of Forests, Lands and Natural Resource Operations (FLNRO), the Commission has started to investigate how ecological recovery, regrowth, reclamation, and restoration impact specific ecological values. This work is in its early stages and has not been factored into this report. |
| Continually updating processes and procedures in response to public input gained through project notification and consultation, and in response to feedback from industry, First Nations and stakeholders. | Changes made to processes and procedures resulting from internal review procedures. |
| Working with government to improve outcomes and incorporating new government direction as it becomes available. | The Commission and FLNRO are collaborating to ensure that the oil and gas sur- face land use methods and calculations generated by the Commission are used in FLNRO's cumulative effects procedures and other corporate-wide programs. |

In addition, the Commission introduced Area-based Analysis into its application review process on Jan. 5, 2015, and accurate surface land use data is a key component of this. For more information see the ABA page on the Commission's website.

Methodology and Data Limitations in the Report

he calculation of the total surface area used by oil and gas activities is primarily based on interpretation of industry submitted spatial data, satellite imagery and government mapping. The majority is Commission data with supplemental checks against other data sources. The calculations are derived from a Commission developed methodology using the data sources, assumptions and limitations detailed in Appendix II.

Anthropogenic disturbances were classified and responsibility for each disturbance was assigned to the appropriate industrial use wherever possible, which allowed a calculation of the net surface area used by oil and gas activities. This analysis will be refined and updated as data and methodologies are improved.

Historical Information

Prior to the creation of the Commission in 1998, a variety of agencies managed the permitting and authorization processes, and a variety of tools were used to track the locations and details of each activity. As technology evolved, so did the tools, and the accuracy of locational information. In 2004

for pipelines and mid-way through 2006 for other activities, the Commission introduced a system called ePass for the electronic submission of all oil and gas activities, including accurate georeferenced location information. The Commission is further enhancing its information submission and tracking programs, through the Application Management System initiative scheduled for release in 2016. The evolution of data quality and location accuracy was used to identify information 'eras', which further define how the Commission manages surface land use data. Two broad eras are identified: pre Dec. 31, 2006; and post Jan. 1, 2007. Details are outlined in Appendix II.

Built-in data enhancement processes

From an information perspective, there are two built-in data enhancement initiatives that will start in 2015. With the introduction of the Oil and Gas Road Regulation (OGRR) on Jun. 3, 2013, any company that maintains a road for oil and gas purposes, must submit a permit to the Commission. Industry has until Nov. 2015 to submit permits for those roads captured under this new requirement. This will provide confirmation of responsibility and clearly identify additional roads used by the oil and gas sector.

A requirement with the Application Management System is that any modification to existing oil and gas activity requires the proponent to submit an up-to-date spatial location of the entire clearing adjacent to the proposed activity. This new information will be used to replace assumed sizes and shapes for older activities, and to confirm more recent data.

Land Use Results - Northeast British Columbia

he Commission calculates the surface footprint resulting from the following disturbances:

- Wells
- Roads
- Facilities
- Pipelines
- Other oil and gas Infrastructures (such as camps)
- Seismic lines (resulting from geophysical exploration)

This summary includes improvements to the analysis and reporting methods the Commission uses to determine surface land use in northeast B.C. since 2013. Following this, the report will shift to a calendar year for reporting.

The data is summarized in four tables. Table 1 shows the net area used by all oil and gas activities in northeast B.C., as well as by Land and Resource Management Plan (LRMP) area and five geological formations (Figure 9). Table 1 also compares the 2014 net areas to the 2013 net areas, and identifies a percentage change. Tables 2, 3 and 4 summarize the gross and net area by activity for each of the reporting areas within Table 1. The cumulative footprint of oil and gas activity as of Dec. 31, 2014 ranges between 1.3 and 3.7 per cent of the reporting area. This variability depends upon the overall size of the reporting area as well as the length of time that oil and gas activity has been occurring. These areas may vary in other surface area related reports due to data uncertainties, improvement activities, different assumptions and more detailed analyses. The changes between the 2013 and 2014 data in the *area* and *percent area* are attributed to three factors:

- Improvements to the quantification and analysis of historical information, and the standardization of how oil and gas activities are measured.
- Improvements/changes in the boundaries of the reporting areas.
- New activity on the landbase.

Details behind the methodology and assessment changes are in Appendix II.

Table 1: Summary of Results by Reporting Area

| Reporting Area | Total Area ¹ (ha) | Net Area Used for Oil and Gas | Per cer | nt of Repor | ting Area |
|--|------------------------------|----------------------------------|---------|-------------|---------------------|
| | | Activities* | 2013 | 2014 | Change ² |
| Northeast British Columbia | 16,303,505 | 331,370 | 2.14 | 2.03 | (0.11) |
| Land and Resource Management Plans | | | | | |
| (LRMP) | | | | | |
| Fort Nelson LRMP | 8,156,470 | 134,768 | 1.51 | 1.65 | 0.14 |
| Fort St. John LRMP | 4,676,323 | 137,351 | 3.43 | 2.94 | (0.49) |
| Dawson Creek LRMP | 2,989,414 | 58,713 | 2.22 | 1.96 | (0.26) |
| Geological Formations (Figure 9) | | | | | |
| Western Canada Sedimentary Basin | 13,452,445 | 330,498 | 2.79 | 2.46 | (0.33) |
| Horn River Basin | 1,145,989 | 34,670 | 3.18 | 3.03 | (0.15) |
| Liard Basin | 934,304 | 12,150 | 1.28 | 1.30 | (0.02) |
| Cordova Embayment | 269,006 | 7,492 | 3.08 | 2.79 | (0.29) |
| Montney Play Trend | 2,985,906 | 110,961 | 4.08 | 3.72 | (0.36) |
| * The net area occurs when the area shared by overla | apping permit types is | removed | | | |

1. The areas of several of the reporting units are smaller than in the 2013 report. For the purposes of this report, the Commission has aligned the western boundary of the reporting units to those that define the watersheds in northeast B.C. An explanation of the changes and rationale is in Appendix 2. 2. The year-over-year change is due to new activity as well as changes in analysis methods and data assumptions. Details are in Appendix 2.

Table 2: Surface Area Used for Oil and Gas Activities in Northeast British Columbia

| Activity | Oil ar | Area Used for nd Gas Activities | (ha) | Northeast | Per cent of B.C. used for O Activities | il and Gas |
|---|--------------------|------------------------------------|--------------------|---------------------|--|----------------|
| | 2013 | 2014 | Change | 2013 | 2014 | Change |
| Wells ** | 30,226 | 31,420 | +1,194 | 0.17 | 0.19 | 0.02 |
| Roads ** | 83,492 | 29,542 | (53,950) | 0.48 | 0.18 | (0.30) |
| Facilities ** | 1,543 | 1,757 | +214 | 0.01 | 0.01 | Nil |
| Pipelines ** | 43,893 | 43,061 | (832) | 0.25 | 0.26 | (0.01) |
| Other Oil & Gas Activities ** | 12,672 | 11,876 | (796) | 0.07 | 0.07 | Nil |
| Geophysical Exploration (seismic lines) ** | 227,815 | 221,860 | (5,955) | 1.30 | 1.36 | 0.06 |
| Total Area Used for Oil and Gas Activities ** | 399,641 | 339,515 | (60,126) | 2.28 | 2.08 | (0.20) |
| Area of Northeast B.C. | 17,534,537 | 16,303,505 | (1,231,032) | | | |
| Net Area* Used for Oil and Gas Activities | 375,600 | 331,370 | (44,230) | 2.14 | 2.03 | (0.11) |
| ** The shared area for identical activities (well site overlapping well site, or geophysical well site) is included. * The net area occurs when the area shared by overlapping activities are removed. | overlapping geophy | ysical) is removed, | but shared area fo | or different activi | ties (geophysica | al overlapping |

Table 3: Surface Area Used for Oil and Gas Activities by Land Resource Management Plan Area 2013/2014

| Activity | Fort Nelson LRMP area (ha) | Per cent of Fort Nelson LRMP (%) | Fort St. John LRMP area (ha) | Per cent of Fort St. John LRMP (%) | Dawson Creek LRMP area (ha) | Per cent of Dawson Creek LRMP (%) |
|---|-------------------------------|--|---------------------------------|--|--------------------------------|---|
| Wells** | 7,765 | 0.10 | 20,364 | 0.44 | 6,600 | 0.22 |
| Roads** | 21,224 | 0.26 | 23,426 | 0.50 | 9,026 | 0.30 |
| Facilities** | 380 | 0.00 | 663 | 0.01 | 745 | 0.02 |
| Pipelines** | 12,623 | 0.15 | 22,029 | 0.47 | 9,863 | 0.33 |
| Other Oil & Gas Activities** | 4,143 | 0.05 | 4,130 | 0.09 | 4,462 | 0.15 |
| Geophysical Exploration (seismic lines)** | 103,555 | 1.27 | 84,358 | 1.80 | 35,133 | 1.18 |
| Total Area Used for Oil and Gas Activities** | 149,689 | 1.84 | 154,970 | 3.31 | 65,830 | 2.20 |
| LRMP area | 8,156,468 | | 4,676,322 | | 2,989,414 | |
| Net Area Used for Oil and Gas Activities * | 134,768 | 1.65 | 137,351 | 2.94 | 58,713 | 1.96 |
| * The net area occurs when the area shared by overlapping permit types is removed. ** The total area occurs when the area shared by overlapping permit types is not removed. | | | | | | |

Figure 9: Shale Gas Basins



Table 4: Surface Area Used for Oil and Gas Activities by Geological Formation 2014

| Activity | Western Canada | Per cent of | Horn River | Per cent of | Liard Basin | Per cent of | Cordova | Per cent | Montney | Per cent of |
|---|----------------|----------------|------------|-------------|-------------|-------------|-----------|------------|------------|-------------|
| | Sedimentary | Western Canada | Basin (ha) | Horn River | (ha) | Liard Basin | Embayment | of Cordova | Play Trend | Montney |
| | Basin (ha) | Sedimentary | | Basin | | | (ha) | Embayment | (ha) | Play Trend |
| | | Basin | | | | | | | | |
| Wells ** | 34,711 | 0.26 | 1,908 | 0.17 | 499 | 0.05 | 553 | 0.21 | 16,756 | 0.56 |
| Roads ** | 53,725 | 0.40 | 5,679 | 0.50 | 3,367 | 0.36 | 1,834 | 0.68 | 15,605 | 0.52 |
| Facilities ** | 1,788 | 0.01 | 261 | 0.02 | 43 | 0.00 | 0 | 0.00 | 1,220 | 0.04 |
| Pipelines ** | 44,396 | 0.33 | 2,502 | 0.22 | 1,093 | 0.12 | 1,093 | 0.41 | 18,474 | 0.62 |
| Other Oil & Gas Activities ** | 12,642 | 0.09 | 2,206 | 0.19 | 642 | 0.07 | 121 | 0.04 | 6,846 | 0.23 |
| Geophysical Exploration (seismic lines) | 222,920 | 1.66 | 26,756 | 2.33 | 8,494 | 0.91 | 4,963 | 1.84 | 65,345 | 2.19 |
| Total Area Used for Oil and Gas Activities** | 370,182 | 2.75 | 39,312 | 3.43 | 14,138 | 1.51 | 8,564 | 3.18 | 124,246 | 4.16 |
| Basin Area | 13,452,445 | | 1,145,989 | | 934,304 | | 296,006 | | 2,958,906 | |
| Net Area Used for Oil and Gas Activities ** | 330,498 | 2.46 | 34,670 | 3.03 | 12,150 | 1.30 | 7,492 | 2.79 | 110,961 | 3.72 |
| * The net area occurs when the area shared by overlapping permit types is removed. ** The total area occurs when the area shared by overlapping permit types is not removed. | | | | | | | | | | |

Next Steps

his report presents a snapshot of existing oil and gas land use in northeast British Columbia, including three LRMP areas, and five geological formations. It also provides a baseline for future comparisons.

Measuring oil and gas activity is one way the Commission is enhancing resource stewardship and increasing understanding of the interplay between surface and subsurface impact. The Commission is undertaking an Area-based Analysis approach to gather information and data specific to each basin to allow for better informed regulatory decisions. The approach evaluates oil and gas activity in order to improve understanding of the relationship between various oil and gas activities across a specific basin or area, and informs the implementation of initiatives that reduce surface and subsurface impact.

A key element of each Area-based Analysis is the baseline definition of the surface area already used for oil and gas activity. A large proportion of this area is presently taken up by seismic lines resulting from geophysical exploration. The land use will change over time as the pattern changes to unconventional development and as anthropogenic impacts are reclaimed or naturally recover. Ultimately, natural succession and reclamation will restore the surface area used to a biologically functional state. As a result, the land use report will be updated periodically to reflect landscape changes. The analysis for each basin or area will be summarized and updated regularly to reflect current land use reporting.

Next steps include:

- Periodically updating this analysis to reflect future oil and gas activities and to report on outcomes.
- Investigating knowledge gaps to improve the data. The Commission recognizes the limitations with the data used for these calculations and the methodology errs on the side of a higher number of surface disturbances than may actually exist.
- Reviewing and improving the data assumptions providing the framework for analysis. For example, vegetation regrowth and potential surface recovery have not been factored into any of the calculations presented. Future reporting may incorporate calculations of vegetation regrowth and other relevant parameters.
- Continually updating processes and procedures in response to public input gained through project notification and consultation, and in response to feedback from industry, First Nations and stakeholders.

More Information

Contact www.bcogc.ca

his report is updated as required. For specific questions or enquiries regarding this report, please contact:

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www.bcogc.ca

Appendix 1: OGAA Specified Enactments

Authority for certain activities has been given to the Commission through specified enactments. These enactments set approvals or authorizations and establish compliance and enforcement oversight. Specified enactments for oil and gas activities and related provisions are listed below in Table 5.

Table 5: OGAA Specified Enactments and Provisions

| "Specified Enactment" | "Specified Provision" |
|------------------------------|--|
| Environmental Management Act | (a) any of the following provisions of the Environmental Management Act: (i) section 9 (hazardous waste storage and disposal). (ii) section 14 (permits). (iii) section 15 (approvals). |
| Forest Act | (b) section 47.4 (licence to cut for persons occupying land or for oil and gas purposes) of the Forest Act, but only in relation to a master licence to cut, and section 117 (road use permits for industrial use) of the Act. |
| Heritage Conservation Act | (c) section 12 (permit authorizing certain actions) of the Heritage Conservation Act. |
| Land Act | (d) any of the following provisions of the Land Act: (i) section 11, but only in relation to a lease or grant described in section 11 (2) (b) to (d) (disposing of Crown land). (ii) section 14 (temporary occupation of Crown land). (iii) section 38 (lease of Crown land), but not to the extent that it relates to the granting of an option to purchase land. (iv) section 39 (licence of occupation). (v) section 40 (right of way and easement). (vi) section 96 (1) (occupational rental). |
| Water Act | (e) any of the following provisions of the Water Act, but only in relation to an approval as defined in section 1 of the Water Act: (i) section 8 (short term use of water). (ii) section 9 (1) (a) (changes in and about a stream). (iii) section 26 (permits over Crown land). (f) a prescribed regulation under a specified enactment. |

Appendix II: Data Sources, Assumptions and Limitations

Data changes from the 2013 report

Reporting areas have changed in this report due to a process to dissolve GIS slivers along the border with Yukon, the Northwest Territories and the Province of Alberta. The area in northeast B.C. is now smaller because in this report the boundary of the watersheds in northeast B.C was used, whereas in 2013 the combination of the three LRMP areas was used to define the area. The main difference is the Fort Nelson LRMP area extends beyond the watershed boundaries. The differences are summarized in the table below.

| Reporting Area | 2013 total | 2014 total | Difference | Reason for the change |
|--------------------|------------|------------|-------------|--|
| | area (ha) | area (ha) | (ha) | |
| Northeast B.C. | 17,534,537 | 16,303,505 | (1,231,032) | Used the outer boundary of the 69 water management |
| | | | | basins to define the area in northeast B.C. |
| Fort Nelson LRMP | 9,868,063 | 8,156,470 | (1,711,593) | Used the outer boundary of the 69 water management |
| (FNLRMP) | | | | basins to define the area in northeast B.C. |
| Fort St. John LRMP | 4,676,637 | 4,676,323 | (314) | |
| (FSJ LRMP) | | | | |
| Dawson Creek LRMP | 2,989,836 | 2,989,414 | (422) | |
| (DCLRMP) | | | | |
| Western Canada | 13,450,458 | 13,452,445 | + 1,987 | |
| Sedimentary Basin | | | | |
| (WCSB) | | | | |
| Horn River Basin | 1,145,989 | 1,145,989 | 0 | |
| Liard Basin | 934,304 | 934,304 | 0 | |
| Cordova Embayment | 315,867 | 269,006 | (46,861) | Boundary was revised through a review of the |
| | | | | geophysical data and re-analysis. |
| Montney Play Trend | 2,985,906 | 2,985,906 | 0 | |

Table 6: Summary of Results by Reporting Area for 2013 and 2014



Overview

This report outlines the data and processing used to generate the Oil and Gas Surface Land Use Dataset (SLU) by the Commission. This dataset encompasses wellsite, pipeline, road, geophysical exploration, facility and associated oil and gas activity in Northeast British Columbia. The SLU information characterizes the clearing and use of land through oil and gas activities. It does not include natural disturbance factors such as fire or flooding. Nor does it include surface clearing activities associated with other industrial activities in northeast B.C.

Background

Standards and criteria have been established for data and specific data sets chosen to calculate surface area used by the oil and gas industry in British Columbia (SLU). Data assumptions act as the framework for analysis results and are continually being upgraded and improved. For the purposes of this analysis, where the data is of unknown accuracy, the most conservative numbers have been used and regrowth is not factored into the calculations. As a result, the surface area used by the oil and gas industry may be overstated. While calculations produced for this analysis are derived from a Commission developed methodology, the available data is known to contain limitations preventing the exact reporting for certain oil and gas activities. Data collection and management technology has advanced and changed over time and the vast size of the study area has placed limitations on the accuracy of some data values. The Commission is working to ensure new data meets exacting standards and will use the most accurate data available for future reporting.

Spatial Data at the Commission

Spatial data is currently collected by the Commission mainly through the Electronic Petroleum Application Spatial Submission System (ePASS). This tool was originally developed and implemented for pipelines in Oct. 2004, then expanded in 2006 to include other surface area applications. It requires industry to submit spatial files detailing location information (for oil and gas applications) to the Commission. Spatial data submitted through ePASS is updated daily to the Commission FTP site and to DataBC as Mineral Tenure datasets.

Historical oil and gas spatial application data used in the analysis has been collected at the Commission through in-house digitizing, spatial analysis and from external GIS sources. For example:

- Historical petroleum development roads spatial file used in the analysis was created by the Ministry of Energy and Mines (MEM) using historical datasets.
- Historical geophysical exploration data compiled by MEM from disks provided to the Commission with the final plan locations.
- Missing wellsite clearing boundaries for wells

constructed prior to 2007 were generated based on surface well location and average well pad size based on research in the Liard Basin.

Other Sources for Spatial Data

DataBC hosts a wide variety of open data from the Province of B.C. Current land act tenure and applications for tenure for oil and gas activities are stored in Tantalis – Crown Tenure Lease or License datasets. Historical records are stored separately and include TRIM data compiled from stereo aerial photography dating from 1979. Crown Tenures data was also used for estimates of oil and gas activity before 2007 and for activities not processed through the Commission. This historical spatial data oil and gas features including facility sites, pipelines, access roads and miscellaneous applications (gravel pits, campsites, pullouts, etc.) was used to augment Commission datasets.

Current vs Historical Data used in Oil and Gas Surface Land Use

Data represented in this analysis is grouped into separate datasets to reflect the diversity in processes and data sources. The historical dataset reflects data for activities up to the end of 2006. The current dataset contains data stored at the Commission and has more stringent data capture standards and reflects data from the start of 2007 to the present. When reporting, consideration should be made to differentiate area of historical, non-active surface land use areas from more recent oil and gas activities and current development when appropriate.

The initial source for oil and gas surface land use data is data that has been collected at some point and managed by the Commission. Additional land use information for oil and gas activities stored in DataBC is used to augment the Commission datasets and better document historical activities. Considerable effort was invested in capturing historic data and characterizing data attributes. This was done with the understanding that these data represent oil and gas activities and that past data capture and documentation standards may vary from current processes. These data represent a point in time without any update to reflect current status. For this reason the historic dataset is assumed to be mostly static while the Commission datasets are more dynamic, updated and augmented on a regular schedule.

Datasets and Selection Criteria

Table 7 lists the datasets used for surface land use. Dataset descriptions and selection criteria are outlined in the Data Dictionary. All data sets are processed independently by oil and gas activity type, split into historical and current data groups and then combined to provide estimates of the amount of surface area currently being used for oil and gas activity.

| Oil and Ga | Dil and Gas Activity Type Source File Name | | | | Timeline | Update Cycle |
|-------------------|--|------------|--|---------|----------|--------------|
| | Road Rights of Way | Commission | WHSE_MINERAL_TENURE.OG_ANCILLARY_OTHER_APPS_PUB_SP | Polygon | >2006 | Nightly |
| | Access Roads | Commission | WHSE_MINERAL_TENURE.OG_PETRLM_ACCESS_ROADS_PUB_SP | Line | >2006 | Nightly |
| Roads | Development Roads (after 2006) | Commission | WHSE_MINERAL_TENURE.OG_PETRLM_DEV_ROADS_PUB_SP | Line | >2006 | As required |
| | Development Roads (before 2006) | Commission | WHSE_MINERAL_TENURE.OG_PETRLM_DEV_ROADS_PRE06_SP | Line | <2006 | n/a |
| ines | Pipeline Rights of Way | Commission | WHSE_MINERAL_TENURE.OG_PIPELINE_ RW_PUB_SP | Polygon | >2006 | Nightly |
| Pipeli | Pipeline Crown Tenures | DataBC | WHSE_TANTALIS.TA_CROWN_TENURES_SVW | Polygon | <2006 | Ongoing |
| | Well Sites | Commission | WHSE_MINERAL_TENURE.OG_WELL_SITES_PUB_SP | Polygon | >2006 | Nightly |
| (0 | Well Surface Location | Commission | WHSE_MINERAL_TENURE.OG_SURFACE_HOLE_STATUS_SP | Point | All | Nightly |
| Wells | Well Pad Boundaries | Commission | OGC_ISR_APP.PAD_WELL | Polygon | All | Nightly |
| | Well Crown Tenures | DataBC | WHSE_TANTALIS.TA_CROWN_TENURES_SVW | Polygon | <2006 | Ongoing |
| ies | Facility Sites | Commission | WHSE_MINERAL_TENURE.OG_FACILITY_SITES_GOV_SP | Polygon | >2006 | Nightly |
| Facilit | Facility Crown Tenures | DataBC | WHSE_TANTALIS.TA_CROWN_TENURES_SVW | Polygon | <2006 | Ongoing |
| il and rmits | Ancillary and Other Applications | Commission | WHSE_MINERAL_TENURE.OG_ANCILLARY_OTHER_APPS_PUB_SP | Polygon | >2006 | Nightly |
| Other O Gas Pe | Other Oil and Gas Crown Tenures | DataBC | WHSE_TANTALIS.TA_CROWN_TENURES_SVW | Polygon | <2006 | Ongoing |
| al | Seismic Lines | Commission | WHSE_MINERAL_TENURE.OG_GEOPHYSICAL_PUB_SP | Line | >2006 | Nightly |
| nysic | Historical Seismic Lines | Commission | WHSE_MINERAL_TENURE.OG_GEOPHYSICAL_2002_2006_SP | Line | <2006 | n/a |
| lqoe | Historical Seismic Lines | Commission | WHSE_MINERAL_TENURE.OG_GEOPHYSICAL_1996_2004_SP | Line | <2006 | n/a |
| Ō | Historical Seismic Lines | DataBC | WHSE_BASEMAPPING.TRIM_MISCELLANEOUS_LINES | Line | <2007 | n/a |

Table 7: Data Sources for Surface Land Use Calculations

Data Assumptions and Selection Criteria

Roads

Oil and gas road data for SLU is the road data stored at the Commission. Road activity applications are linked to oil and gas legislation at the time of approval. The Commission began to collect data on access and development roads in Oct. 2006. Petroleum development roads approved or in progress before Oct. 30, 2006 form the historical development roads dataset. Access and development roads approved between Oct. 2006 and Oct. 2010 are stored in separate datasets. With the implementation of the Oil and Gas Activities Act (OGAA) in Oct. 2010, all linear road data is stored in the petroleum access roads dataset. Right-of-way polygons submitted through ePASS as polygons are identified as ROAD in the ancillary oil and gas activity dataset.

Roads may be used for multiple uses including forestry, other industries and general transportation routes, and only those roads identified in the four Commission datasets (Table 8) are defined as roads for the oil and gas dataset. Road rights-of-way submitted through ePASS are stored as a polygon representing the right-of-way boundary. Petroleum roads are stored as a linear dataset and buffered according to the road type. Linear features representing winter roads are buffered to 10 metres, low-grade roads are buffered to 15 metres and high-grade roads are buffered to 20 metres to represent the right-of-way clearing on the landscape for each road type.

|--|

| Dataset | Selection Query | Additional Actions |
|--|---|--|
| | | |
| WHSE_MINERAL_TENURE.OG_ANCILLARY_OTHER_ APPS_PUB_SP | ANCILLARY_OTHER_APP_TYPE = 'ROAD' AND APPLICA- TION_STATUS IN ('APPROVED','POSTCONST') | None |
| WHSE_MINERAL_TENURE.OG_PETRLM_ACCESS_ ROADS_PUB_SP | APPLICATION_STATUS IN ('APPROVED', 'POSTCONST') | Buffer line by PETRLM_EVELOPMENT_ROAD_TYPE (HIGH (10m), LOW(7.5),WINT(5), UNKN(7.5) ETWA(7.5)) |
| WHSE_MINERAL_TENURE.OG_PETRLM_DEV_ROADS_ PUB_SP | APPLICATION_STATUS IN ('APPROVED', 'POSTCONST') | Buffer line by PETRLM_EVELOPMENT_ROAD_TYPE (HIGH (10m), LOW(7.5),WINT(5), UNKN(7.5) ETWA(7.5)) |
| WHSE_MINERAL_TENURE.OG_PETRLM_DEV_RDS_ PRE06_PUB_SP | PETRLM_DEVELOPMENT_ROAD_STATUS IN ('APPROVED', 'IN_PROGRESS', 'INTERIM_APPROVAL') | Buffer line by PETRLM_EVELOPMENT_ROAD_TYPE (HIGH (10m), LOW(7.5),WINT(5), UNKN(7.5) ETWA(7.5)) |

Pipelines

Pipeline Right-of-Way (RoW) data has been collected since 2004 and includes actual RoW widths. The dataset contains pipelines which have a construction 'start' or 'leave to open' date. Pipelines constructed prior to 2004 are identified from the Tantalis records for subpurpose 'gas and oil pipeline' data.

Table 9: Data Used for Pipelines

| Dataset | Selection Query |
|---|--|
| WHSE_MINERAL_TENURE.OG_PIPELINE_RW_PUB_SP | APPLICATION_STATUS IN ('POSTCO', 'LTO', 'SRW') |
| WHSE_TANTALIS.TA_CROWN_TENURES_SVW | TENURE_STAGE='TENURE' AND TENURE_SUBPURPOSE='GAS AND OIL PIPELINE' |

Wells

Wellsite spatial boundary information has been collected by the Commission since 2006. Any cleared wellsite is included in the dataset including those attached to unproductive, abandoned, suspended or cancelled wells. The drilling in northeast B.C. includes multi-well pads where up to 24 individual wells may be located on a single cleared site.

Wellsite point locations are linked with the cleared wellpad boundaries on the Well Authority number to show the cleared area. Wells constructed after 2007 have been added to the Commission database with a linked wellpad boundary. If no boundary was available, a generated boundary around the well location to represent a 1.44 hectare site was created. The 1.4 hectare wellpad size is based on typical wellpad size for wells prior to 2006 and was confirmed during sampling in the Liard Basin.

The Tantalis Crown Tenure (TA_CROWN_TENURES_SVW) data identified as ENERGY PRODUCTION and DRILLSITE/WELLSITE with an existing TENURE represent wells constructed prior to 2006. Crown right-of-way polygons (TA_CROWN_RIGHTS_OF_WAY_SVW) assigned TENURE_SUBPURPOSE of "DRILLSITE/WELLSITE" were also included if not reflected in the Commission datasets.

Table 10: Data Used for Wellsites and Wellpads

| Dataset | Selection Query |
|---|--|
| WHSE_MINERAL_TENURE.OG_SURFACE_HOLE_STATUS_SP | APPLICATION_STATUS IN ('POSTCONST', 'SRW') |
| OGC_ISR_APPS.PAD_WELL | WA_NUM links to WELL_AUTHORITY_NUMBER in OG_HOLE_STATUS_SP DATASET |
| WHSE_TANTALIS.TA_CROWN_TENURES_SVW | TENURE_STAGE='TENURE' AND TENURE_SUBPURPOSE='DRILLSITE/WELLSITE' |

Facilities

Facility site spatial information has been collected by the Commission since 2006. This includes areas supporting oil and gas development such as compressor, battery, plant and flare sites found in the OG_FACILITY_SITES_PUB_SP dataset. The Crown Tenures data for oil and gas features is used to show additional facility locations. Tenure records within northeast B.C. for battery, camp, compressor, dehydrator, drill, flare, gas processing, inlet, meter, land farms and water analysis oil and gas sites are included in the dataset.

Facility is a broad category and information is carried in a number of datasets. The Commission dataset of supporting activities (OG_ANCILLARY_OTHER_APPS_PUB_SP) has boundaries for land clearing relating to oil and gas activities. This includes a variety of types including clearings, camps, decking sites, borrow pits, sump sites, flare sites, helicopter pads and storage sites which are included in SLU (Table 11).

Table 11: Data Used for Facilities

| Dataset | Selection Query |
|--|---|
| WHSE_MINERAL_TENURE.OG_FACILITY_SITES_GOV_SP | APPLICATION_STATUS IN ('LTO', 'POSTCO', 'SRW') |
| WHSE_TANTALIS.TA_CROWN_TENURES_SVW | TENURE_STAGE='TENURE' AND TENURE_SUBPURPOSE NOT IN('DRILLSITE/WELLSITE', GAS AND OIL |
| WHSE_TANTALIS.TA_CROWN_TENURES_SVW | APPLICATION_STATUS IN ('LTO', 'POSTCO') AND ANCILLARY_AND_OTHER_TYPE NOT IN ('GEOT', 'INV') |

Data Limitations

The majority of data used in the analysis is provided to the Commission by industry and therefore the accuracy of the data is dependent on the quality of data submitted. Though quality assurance techniques are in place when submissions reach the Commission, historically there have been limitations on data administration accuracy due to technology, systems and processing procedures.

The issues surrounding data limitations are a priority and the Commission is committed to continuing to develop a plan to fill knowledge gaps and improve data management systems. Future system and data enhancements as part of the Commission's Business Transition Strategy (BTS) will help to meet these goals.

Processing

All contributing data was captured as polygons or buffered to generate polygons to represent the area boundaries. Data was grouped by type (wells, facilities, pipelines, roads, other oil and gas infrastructure and seismic lines). Within each oil and gas SLU type, the boundaries of activities may contain overlap where an activity area may be permitted at more than one time, or be permitted as a different activity type. Activities are assigned the year of the most recent operational status and all activities permitted before Jan. 1, 2007, are grouped together as historical. Data is dissolved by SLU type and year group to remove overlapping areas and allow reporting of activity by year. The resultant SLU datasets combine all activities by type and dissolves all overlap. A final dissolve for reporting requirements merges all oil and gas surface land use types into a single dataset with no differentiation between types.

