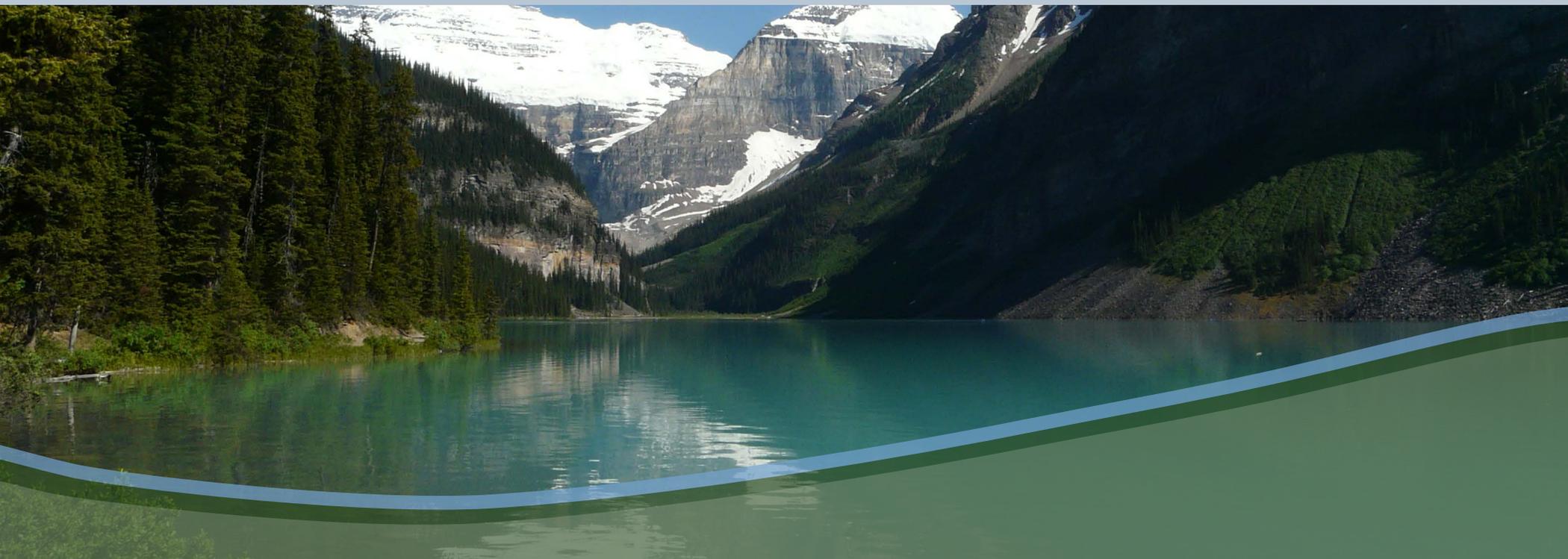


# Water Management for Oil and Gas Activity



2015 Annual Report



## PURPOSE

The purpose of the *2015 Annual Report on Water Management for Oil and Gas Activity* is to present data and information on water management related to the oil and gas industry, including hydraulic fracturing.



Previous annual water reports and quarterly updates are available on the Commission's website at:  
<http://www.bcogc.ca/public-zone/water-information>

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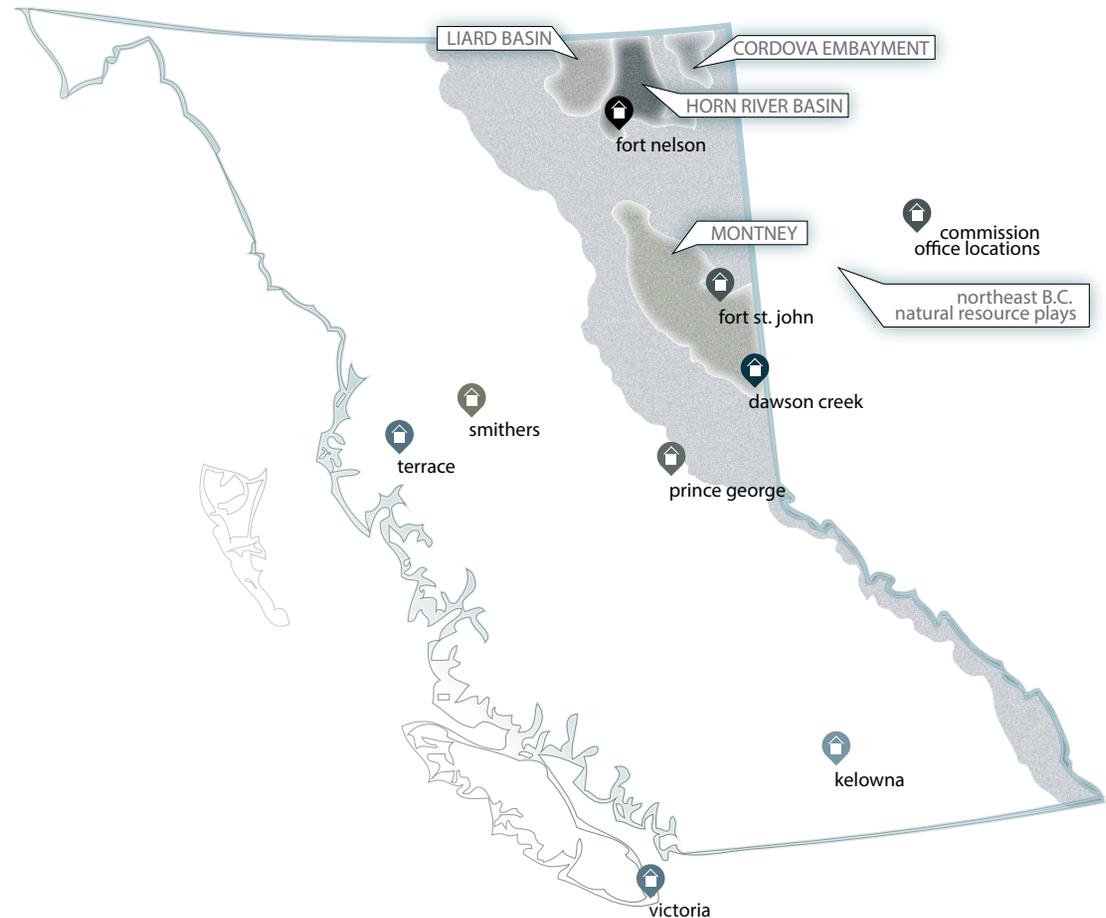
Role of the

# BC OIL AND GAS COMMISSION

The [BC Oil and Gas Commission](#) (Commission) is the provincial 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.

The Commission is responsible for reviewing, assessing, and making decisions on water authorizations from both surface and subsurface water sources. The Commission has the expertise and tools to make informed water allocation decisions. Protecting and maintaining environmental and community water needs are its first priorities.



Commission Office Locations  
Throughout B.C.

## HOW WATER IS USED

Water is used for various purposes in the oil and gas industry.



The largest use of water for oil and gas activities is for hydraulic fracturing.

However, water is used for other purposes, such as:



Seismic or geophysical exploration



Drilling



Machine washing



Dust control



Water floods (to enhance oil recovery)



Ice road freezing



Hydrostatic testing of pipelines

## HOW WATER IS ACCESSED

There are different ways the oil and gas industry may access water in British Columbia. Some methods are managed through provincial legislation, including:

- **Water licences** issued under the Water Act in 2015. The Commission has staff designated as Regional Water Managers with authority for issuing and administering long-term water licences.
- **Short-term surface water use or diversion approvals** issued under Section 8 of the Water Act. Short-term water use is administered by the Commission.
- **Water source wells** authorized by the Commission under the Oil and Gas Activities Act (OGAA). Water source wells are a specific type of well where the water withdrawn is intended for the purpose of injection into an underground formation to enhance oil or natural gas recovery.
- **Flowback water** that returns to the surface after being injected for hydraulic fracturing.
- **Produced water** that flows to the surface as a by-product of oil and gas production.

In 2015, the oil and gas industry could access water by means outside of regulatory oversight:



- **Private agreements** can be made with landowners or others who have a source of water supply such as a dugout or a groundwater well.
- **Groundwater wells** for oil and gas use where the activity does not involve water injection (hydraulic fracturing) into the subsurface. These purposes include road maintenance, geophysical exploration, and other possible uses.

## COMMISSION AUTHORITY FOR WATER

In 2015, the [Water Act](#) was the primary provincial statute regulating water resources in B.C.

Specific Commission staff were designated as Regional Water Managers under the Water Act, giving the Commission authority to issue and administer water licences, generally for terms of five years or more, to the oil and gas sector.

Through the Oil and Gas Activities Act (OGAA), the Commission has authority to issue water use permits under Section 8 of the Water Act to manage short-term water use (STWU). Approvals under Section 8 authorize the diversion and use of water for a term not exceeding two years. Short-term water use approvals are typically

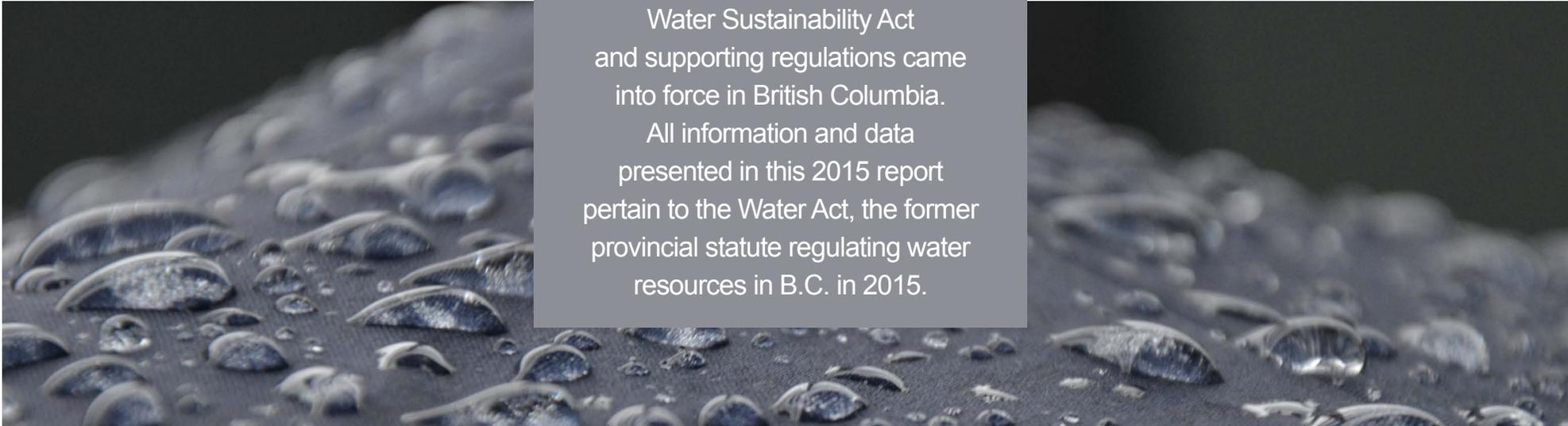
used by industry during the exploration phase of development of natural gas or oil leases. Upon expiry, subsequent short-term water use approvals can be issued to applicants should further use of a short-term nature be required.

On Feb. 29, 2016 the Water Sustainability Act (WSA) and supporting regulations came into force in British Columbia, however, all information and data presented in this report pertain to the previous Water Act.

The Commission regulates aspects of subsurface water resources. OGAA provides the Commission authority for groundwater management of water source wells.

A water source well is used to acquire water for injection purposes to either enhance oil recovery, or for hydraulic fracturing to enhance gas recovery.

The Commission has natural resource specialists trained to review and adjudicate applications for water use associated with oil and gas activities. The water used by industry is carefully monitored by knowledgeable hydrologists, hydrogeologists, geologists and engineers with the Commission. These specialists have expertise in northeast B.C.'s (NEBC) water resources and apply scientific and technical rigour to manage and protect the province's water resources.



On Feb. 29, 2016 the Water Sustainability Act and supporting regulations came into force in British Columbia. All information and data presented in this 2015 report pertain to the Water Act, the former provincial statute regulating water resources in B.C. in 2015.

## WATER USE REPORTING

The Commission requires mandatory regular reporting of water withdrawals for water authorizations. For surface water sources managed under short-term water use approvals, operators must report monthly water withdrawals from each approved withdrawal location on a quarterly basis. For water licences, operators must submit daily withdrawal data on a quarterly basis.



Companies failing to report water usage are referred to the Commission's Compliance and Enforcement team to investigate non-compliance of permit conditions and possible issuance of violation tickets.

Water withdrawal data from water source wells is required to be reported to the Commission by companies on a monthly basis.

## TOOLS FOR WATER MANAGEMENT

The Commission manages water approvals and use with specific focus on environmental values.



Methods and tools include:

- The development of [OGC Water Management Basins](#) for NEBC (derived from the Ministry of Environment's Freshwater Atlas base map).
- The review of water use applications on a watershed basis with an understanding of cumulative effects to ensure withdrawals do not exceed environmental limits and environmental flows are maintained.
- The production of [publicly available reports](#) on water approvals and use.
- The management of special or unique situations, and the ability to take action if necessary, such as [suspending oil and gas water use](#) during the 2010, 2012 and 2014 summer droughts in NEBC.
- [The NorthEast Water Tool](#) and [NorthWest Water Tool](#), and the [Omineca Water Tool](#), GIS-based hydrology decision-support tools.
- The development of a [Water Portal](#) to display available surface water and groundwater quantity and quality data throughout NEBC.
- Cooperation with water stewardship staff from Ministry of Forests, Lands and Natural Resource Operations ([FLNRO](#)) to ensure decisions are fully informed and coordinated.
- The transparent publication of all chemicals included in fracturing fluids and the total amount of water injected for hydraulic fracturing on [FracFocus.ca](#).

## EXECUTIVE SUMMARY - 2015 SNAPSHOT

In 2015, there were seven companies holding 16 water licences, representing 31 points-of-diversion, associated with oil and gas activities (Table 1). The annual total licenced volume for water use was 14,548,135 m<sup>3</sup>. A total of 2,261,435 m<sup>3</sup> was withdrawn under water licence. In 2015, the Commission did not issue any water licences. One water licence was cancelled by the Environmental Appeal Board, and another water licence was cancelled by the licensee. Two water licence applications were submitted to the Commission, and a previously submitted application was denied.

There were 54 companies with 294 active short-term water use approvals from 1,027 points-of-diversion in 2015. The total annual volume of water approved for withdrawal was 19,012,301 m<sup>3</sup>. The total volume of extracted water reported was 1,992,462 m<sup>3</sup> (Figure 1). The majority of water withdrawn under short-term water use approval was from water source dugouts (70.1 per cent), followed by stream/rivers (29.6 per cent). Very little water was withdrawn from Basin or Lake approvals.

Water Source Wells are used to source groundwater for enhanced oil recovery or hydraulic fracturing. Seven companies reported withdrawing 575,434 m<sup>3</sup> of water from 27 water source wells in 2015. Seventeen water source wells accessed groundwater above 300 m depth, five water source wells accessed groundwater at depths

between 301 and 600 m, and five water source wells accessed groundwater from deeper reservoirs at depths greater than 600 m.

A total of 7,735,618 m<sup>3</sup> of water was injected by 26 companies for hydraulic fracturing of 534 wells in 2015.

Most wells hydraulically fractured were in the Montney Play (North and Heritage). Water for hydraulic fracturing was sourced by water licences, short-term water use approvals, water source wells, reuse of flowback water, treatment of municipal wastewater and private acquisition.

TABLE 1: WATER ALLOCATION AND USE FOR OIL AND GAS ACTIVITIES IN 2015

WATER LICENCES	Companies with Active Water Licences	7
	Active Water Licences	16
	Licensed Withdrawal Locations	31
	Volume Available for Use for Water Licences (m <sup>3</sup> )	14,548,135
	Volume Reported Used for Water Licences (m <sup>3</sup> )	2,261,435
SHORT-TERM WATER USE APPROVALS	Companies with Active Use Approvals	54
	Active STWUs	294
	Approved Withdrawal locations for STWUs	1,027
	Volume Available for Use for STWUs (m <sup>3</sup> )	19,012,301
	Volume Reported Withdrawn for STWUs (m <sup>3</sup> )	1,992,462
WATER SOURCE WELLS	Companies Reporting Water Source Wells	7
	Water Source Wells	27
	Volume of Water Extracted from Water Source Wells (m <sup>3</sup> )	575,434
HYDRAULIC FRACTURING	Companies that Hydraulically Fractured Wells	26
	Hydraulically Fractured Wells	534
	Volume of Water Injected for Hydraulic Fracturing (m <sup>3</sup> )	7,735,618

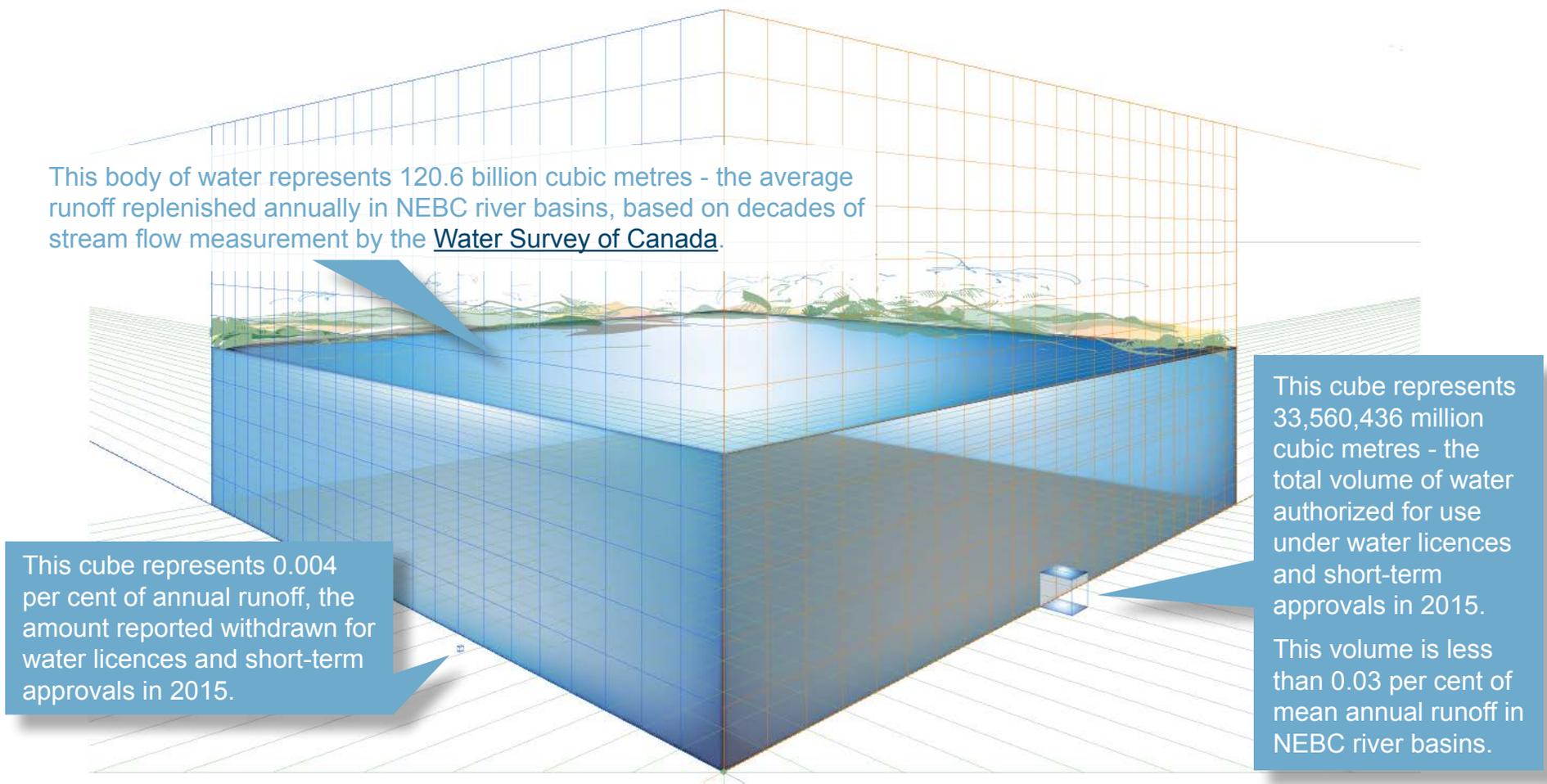


FIGURE 1: COMPARISON OF ANNUAL RUNOFF, WATER ALLOCATION AND VOLUMES REPORTED WITHDRAWN IN 2015

Figure 1 provides a comparison of the average volume of annual runoff in NEBC river basins against water licence and short-term approval volumes, and actual volumes reported withdrawn.

# WATER LICENCES

## LONG-TERM WATER USE

Commission staff have been designated as Regional Water Managers by the Deputy Minister of the Ministry of Forests, Lands and Natural Resource Operations (FLNRO), with authority for adjudicating and administering water licence applications. Below is a summary of the Commission's water licence management activity from 2015.

### 2015 WATER USE DATA

In 2015, there were 16 water licences active, representing 31 points-of-diversion (Table 2). The total annual volume of water licenced for 2015 was 14,548,135 m<sup>3</sup>. The total volume of extracted water reported was 2,261,435 m<sup>3</sup> (15.5 per cent of the total licenced volume) from only five licences representing five points-of-diversion (Table 5).

### 2015 WATER USE - BY SOURCE

Under the Water Act, a water licence could only be issued for streams. A stream included a natural watercourse or source of water supply, whether usually containing water or not, and a lake, river, creek, spring, ravine, swamp and gulch. There were only two categories of water sources in 2015 that were licenced for oil and gas purposes: rivers and lakes. River and lake water licences were very similar with respect to the number of active water licences, number of points-of-diversion, and licenced volume; however the withdrawal volumes were four times greater from rivers as compared to lakes (Table 3).

### 2015 WATER USE - BY COMPANY

Encana Corporation had the greatest number of water licences (7) and points-of-diversion (22) (Table 4), however, no water was withdrawn

TABLE 2: OIL AND GAS RELATED WATER LICENCES ACTIVE IN 2015

under these licences in 2015. Five of Encana's water licences, representing 20 points-of-diversion, are scheduled to expire Dec. 31, 2016. Progress Energy had the highest licenced volume (6,643,000 m<sup>3</sup>) and total water withdrawal (1,298,181 m<sup>3</sup>). The highest withdrawal from a single point-of-diversion was Progress Energy's water licence (C131230, Table 2) on the Sikanni Chief River (1,269,189 m<sup>3</sup>).

TABLE 3: SOURCES OF WATER LICENCES IN 2015

SOURCE	# of WATER LICENCES	# of POINTS OF DIVERSION	APPROVAL VOLUME (m <sup>3</sup> )	%	WITHDRAWN VOLUME (m <sup>3</sup> )	%
Rivers	10	17	6,701,635	46.1	1,804,136	79.8
Lakes	6	14	7,846,500	53.9	457,299	20.2
<b>Total</b>	<b>16</b>	<b>31</b>	<b>14,548,135</b>	<b>100</b>	<b>2,261,435</b>	<b>100</b>

TABLE 4: COMPANIES WITH WATER LICENCES IN 2015

COMPANY	# of WATER LICENCES	# of POINTS OF DIVERSION	LICENCED VOLUME (m <sup>3</sup> )	%	WITHDRAWN VOLUME (m <sup>3</sup> )	%
Canbriam	1	1	3,650,000	25.1	374,095	16.5
CNRL	2	2	579,000	4.0	54,212	2.4
Encana	7	22	208,666	1.4	0	0.0
Progress Energy	2	2	6,643,000	45.7	1,298,181	57.4
Shell	2	2	750,000	5.2	0	0.0
TAQA North	1	1	892,469	6.1	0	0.0
Whitecap Resources	1	1	1,825,000	12.5	534,947	23.7
<b>Total</b>	<b>16</b>	<b>31</b>	<b>14,548,135</b>	<b>100</b>	<b>2,261,435</b>	<b>100</b>

TABLE 5: QUARTERLY WATER WITHDRAWALS (m<sup>3</sup>) FROM WATER LICENCES, 2014 - 2015

	Q1	Q2	Q3	Q4	SUM
<b>2014</b>	246,887	1,143,170	812,534	595,969	2,798,560
<b>2015</b>	587,562	358,030	607,397	708,446	2,261,435

LICENCE NUMBER	LICENCEE	PRIORITY DATE (yyyy.mm.dd)	LICENCE STATUS DATE (yyyy.mm.dd)	EXPIRY DATE (yyyy.mm.dd)	SOURCE	NUMBER OF POINTS OF DIVERSION	OGC WATER MANAGEMENT BASIN	DAILY APPROVAL (m <sup>3</sup> /day)	ANNUAL APPROVAL (m <sup>3</sup> /yr)	2015 WATER USE (m <sup>3</sup> /yr)	PURPOSE	PERIOD OF USE
C111413	Shell	1996.08.20	1998.03.25	2027.04.28	Kiskatinaw River	1	Lower Kiskatinaw River	1,080	400,000	0	Oil Field Injection (OFI)	Whole Year
C112155	Whitecap Resources	1970.09.04	1998.03.18	N/A	Peace River	1	Lower Peace River	5,000	1,825,000	534,947	OFI	Whole Year
C113187	CNRL	1970.01.08	1998.08.26	N/A	Coplin Creek	1	Cache Creek	507	185,000	0	OFI	Whole Year
C117683	TAQA North Ltd	1964.09.16	2002.10.31	N/A	Hogg Creek	1	Lower Peace River		892,469	0	OFI	Whole Year
C122399	Encana Corp	2006.11.27	2007.03.13	N/A	Tupper River	1	Pouce Coupe River	230	2,000	0	Industrial (processing)	Apr. 1 - Dec. 31
C122423	Encana Corp	2006.12.13	2007.03.13	N/A	Steeprock Creek	1	Smoky River	115	2,500	0	Industrial (processing)	Whole Year
C125903	Encana Corp	2007.04.02	2011.02.18	2016.12.31	Lower Trail Lake and Trail Lake	2	Tsea River	500	20,000	0	OFI, Mining Equipment, Road Maintenance	Whole Year
"	"	"	"	"	Tightfit Lake	1	Lower Petitot River	500	20,000	0	"	"
C125925	Encana Corp	2007.04.02	2011.02.18	2016.12.31	Yesshadle Creek	2	Middle Petitot River	250	26,666	0	OFI, Mining Equipment, Road Maintenance	Whole Year
C125934	Encana Corp	2007.03.16	2011.02.18	2016.12.31	5 unnamed lakes	5	Kiwigana River	500	42,500	0	OFI, Cooling, Road Maintenance	Nov. 1 - Mar. 31
C126000	Encana Corp	2007.01.25	2011.03.14	2016.12.31	Coldstream Creek, Salt Creek, Skunk Creek, Tepee Creek, & 3 unnamed creeks	7	Murray River	240	25,000	0	OFI, Cooling, Road Maintenance	Whole Year
C126023	Encana Corp	2007.04.02	2011.02.18	2016.12.31	Komie Lake, South Texaco Lake	2	Sahtaneh River	500	40,000	0	OFI, Mining Equipment, Road Maintenance	Apr. 1 - Oct. 31
"	"	"	"	"	Tightfit Lake	1	Lower Petitot River	500	30,000	0	"	"
C126568	Progress Energy Ltd.	2010.10.26	2011.07.25	2031.12.31	Williston Lake	1	Peace Arm	10,000	3,650,000	28,992	OFI	Whole Year
C126877	CNRL	1979.06.08	2011.12.09	2021.12.31	Charlie Lake	1	Lower Beaton River	1,079	394,000	54,212	OFI	Whole Year
C127223	Canbriam Energy Inc	2011.02.15	2012.01.12	2031.12.31	Williston Lake	1	Peace Arm	10,000	3,650,000	374,095	OFI	Whole Year
C131230	Progress Energy Ltd.	2013.02.15	2014.02.28	2029.12.31	Sikanni Chief River	1	Upper Sikanni Chief River	8,000/ 12,000	2,993,000	1,269,189	OFI	Apr. 16 - Oct. 31 12,000 m <sup>3</sup> /day, Nov. 1 - Apr. 15 8,000 m <sup>3</sup> /day
C131594	Shell	2014.04.10	2014.07.09	2029.12.31	Peace River	1	Lower Peace River	5,000	350,000	0	OFI	Whole Year

# WATER LICENCES continued

## 2015 WATER USE - PURPOSE

Oil and gas-related water licences are issued for the purpose of Oil Field Injection (OFI), which includes hydraulic fracturing, except C122399 and C122423 (smaller volume water licences issued to Encana for the purpose of Industrial Processing). The majority of the water withdrawn from water licences was for hydraulic fracturing (1,726,488 m<sup>3</sup>); however, Whitecap Resources was likely using the water for enhanced oil recovery (534,947 m<sup>3</sup>).

## WATER LICENCE ADMINISTRATION

### APPROVED WATER LICENCES

There were no oil and gas related water licences issued by the Commission in 2015.

### CANCELLED WATER LICENCES

On Sep. 3, 2015, the Environmental Appeal Board released a decision to cancel water licence C127986 belonging to Nexen Inc. on North Tsea Lake. The water licence was issued by FLNRO on May 11, 2012. It had an annual approval volume of 2,500,000 m<sup>3</sup>. Nexen did not withdraw water under this licence in 2015. The full text of the decision can be found [here](#).

Encana Corporation canceled water licence C129170 for the Fort Nelson River on Oct. 1, 2015. It was issued Mar. 3, 2014 by FLRNO. The licence had an annual approval volume of 3,000,000 m<sup>3</sup>. Encana did not withdraw any water while this licence was active.

### TRANSFERRED WATER LICENCES

There were no oil and gas related water licences transferred in 2015.

## WATER LICENCE APPLICATIONS

The following is a summary of active, withdrawn, and refused applications in 2015.

### ACTIVE APPLICATIONS

Active applications are currently under review by the Commission. At the end of 2015, there were six active water licence applications (Table 6). They have a combined total annual volume request of 2.4 million m<sup>3</sup>.

TABLE 6: ACTIVE OIL AND GAS WATER LICENCE APPLICATIONS

FILE #	PRIORITY DATE (YYYY/MM/DD)	COMPANY	SOURCE	VOLUME (m <sup>3</sup> /YR)	PURPOSE
7002123	2011/01/26	Quicksilver	Emile Creek	250,000	Oil Field Injection
7002127	2011/01/26	Quicksilver	Unnamed Lake	250,000	Oil Field Injection
7002129	2011/01/26	Quicksilver	4 unnamed Lakes	250,000	Oil Field Injection
7002137	2011/05/03	Quicksilver	Coles Lake	250,000	Oil Field Injection
9000033	2015/02/04	CNRL	Pine River	650,000	Oil Field Injection
9000036	2015/03/19	Black Swan	Beatton River	780,000	Oil Field Injection

### WITHDRAWN APPLICATIONS

There were no water licence applications withdrawn by any applicant in 2015.

### DENIED APPLICATIONS

Upon review by the Commission, one application for 40,000 m<sup>3</sup> was denied (Table 7).

TABLE 7: DENIED OIL AND GAS WATER LICENCE APPLICATIONS

FILE #	APPLICATION DATE (YYYY/MM/DD)	COMPANY	SOURCE	VOLUME (m <sup>3</sup> /YR)	PURPOSE
7002110	2010/04/27	Crew Energy	Pine River	40,000	Oil Field Injection

# WATER USE APPROVALS

## SHORT-TERM WATER USE

**O**GAA provides authority to the Commission to issue short-term water use approvals under Section 8 of the Water Act:

### WATER ACT

#### Short-term use of water (Section 8)

8 (1) If diversion or use of water is required for a term not exceeding 24 months, the comptroller or a regional water manager may, without issuing a licence, grant an approval in writing, approving the diversion or use, or both, of the water on the conditions the comptroller or regional water manager considers advisable.

### 2015 WATER USE DATA

In 2015, there were 54 companies with 294 active short-term water use approvals from 1,027 points-of-diversion (Table 1, page 8). The total annual volume of water approved for withdrawal was 19,012,301 m<sup>3</sup>. The total volume of extracted water reported was 1,992,462 m<sup>3</sup> (9.8 per cent of the approved volume).

Short-term water withdrawals for 2015 (1,992,462 m<sup>3</sup>) were the lowest in the previous five year period: 2011 (3,812,085 m<sup>3</sup>), 2012 (3,756,464 m<sup>3</sup>), 2013 (2,900,519 m<sup>3</sup>), and 2014 (2,556,000 m<sup>3</sup>) respectively (Table 8).

TABLE 8 - QUARTERLY WITHDRAWALS SHORT-TERM WATER USE APPROVALS (m<sup>3</sup>), 2011 - 2015

YEAR	Q1	Q2	Q3	Q4	SUM
2011	782,388	662,767	1,266,317	1,100,613	3,812,085
2012	1,345,289	982,376	1,088,192	340,607	3,756,464
2013	1,077,316	482,054	612,542	728,607	2,900,519
2014*	1,129,749	524,058	622,614	279,579	2,556,000
2015	261,889	269,040	1,009,402	452,121	1,992,462

\*2014 withdrawal data has been amended based on additional water submissions.

TABLE 9: SHORT-TERM WATER USE APPROVALS BY WATER SOURCE TYPES IN 2015

SOURCE	NUMBER OF APPROVED WITHDRAWAL LOCATIONS		WATER APPROVAL VOLUME (m <sup>3</sup> )		WATER WITHDRAWAL VOLUME (m <sup>3</sup> )	
		%		%		%
STREAM/RIVER	190	18.5	7,763,299	40.8	590,257	29.6
LAKE	53	5.2	495,884	2.6	440	0.0
WATER SOURCE DUGOUT	760	74.0	10,626,328	55.9	1,396,560	70.1
BASIN	24	2.3	126,790	0.7	5,205	0.3
<b>GRAND TOTAL</b>	<b>1,027</b>	<b>100.0</b>	<b>19,012,301</b>	<b>100</b>	<b>1,992,462</b>	<b>100</b>

TABLE 10: 2015 SHORT-TERM APPROVALS AND USE DATA ORGANIZED BY COMPANY

## 2015 WATER USE - BY SOURCE

In 2015, water source dugouts comprised the most points-of-diversion under short-term use approval at 760 (74.0 per cent) as shown in Table 9. Rivers accounted for 190 (18.5 per cent) points-of-diversion. Water source dugouts had the highest annual approval volume at 10,626,328 m<sup>3</sup> (55.9 per cent), while rivers had the second highest with an approval volume of 7,763,299 m<sup>3</sup> (40.8 per cent). The highest volume of water withdrawn was from water source dugouts, which accounted for a withdrawal volume of 1,396,560 m<sup>3</sup> (70.1 per cent). Short-term water use approvals associated with rivers reported withdrawing a volume of 590,257 m<sup>3</sup> (29.6 per cent).

## 2015 WATER USE - BY COMPANY

A summary of short-term water use approvals for individual oil and gas companies is shown in Table 10.

In 2015, Canadian Natural Resources Limited (CNRL) had the most active points-of-diversion at 160 (15.6 per cent), followed by Endurance B.C. Gas Ltd. (133 points-of-diversion, 13.0 per cent) and Progress Energy Canada (79 points-of-diversion, 7.7 per cent). Progress Energy Canada had the greatest total approval volume at 6,701,341 m<sup>3</sup> (35.2 per cent), followed by CNRL (2,197,646 m<sup>3</sup>, 11.6 per cent) and Chevron Canada Limited (1,399,966 m<sup>3</sup>, 7.4 per cent).

Four companies, Progress Energy Limited (671,353 m<sup>3</sup>, or 33.7 per cent), Chevron Canada Limited (463,029 m<sup>3</sup>, or 23.2 per cent), Crew Energy Inc. (160,692 m<sup>3</sup>, or 8.1 per cent) and Black Swan Energy Ltd. (153,723 m<sup>3</sup>, or 7.7 per cent) accounted for nearly three quarters of all water withdrawn under short-term water use approvals.

## NORTHEAST B.C. WATER ALLOCATION

The mean annual runoff for the various rivers and streams across NEBC is about 120.6 billion m<sup>3</sup> (based on data collected by the Water Survey of Canada) as shown in Figure 1. The OGC Water Management Basins with the largest oil and gas-related total water allocation, combining water licences and short-term water use approvals, as a percentage of mean annual runoff for 2015 are listed in Table 11. For all the remaining basins, the combined oil and gas-related water allocation corresponded to less than 0.3 per cent of mean annual runoff.

Actual water withdrawal in individual basins is a small fraction of the allocated water use. The basins with largest actual volume of water withdrawn as a percentage of mean annual runoff for 2015 are listed in Table 12. For all the remaining basins, the actual volume of water withdrawn corresponded to less than 0.1 per cent of mean annual runoff.

TABLE 11: BASINS WITH THE LARGEST OIL AND GAS RELATED ALLOCATION VOLUMES AS A PERCENTAGE OF MEAN ANNUAL RUNOFF

OGC WATER MANAGEMENT BASIN	PERCENTAGE
Cameron River	0.93
Capot-Blanc Creek	0.58
Upper Beaton River	0.40
Upper Sikanni Chief River	0.38
Blueberry River	0.37
Cache Creek	0.31

TABLE 12: BASINS WITH THE LARGEST OIL AND GAS RELATED WITHDRAWAL VOLUMES AS A PERCENTAGE OF MEAN ANNUAL RUNOFF

OGC WATER MANAGEMENT BASIN	PERCENTAGE
Upper Sikanni Chief River	0.16
Cameron River	0.16
Capot-Blanc Creek	0.14
Upper Beaton River	0.10

COMPANY	NUMBER OF APPROVED WITHDRAWAL LOCATIONS	TOTAL VOLUME APPROVED (m <sup>3</sup> )	TOTAL VOLUME WITHDRAWN (m <sup>3</sup> )	COMPANY	NUMBER OF APPROVED WITHDRAWAL LOCATIONS	TOTAL VOLUME APPROVED (m <sup>3</sup> )	TOTAL VOLUME WITHDRAWN (m <sup>3</sup> )
Alliance Pipeline Ltd.	1	300	262	Imperial Oil Resources Ltd.	3	25,000	123
Apache Canada Ltd.	20	324,095	5,501	Leucrotta Exploration Inc.	1	37,500	9,323
Arc Resources Ltd.	4	257,100	0	LNG Canada Development Inc.	6	50,750	0
Baytex Energy Ltd.	1	710	0	Murphy Oil Company Ltd.	1	50,000	38,790
Black Swan Energy Ltd.	6	195,000	152,723	Nabors Drilling Canada Limited	5	31,357	0
Bonavista Energy Corp.	8	129,650	10,716	Nexen Energy ULC	37	915,950	92,691
Canadian Natural Resources Ltd.	160	2,197,646	93,208	Norcan Energy Corporation	2	7,200	0
Canadian Spirit Resources Inc.	1	42,000	0	Northpoint Resources Ltd.	1	2,000	0
Canbriam Energy Inc.	4	316,316	196	Nova Gas Transmission Ltd.	4	8,900	0
Cequence Energy Ltd.	1	560	0	Pacific Northern Gas Ltd.	8	99	0
Chevron Canada Ltd.	64	1,399,966	463,029	Pacific Trail Pipelines Mgmt Inc.	68	24,342	3,202
Chinook Energy Inc.	22	178,644	36,096	Painted Pony Petroleum Ltd.	3	224,000	0
Coastal Gaslink Pipeline Ltd.	16	7,132	0	Paramount Resources Ltd.	15	527,750	4,255
ConocoPhillips Canada Operations Ltd.	65	680,829	74,786	Pengrowth Energy Corp.	2	16,000	0
Crew Energy Inc.	2	900,000	160,692	Penn West Petroleum Ltd.	61	168,605	12,748
Devon NEC Corp.	4	4,000	549	Plateau Pipe Line Ltd.	2	19,000	0
Direct Energy Marketing Ltd.	1	4,000	816	Polar Star Canadian Oil and Gas, Inc.	8	24,640	0
Encana Corp.	47	599,307	9,409	Prince Rupert Gas Transmission Ltd.	10	9,175	0
Endurance B.C. Gas Ltd.	133	685,939	44,424	Progress Energy Canada Ltd.	79	6,701,341	671,353
Enerplus Corp.	17	169,634	2,730	Quattro Exploration and Production Ltd.	5	33,000	684
Explor Geophysical Ltd.	2	5,355	32	Quicksilver Resources Canada Ltd.	2	405,000	0
FortisBC Energy Inc.	3	3,300	0	Saguaro Resources Ltd.	6	447,714	75,856
GS E&R Canada Inc.	33	108,400	855	Secure Energy Services Ltd.	2	15,000	114
Harvest Operations Corp.	23	332,700	5,973	Seitel Canada Ltd.	2	10,990	311
Husky Oil Operations Ltd.	13	52,140	6,831	Shell Canada Limited	37	652,266	14,184
Ikkuma Resources Corp.	5	8,000	0	Trans Mountain Pipeline ULC	1	2,000	0
				<b>GRAND TOTAL</b>	<b>1,027</b>	<b>19,012,301</b>	<b>1,992,462</b>

# WATER SOURCE WELLS

The Commission has authority through OGAA for groundwater management and the regulation of water source wells. Water source wells are defined in the Petroleum and Natural Gas Act as:

“[A] hole in the ground drilled to obtain water for the purpose of injecting water into an underground formation in connection with the production of petroleum or natural gas.”

All water source wells require a well authorization from the Commission. A permit holder must measure and record the quantity and rate of water produced from the permit holder’s water source well, and report water production to the Commission monthly.

In 2015, seven companies reported withdrawing 575,434 m<sup>3</sup> of water from 27 water source wells (Table 1). The OGC Water Management Basins with the greatest groundwater extraction were Lower Sikanni Chief River (four wells, 140,067 m<sup>3</sup>), Milligan Creek (six wells, 121,125 m<sup>3</sup>), and Lower Kiskatinaw River (three wells, 96,656 m<sup>3</sup>) Table 13.

The depths of the water source wells ranged from 46 to 1,000 metres. Seventeen water source wells accessed groundwater above 300 m depth, five water source wells accessed groundwater at depths between 301 and 600 m, and five water source wells accessed groundwater from deeper reservoirs at depths greater than 600 m (Table 14).

The location of active water source wells in 2015 in relation to unconventional gas play trends is provided in Appendix 1. Several companies’ wells were outside

TABLE 13:  
REPORTED WATER SOURCE WELL  
WITHDRAWALS FOR 2015

the play trends. These companies include Ish Energy, Dejour Energy and Canadian Natural Resources Limited’s wells. These wells are used to source water to inject into the subsurface for enhanced oil recovery. The three companies withdrew 334,961 m<sup>3</sup> of water from water source wells (Table 13).

The rest of the water produced from water source wells (240,473 m<sup>3</sup>) was likely used for hydraulic fracturing for natural gas development. Saline or brackish water source wells accessing groundwater at depths > 600 m contributed 130,247 m<sup>3</sup> for hydraulic fracturing, while shallower fresh water source wells contributed 110,226 m<sup>3</sup>.

TABLE 14:  
COMPARISON  
OF WATER  
SOURCE WELL  
WITHDRAWALS  
FOR 2015

DEPTH OF WATER SOURCE WELL	HYDRAULIC FRACTURING		OIL FLOODING		TOTAL	
	Number of wells	Withdrawal Volume m <sup>3</sup>	Number of wells	Withdrawal Volume m <sup>3</sup>	Number of wells	Withdrawal Volume m <sup>3</sup>
20 - 300 m	8	110,226	9	272,253	17	324,202
301 - 600 m	1	5,140	4	62,708	5	126,125
>600 m	5	125,107	0	0	5	125,107
<b>TOTAL WELLS</b>	<b>14</b>	<b>240,473</b>	<b>13</b>	<b>334,961</b>	<b>27</b>	<b>575,434</b>

MAJOR and Sub-Basin Name	WELL NUMBER	COMPANY	DEPTH OF WELL (m)	AQUIFER FORMATION	EASTING	NORTHING	2015 WATER WITHDRAWAL (m <sup>3</sup> )
<b>BEATTON RIVER</b>							
Upper Beatton River	26846	Progress Energy Ltd.	80	Dunvegan	525002	6325277	23,674
Upper Beatton River	26848	Progress Energy Ltd.	46	Dunvegan	543348	6319308	807
Upper Beatton River	26864	Progress Energy Ltd.	98	Dunvegan	543626	6318982	12,121
Upper Beatton River	27413	Progress Energy Ltd.	49	Dunvegan	538320	6323888	15,654
Milligan Creek	25370	Canadian Natural Resources Ltd.	91	Dunvegan	643081	6303882	22,872
Milligan Creek	25371	Canadian Natural Resources Ltd.	152	Dunvegan	641831	6305985	35,751
Milligan Creek	25373	Canadian Natural Resources Ltd.	165	Dunvegan	640056	6335748	15,286
Milligan Creek	26952	Dejour Energy Ltd.	305	Dunvegan	650759	6338188	8,113
Milligan Creek	27214	Dejour Energy Ltd.	305	Dunvegan	650809	6338207	21,313
Milligan Creek	27281	Dejour Energy Ltd.	316	Dunvegan	650723	6338251	17,790
Lower Beatton River	26962	Canadian Natural Resources Ltd.	250	Dunvegan	646044	6296253	15,492
Lower Beatton River	16332	Pengrowth Energy Corporation	140	Dunvegan	637357	6262984	23,496
Lower Beatton River	25556	Pengrowth Energy Corporation	135	Dunvegan	626822	6259069	6,235
<b>BEATTON RIVER TOTAL</b>							<b>218,604</b>
<b>HALFWAY RIVER</b>							
Cameron River	26240	Progress Energy Ltd.	124	Dunvegan	547270	6313457	1,304
Cameron River	27142	Progress Energy Ltd.	49	Dunvegan	555758	6303639	26,935
Cameron River	27813	Progress Energy Ltd.	500	Dunvegan	555087	6304225	5,140
<b>HALFWAY RIVER TOTAL</b>							<b>33,379</b>
<b>KISKATINAW RIVER</b>							
Middle Kiskatinaw	29740	Encana Corporation	985	Cadotte	654347	6184880	28,308
Lower Kiskatinaw	26471	Encana Corporation	888	Cadotte	651500	6187445	13,046
Lower Kiskatinaw	28495	Encana Corporation	1,000	Cadotte	654386	6186970	42,742
Lower Kiskatinaw	28496	Encana Corporation	1,000	Cadotte	654377	6186970	40,868
<b>KISKATINAW RIVER TOTAL</b>							<b>124,964</b>
<b>PETITOT RIVER</b>							
Sahdoanah River	14893	Ish Energy Ltd.	232	Quaternary	628010	6568548	57,913
Sahdoanah River	17557	Ish Energy Ltd.	255	Quaternary	627989	6568704	364
Tsea River	25945	Nexen Inc.	749	Debolt	551298	6587792	143
<b>PETITOT RIVER TOTAL</b>							<b>58,420</b>
<b>SIKANNI CHIEF RIVER</b>							
Lower Sikanni Chief River	11449	Canadian Natural Resources Ltd.	92	Dunvegan	628676	6379191	16,806
Lower Sikanni Chief River	11499	Canadian Natural Resources Ltd.	96	Dunvegan	628415	6379606	36,115
Lower Sikanni Chief River	11500	Canadian Natural Resources Ltd.	183	Dunvegan	628004	6379264	34,252
Lower Sikanni Chief River	14995	Canadian Natural Resources Ltd.	104	Dunvegan	628436	6380161	52,894
<b>SIKANNI CHIEF RIVER TOTAL</b>							<b>140,067</b>
<b>GRAND TOTAL</b>							<b>575,434</b>

# HYDRAULIC FRACTURING

## WATER SOURCES AND REPORTING

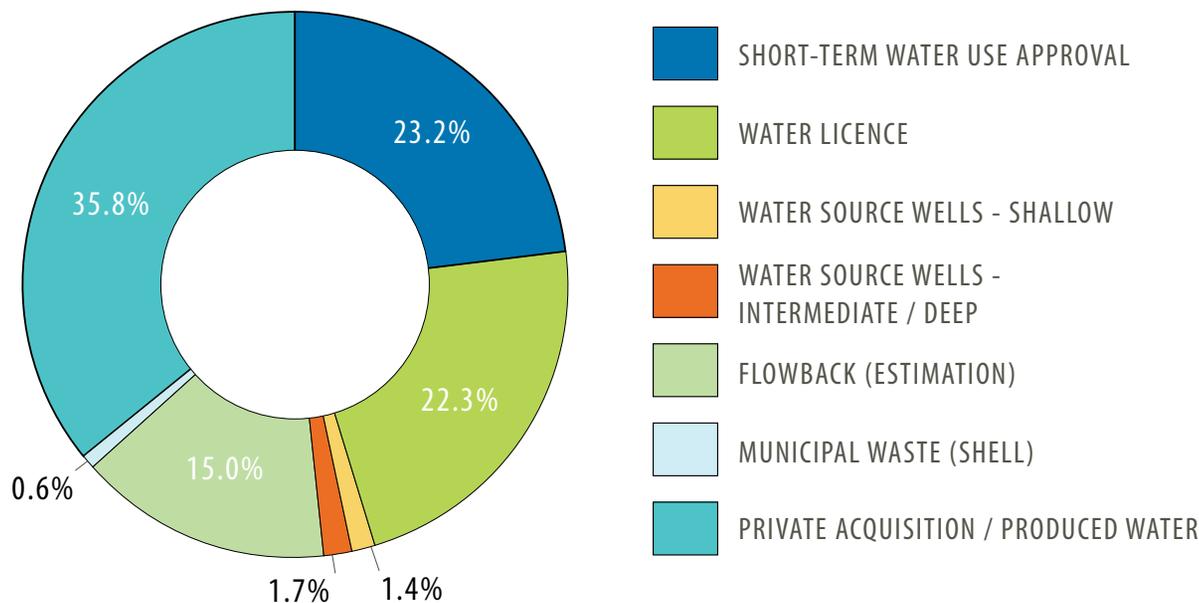
In 2012, British Columbia implemented the mandatory disclosure of ingredients used in hydraulic fracturing fluids. The website [FracFocus.ca](http://FracFocus.ca) was launched to provide public access to information on fluids and ingredients used for the hydraulic fracturing of individual natural gas wells, as well as information on the process of hydraulic

Hydraulic fracturing operations are closely monitored with related well data reported to the Commission; protection of surface water and groundwater are key priorities in the regulation of hydraulic fracturing.

fracturing and the total volumes of water injected into the subsurface. Hydraulic fracturing operations are closely monitored and related well data is reported to the Commission.

In 2015, 26 companies used a total volume of 7,735,618 m<sup>3</sup> of water for hydraulic fracturing of 534 wells (Table 1 on page 8).

FIGURE 2: SOURCES FOR ACQUISITION OF WATER USED FOR HYDRAULIC FRACTURING



The OGC Water Management Basin with the highest total volume of water used for hydraulic fracturing in 2015 was the Lower Kiskatinaw River, which is located in the Heritage Montney gas play (page 2 of Appendix 2), with 1,366,069 m<sup>3</sup> used for hydraulic fracturing of 120 wells. The next highest basins for hydraulic fracturing water use were the Upper Beatton River (1,333,110 m<sup>3</sup>; 86 wells) and the Cameron River (998,295 m<sup>3</sup>; 52 wells), both located in the North Montney.

In 2015, the average water use was 12,225 m<sup>3</sup>/well (241 wells) in the Heritage Basin, 16,258 m<sup>3</sup>/well (280 wells) in the North Montney, and 93,314 m<sup>3</sup>/well (2 wells) in the Liard Basin. There were no hydraulically fractured wells in the Horn River Basin or Cordova Embayment (Table 15).

The majority of the 7,735,618 m<sup>3</sup> of water accessed for hydraulic fracturing came from fresh surface water sources (44.5 per cent) such as rivers, lakes, and dugouts through water licences (22.3 per cent) and short-term water use approvals (23.2 per cent), Figure 2. Water source wells contributed 3.1 per cent of water, with shallower wells representing 1.4 per cent and intermediate/deep wells representing 1.7 per cent. Approximately 15.0 per cent of water was sourced by flowback and one company used a small amount of water from municipal waste treatment (0.6 per cent). The remaining water (38.5 per cent) was sourced from private acquisition or produced water.

It is against the law in B.C. to dispose of fluids that have been used for hydraulic fracturing into the environment.

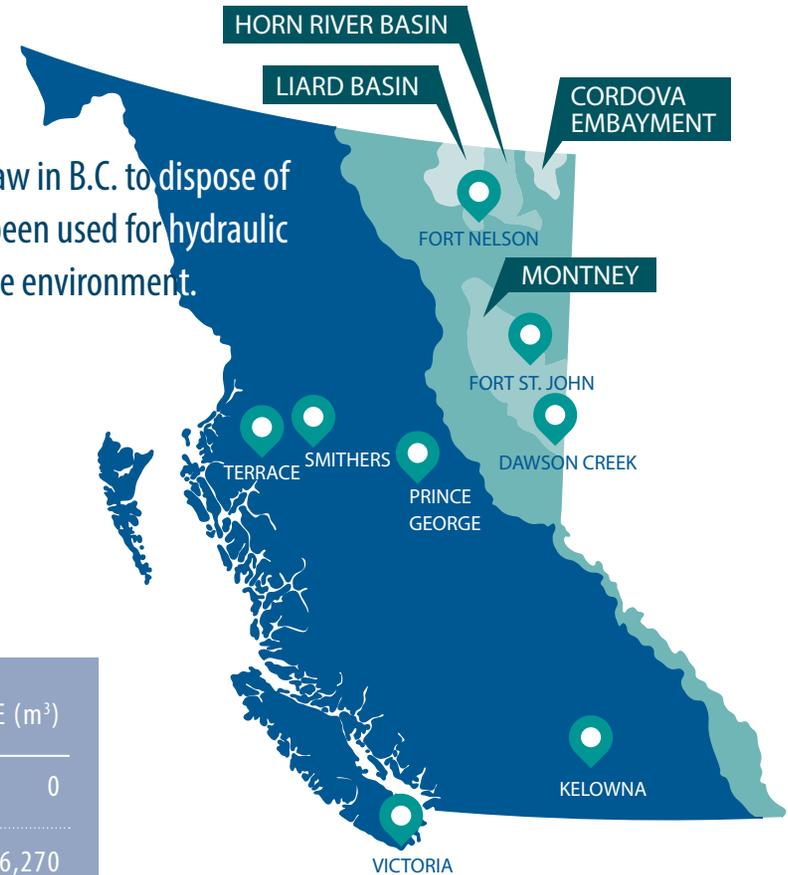


TABLE 15: WATER USED FOR HYDRAULIC FRACTURING IN 2015

PLAY	NUMBER OF WELLS	MEAN (m <sup>3</sup> / WELL)	TOTAL WATER USE (m <sup>3</sup> )
HORN RIVER BASIN	0	0	0
MONTNEY - HERITAGE	241	12,225	2,946,270
MONTNEY - NORTH	280	16,258	4,552,124
LIARD BASIN	2	93,314	186,627
CORDOVA EMBAYMENT	0	0	0
OTHER	11	4,600	50,597
<b>TOTAL</b>	<b>534</b>	<b>17,034</b>	<b>7,735,618</b>

FIGURE 3: NEBC NATURAL GAS PLAYS AND COMMISSION OFFICE LOCATIONS

## HYDRAULIC FRACTURING WATER USE - COMPANY

Progress Energy Canada Ltd. used the most water and completed the largest number of wells for hydraulic fracturing in 2015. Progress Energy injected 3,351,744 m<sup>3</sup> of water to hydraulically fracture 189 wells (Table 16). Progress Energy's wells were completed in the North Montney.

The next highest water volumes used by companies for hydraulic fracturing injection were Arc Resources Ltd. (injected 812,626 m<sup>3</sup> for 47 wells in the Heritage and North Montney), Encana Corporation (injected 587,856 m<sup>3</sup> for 30 wells in the Heritage), Shell Canada Limited (injected 551,194 m<sup>3</sup> for 57 wells in the Heritage and North Montney), and Tourmaline Oil Corporation (injected 471,074 m<sup>3</sup> for 56 wells in the Heritage).

Several companies used very little water for their hydraulic fracturing operations and may have used propane as the carrier fluid. Some companies may have only fractured one stage of a multi-stage horizontal well to maintain ownership of a particular gas lease.

TABLE 16: SUMMARY OF 2015 HYDRAULIC FRACTURING WATER INJECTION BY COMPANY

COMPANY	NUMBER OF WELLS	TOTAL WATER VOLUME INJECTED (m <sup>3</sup> )	AVERAGE WATER VOLUME PER WELL (m <sup>3</sup> )	COMPANY	NUMBER OF WELLS	TOTAL WATER VOLUME INJECTED (m <sup>3</sup> )	AVERAGE WATER VOLUME PER WELL (m <sup>3</sup> )
Aqua Terra Water Inc.	1	62	62	Kelt LNG	5	68,258	13,652
Arc Resources Ltd.	47	812,626	17,290	Leucrotta Exploration Inc.	4	42,542	10,636
Black Swan Energy Ltd.	15	145,268	9,685	Murphy Oil Company Ltd.	19	243,440	12,813
Bonavista Energy Corp.	1	16,558	16,558	Omers Energy Inc.	1	308	308
Canbriam Energy Inc.	19	419,857	22,098	Painted Pony Petroleum Ltd.	9	124,965	13,885
Chevron Canada Ltd.	2	186,627	93,314	Polar Star Canadian Oil and Gas, Inc.	2	170	85
Chinook Energy (2010) Inc.	4	20,915	5,229	Progress Energy Canada Ltd.	189	3,351,744	17,734
Canadian Natural Resources Ltd.	10	111,720	11,172	Saguaro Resources Ltd.	8	113,688	14,211
ConocoPhillips Canada Operations Ltd.	3	58,243	19,414	Shell Canada Ltd.	57	551,194	9,670
Crew Energy Inc.	25	219,068	8,763	Storm Resources Ltd.	12	71,821	5,985
Encana Corp.	30	587,856	19,595	Todd Energy Canada Ltd.	1	14,423	14,423
Endurance B.C. Gas Ltd.	10	34,163	3,416	Tourmaline Oil Corp.	56	471,074	8,412
Huron Resources	1	44	44	UGR Blair Creek Ltd.	3	68,984	22,995
				<b>TOTAL</b>	<b>534</b>	<b>7,735,618</b>	<b>14,486</b>

# OGC WATER MANAGEMENT BASINS SUMMARY MAPS

The following four pages present summary maps of the OGC Water Management Basins (WMB). The WMBs were established using the Ministry of Environment's Freshwater Atlas mapping and developed for the purpose of managing oil and gas-related water activities.

The maps provide coverage of the NEBC river basins, summarizing 2015 water use in the Montney, Liard Basin, Horn River Basin, and Cordova Embayment gas plays.

The water volume colour scheme is the same for all the maps. Specific data for the individual watersheds is found in Appendix 2.

## MAP LEGEND

The maps present three sets of information:



### TOTAL VOLUME OF WATER LICENCED AND APPROVED

The first maps display the total volume of water licenced and approved under short-term approvals for 2015. The yellow circles show the individual points-of-diversion for water licences and the white circles represent the points-of-diversion for short-term approvals.



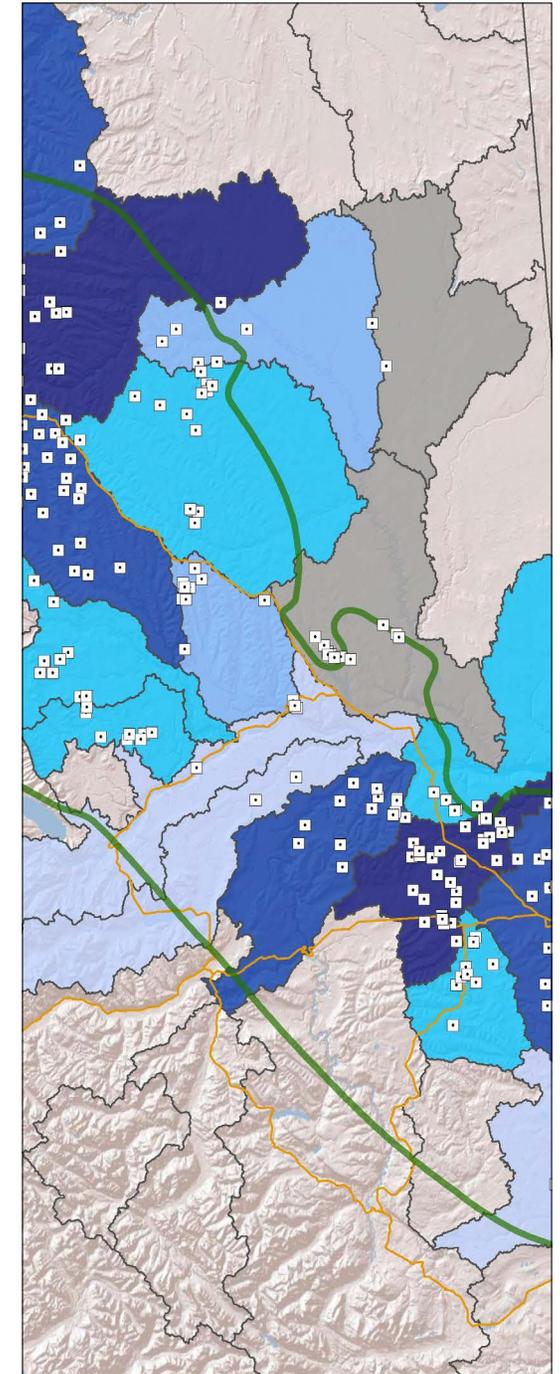
### TOTAL VOLUME OF WATER WITHDRAWN FROM LICENCES AND APPROVALS

The second maps show the actual cumulative amount of water withdrawn from water licences and short-term approvals in 2015. The yellow circles with black dots represent water licence points-of-diversion that withdrew water. The white circles with black dots are the short-term approval points-of-diversion that withdrew water. Nearly two-thirds of the short-term approvals reported zero withdrawals from the approved locations.



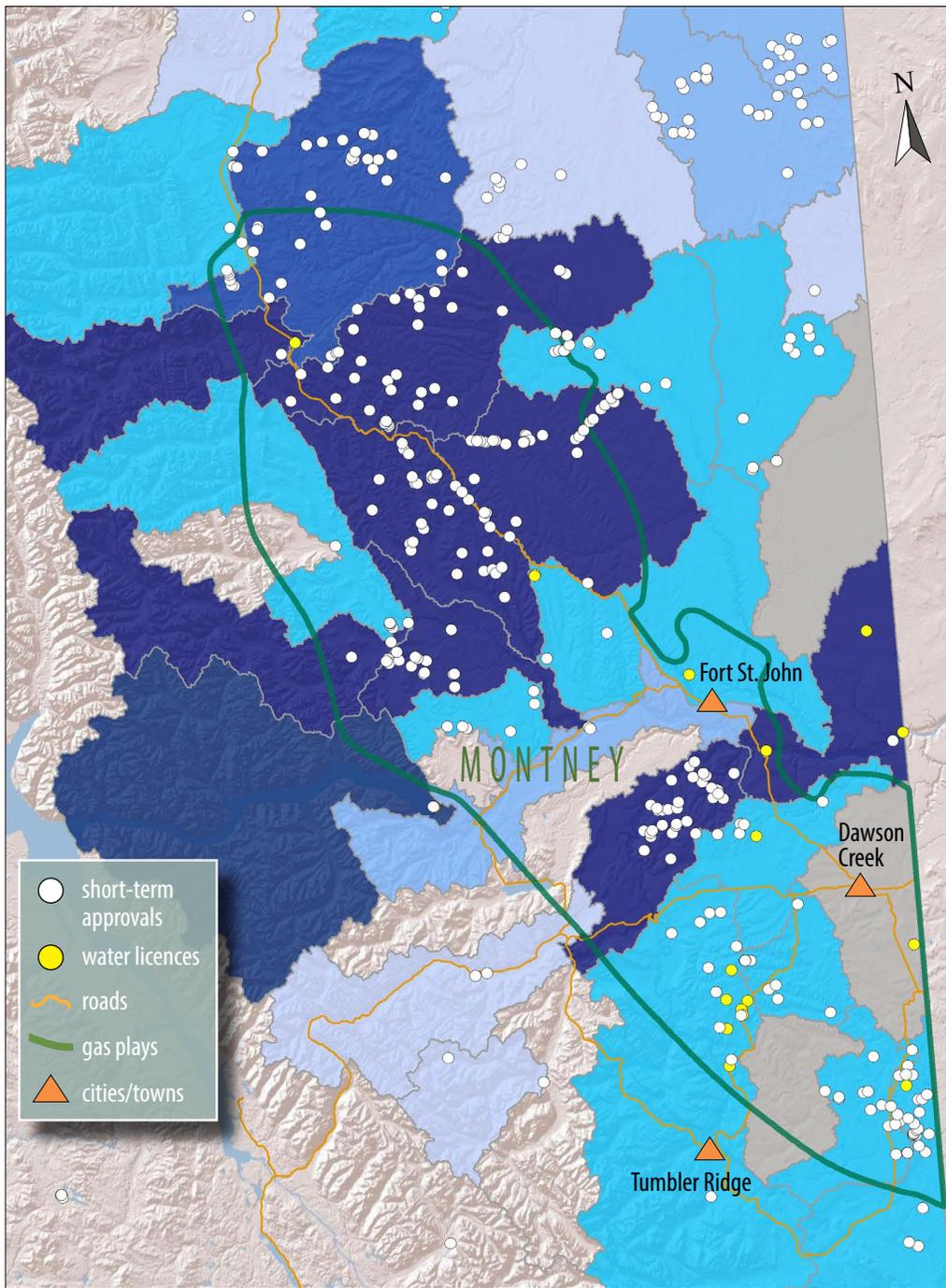
### TOTAL VOLUME OF WATER INJECTED FOR HYDRAULIC FRACTURING

The third and final maps display the total volume of water injected for hydraulic fracturing in 2015 within an OGC WMB. The white squares with dots inside represent the location of a hydraulic fracturing well. Wells may be located on multi-well pads, so several wells may appear to be located at a single point on the map.



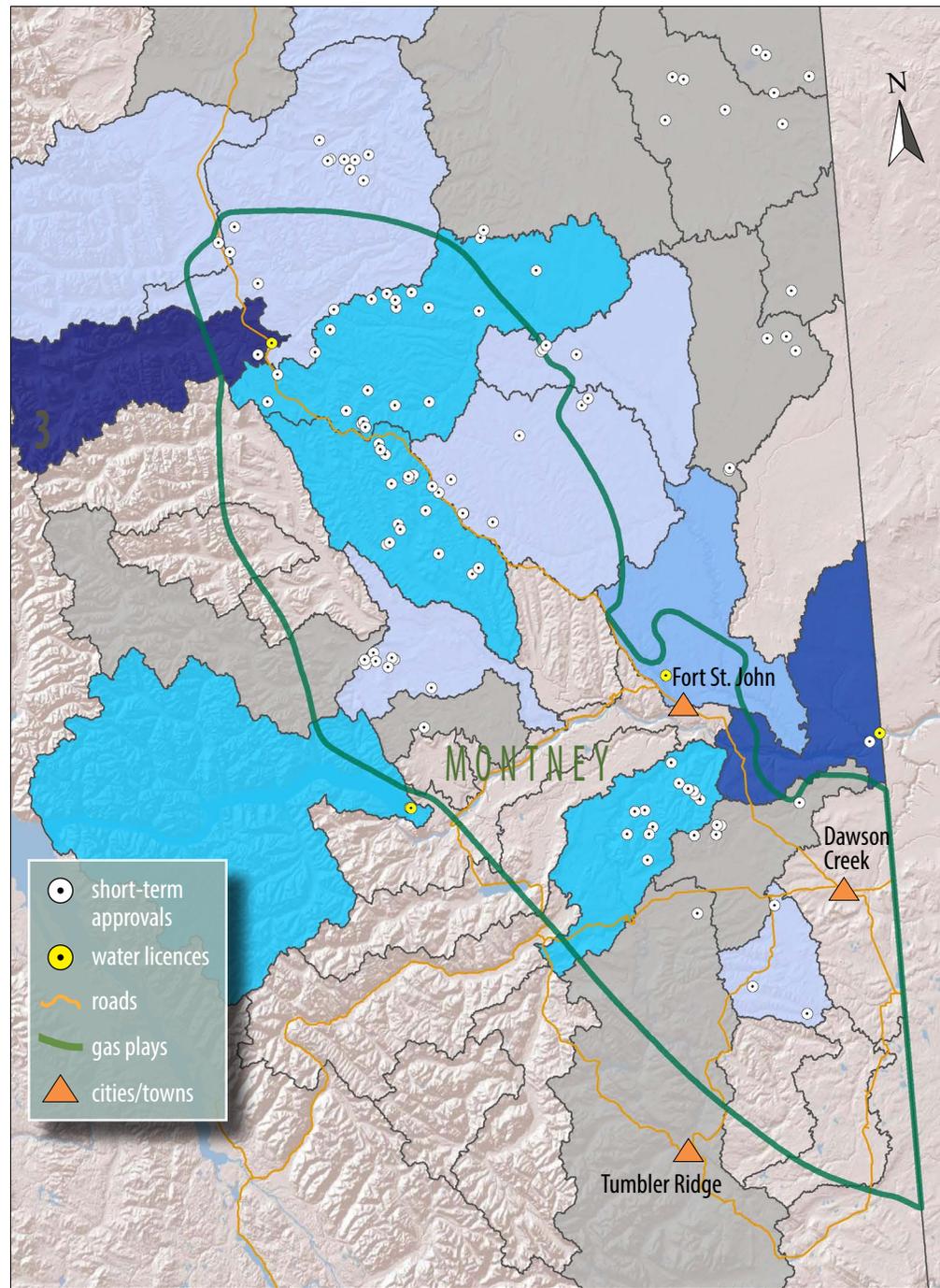
1

VOLUME OF WATER LICENCED AND APPROVED UNDER SHORT-TERM FOR 2015

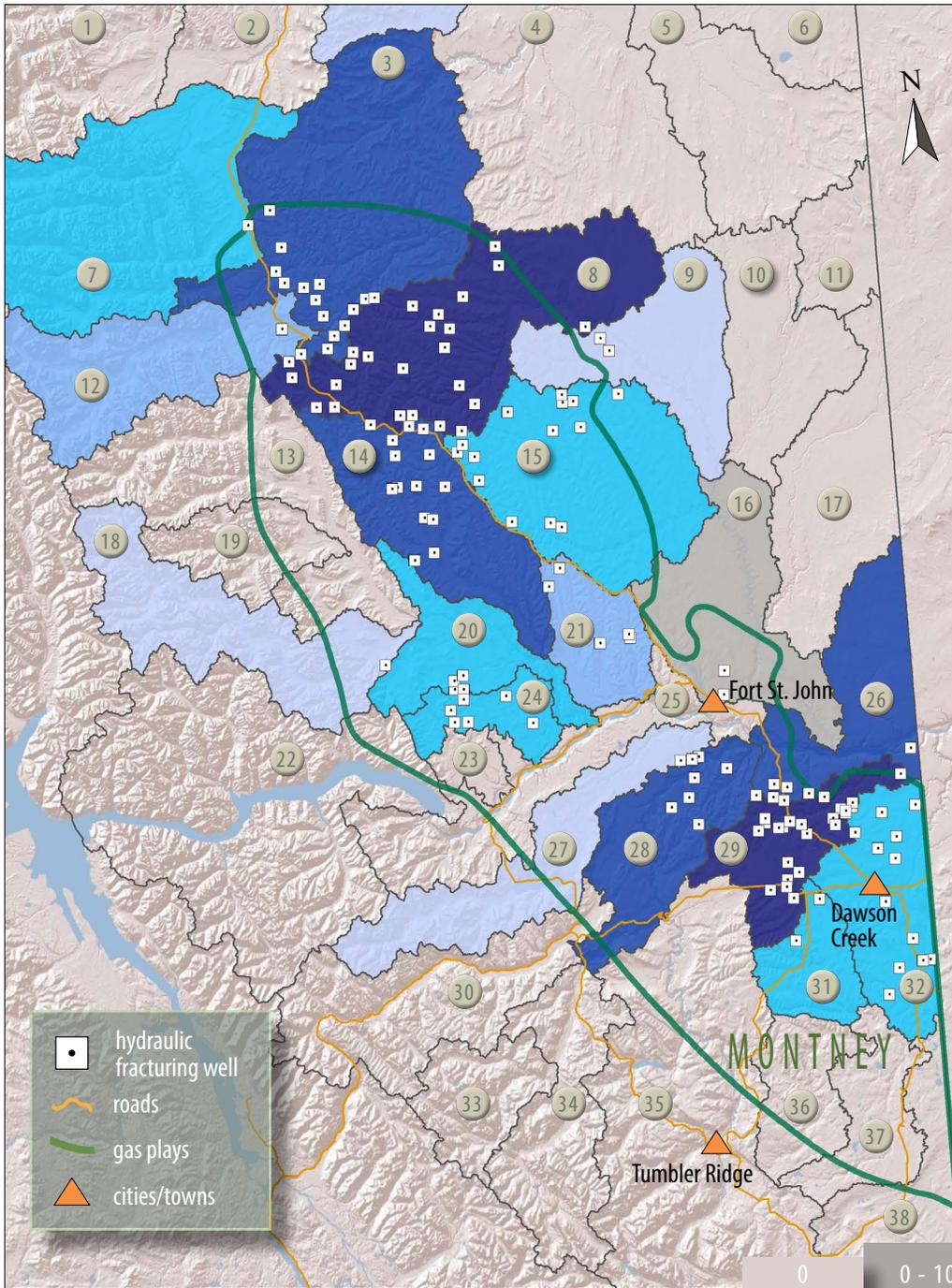


2

VOLUME OF WATER WITHDRAWN FROM LICENCES AND APPROVALS IN 2015



VOLUME OF WATER INJECTED FOR HYDRAULIC FRACTURING IN 2015



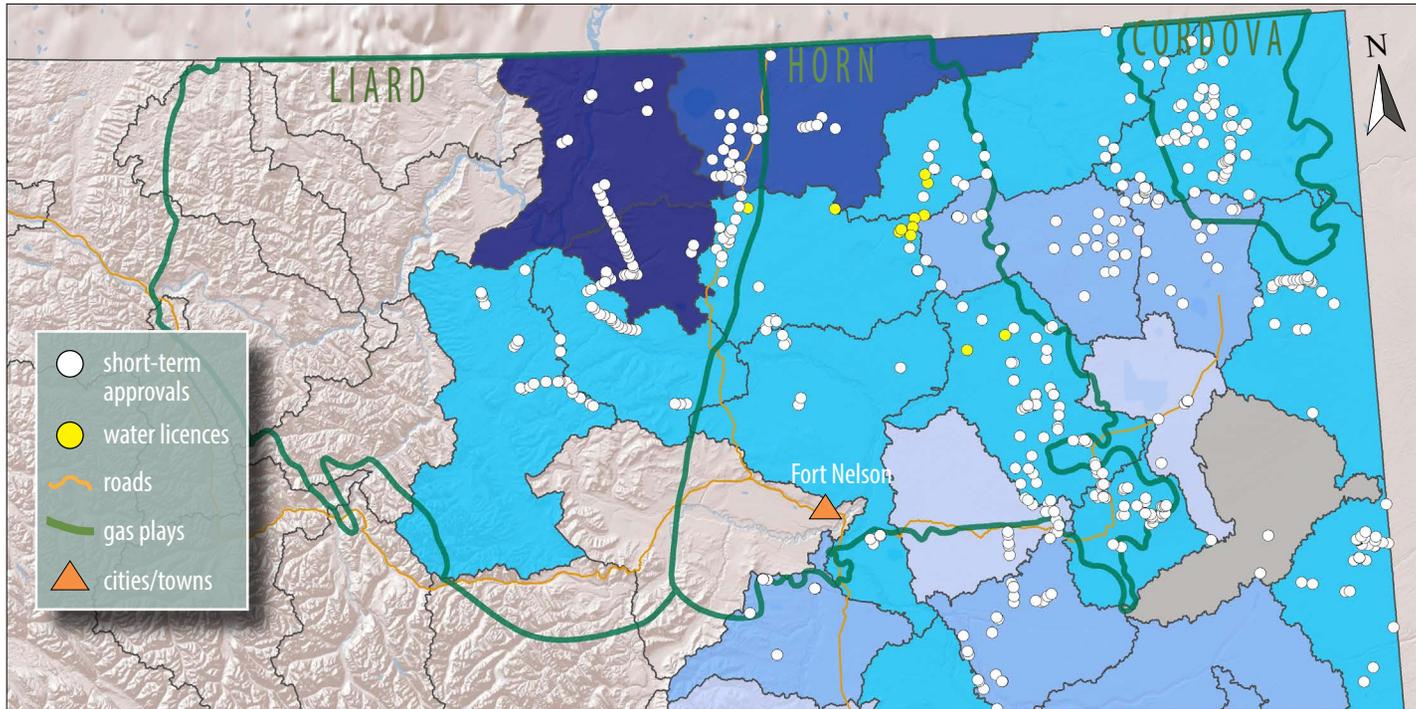
MONTNEY WATERSHEDS

scale 1:1,500,000

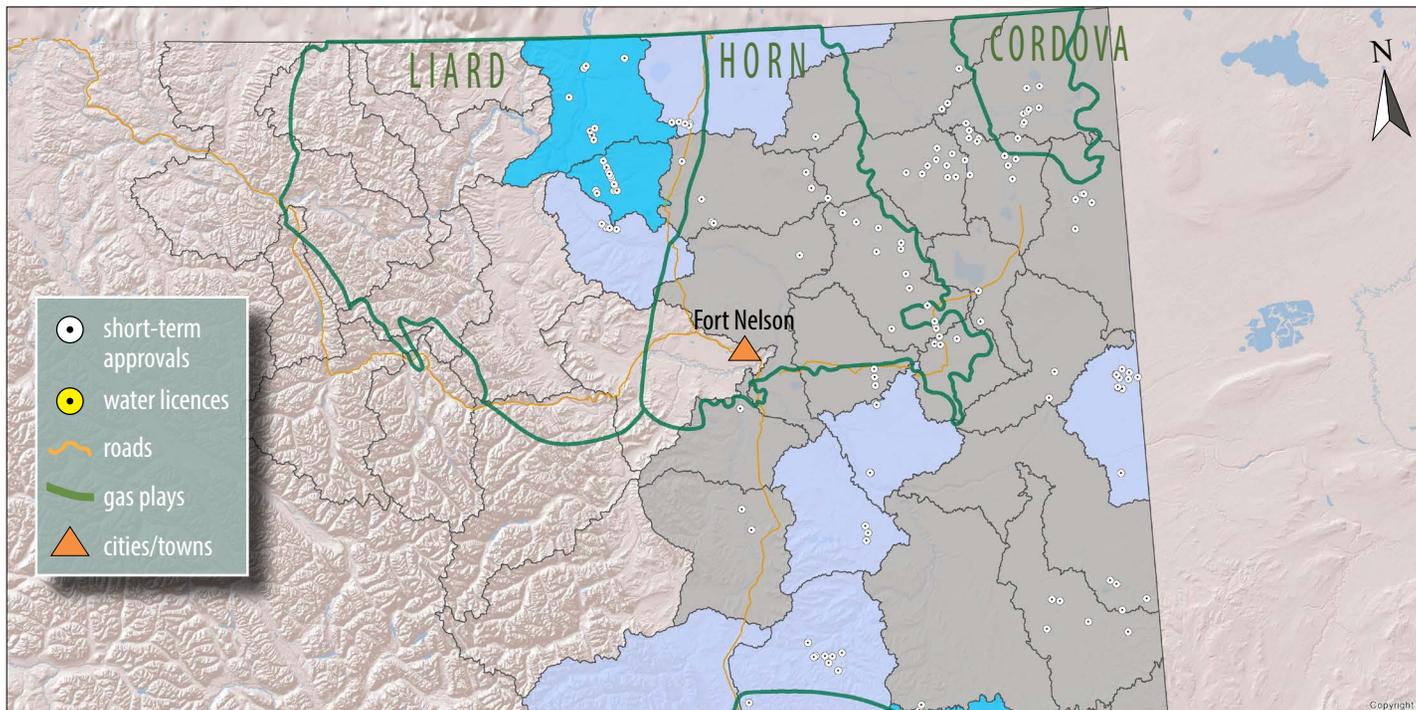
- 1 Upper Muskwa River
- 2 Middle Prophet River
- 3 Middle Sikanni Chief River
- 4 Lower Sikanni Chief River
- 5 Kahntah River
- 6 Fontas River
- 7 Upper Prophet River
- 8 Upper Beatton River
- 9 Middle Beatton River
- 10 Milligan Creek
- 11 Chinchaga River
- 12 Upper Sikanni Chief River
- 13 Upper Halfway River
- 14 Cameron River
- 15 Blueberry River
- 16 Lower Beatton River
- 17 Doig River
- 18 Graham River
- 19 Chowade River
- 20 Lower Halfway River
- 21 Cache Creek
- 22 Peace Arm
- 23 Lynx Creek
- 24 Farrell Creek
- 25 Upper Peace River
- 26 Lower Peace River
- 27 Moberly River
- 28 Lower Pine River
- 29 Lower Kiskatinaw River
- 30 Upper Pine River
- 31 Middle Kiskatinaw
- 32 Pouce Coupe River
- 33 Burnt River
- 34 Sukunka River
- 35 Murray River
- 36 West Kiskatinaw River
- 37 East Kiskatinaw River
- 38 Smoky River

m<sup>3</sup> = cubic metres  
 K = 1,000 m<sup>3</sup>  
 M = 1,000,000 m<sup>3</sup>





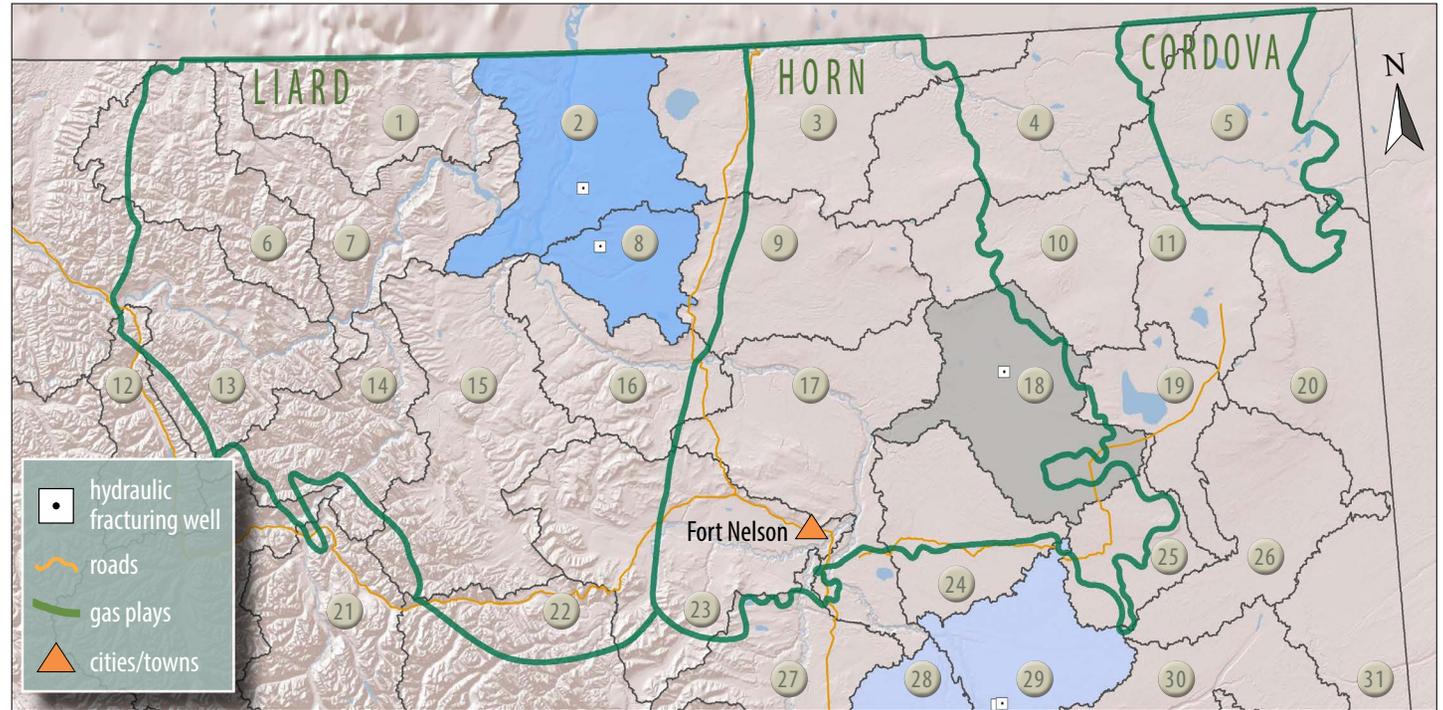
**1**  
TOTAL VOLUME OF WATER  
LICENCED AND APPROVED  
FOR 2015



**2**  
TOTAL VOLUME OF WATER  
WITHDRAWN FROM  
LICENCES AND APPROVALS  
IN 2015

# LIARD BASIN, HORN RIVER BASIN, & CORDOVA EMBAYMENT WATERSHEDS

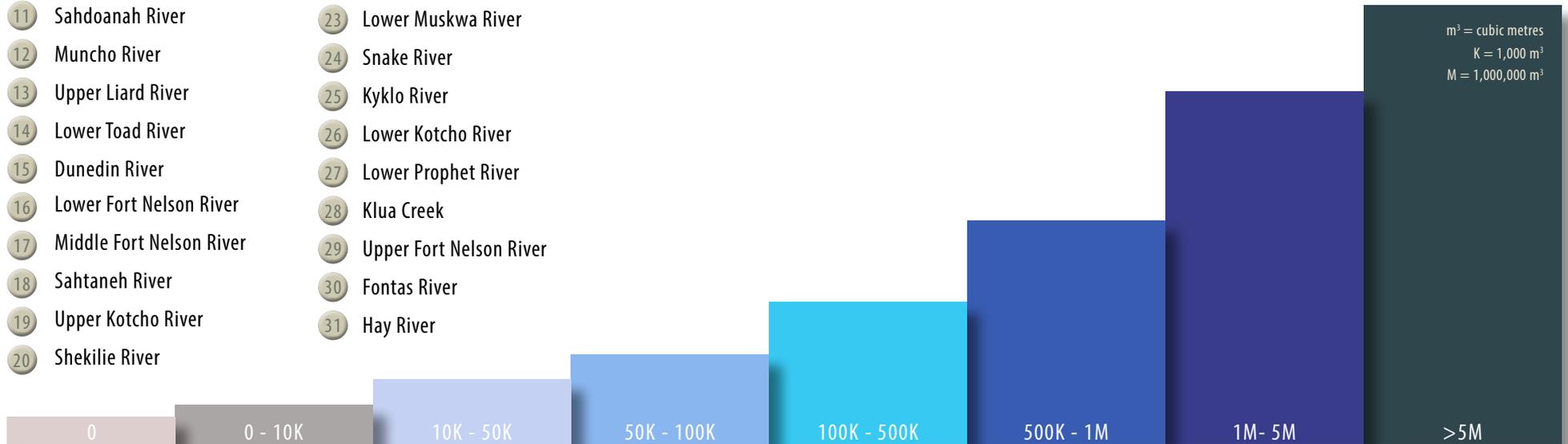
scale 1:1,500,000



- 1 Beaver River
- 2 Lower Liard River
- 3 Lower Petitot River
- 4 Middle Petitot River
- 5 Upper Petitot River
- 6 Grayling River
- 7 Middle Liard River
- 8 Capot-Blanc Creek
- 9 Kiwigana River
- 10 Tsea River
- 11 Sahdoanah River
- 12 Muncho River
- 13 Upper Liard River
- 14 Lower Toad River
- 15 Dunedin River
- 16 Lower Fort Nelson River
- 17 Middle Fort Nelson River
- 18 Sahtaneh River
- 19 Upper Kotcho River
- 20 Shekilie River

- 21 Racing River
- 22 Middle Muskwa River
- 23 Lower Muskwa River
- 24 Snake River
- 25 Kyklo River
- 26 Lower Kotcho River
- 27 Lower Prophet River
- 28 Klua Creek
- 29 Upper Fort Nelson River
- 30 Fontas River
- 31 Hay River

## 3 TOTAL VOLUME OF WATER INJECTED FOR HYDRAULIC FRACTURING IN 2015



# COMMISSION INNOVATION

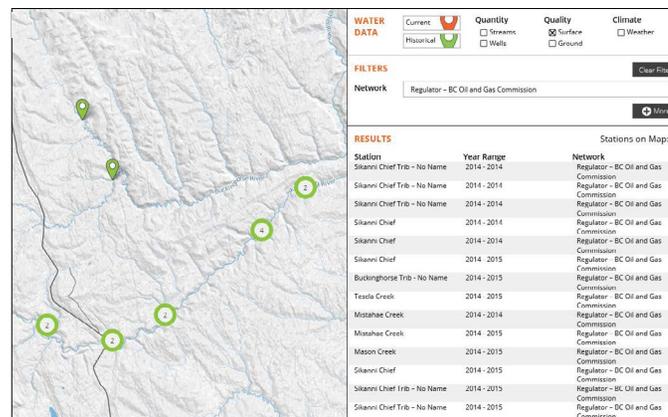
## ACADEMIC RESEARCH

The Commission continues to provide technical support for water-related academic research initiatives:

- UVic Isotope Database: has the potential to assist in assessment of methane sources in groundwater.
- Simon Fraser University (SFU) studies: springs characterization, and aquifer vulnerability (completed).
- SFU Proposed Research: subsurface risks of wastewater handling.
- UBCO Research: estimating the life-cycle water footprint of hydraulic fracturing.
- UBC Evaluation: gas migration near production wells and abandoned wells associated with unconventional gas developments.
- Provision of letters of endorsement supporting academic research with outcomes potentially relevant to the regulation of oil and gas activities in B.C. (e.g., [GenomeBC](#)).
- Assisting with the review of research proposals by way of funding from the BC Oil and Gas Research and Innovation Society ([BC OGRIS](#)).

## INDUSTRY WATER DATA

The Commission requires industry to submit hydrometric and water quality data as a requirement for water licence application or as an ongoing condition of the water licence. The data is uploaded into the Water Portal and can be filtered using the appropriate oil and gas related network. In many areas, the data is filling gaps of coverage from other networks.



## WATER SOURCE WELL APPLICATION REVIEW PROCESS AMENDED

The Commission modified two aspects of the water source well application review process.

### 1. Water source well requirements:

- New requirements associated with hydrogeological assessment, data submission, and monitoring have been established for two categories of water source wells: “shallow” water source wells (<600 m depth) and “deep” water source wells (>600 m depth).

### 2. Permitting requirements:

- Water source wells greater than 300 m depth, or if located on private land at any depth, require application for a well permit.
- Water source test wells drilled on Crown Land up to 300 m depth require an Investigative Use Permit (IUP) through a Crown Land Application. A well permit is required for each water source test well that will be operated as a water source well.

Further details are outlined in the [“Supplementary Information for Water Source Wells”](#).

## GLOSSARY

**Aquifer:** An underground layer of permeable rock that can contain groundwater.

**Basin Short-term Water Use Approval:** A basin approval not for a specific point-of-diversion. Instead, it allows for withdrawals of up to 45 m<sup>3</sup>/day, to a maximum of 5,000 m<sup>3</sup>/year, specific to a drainage basin.

**Brackish or Briny Water:** Water with a salinity level between fresh water and saline water.

**Dugout (Water Source Dugout):** A pit used as a source of water that has naturally accumulated (from snowmelt, rainfall, or groundwater inflow).

**Flowback Water:** Water that returns to the surface after being injected for hydraulic fracturing.

**Fresh Water:** Water containing low concentrations of dissolved salts that may be suitable for drinking (before or after treatment).

**Groundwater:** Water located beneath the Earth's surface.

**Groundwater Well:** A well drilled for the purpose of obtaining water.

**Hydraulic Fracturing:** The injection of liquid at high pressure into the subsurface to fracture rock for the purpose of extracting oil or gas.

**Hydrogeology:** (hydro - meaning water, and - geology meaning the study of the Earth) is the area of geology that deals with the distribution and movement of groundwater in the soil and rocks of the Earth's crust (commonly in aquifers).

**Hydrology:** The study of the movement, distribution, and quality of water on Earth, including water resources and cycles, and environmental watershed sustainability.

**m<sup>3</sup>:** A measure of volume - cubic metres; 1m x 1m x 1m; 1,000 litres.

**OGAA:** The Oil and Gas Activities Act.

**Points-of-Diversion:** A location on the natural channel of a stream where an applicant proposes, or a licensee is authorized, to divert water from the stream.

**Produced Water:** Water that flows to the surface as a by-product of oil and gas production.

**Runoff:** The draining of water over a land surface.

**Saline Water:** Water containing a significant concentration of dissolved salts that is non-potable (not safe for consumption).

**Short-term Water Use (STWU) Approval:** A short-term water use approval issued under Section 8 of the Water Act for up to 24 months.

**Stream:** A natural watercourse or source of water supply, whether usually containing water or not, and a lake, river, creek, spring, ravine, swamp and gulch.

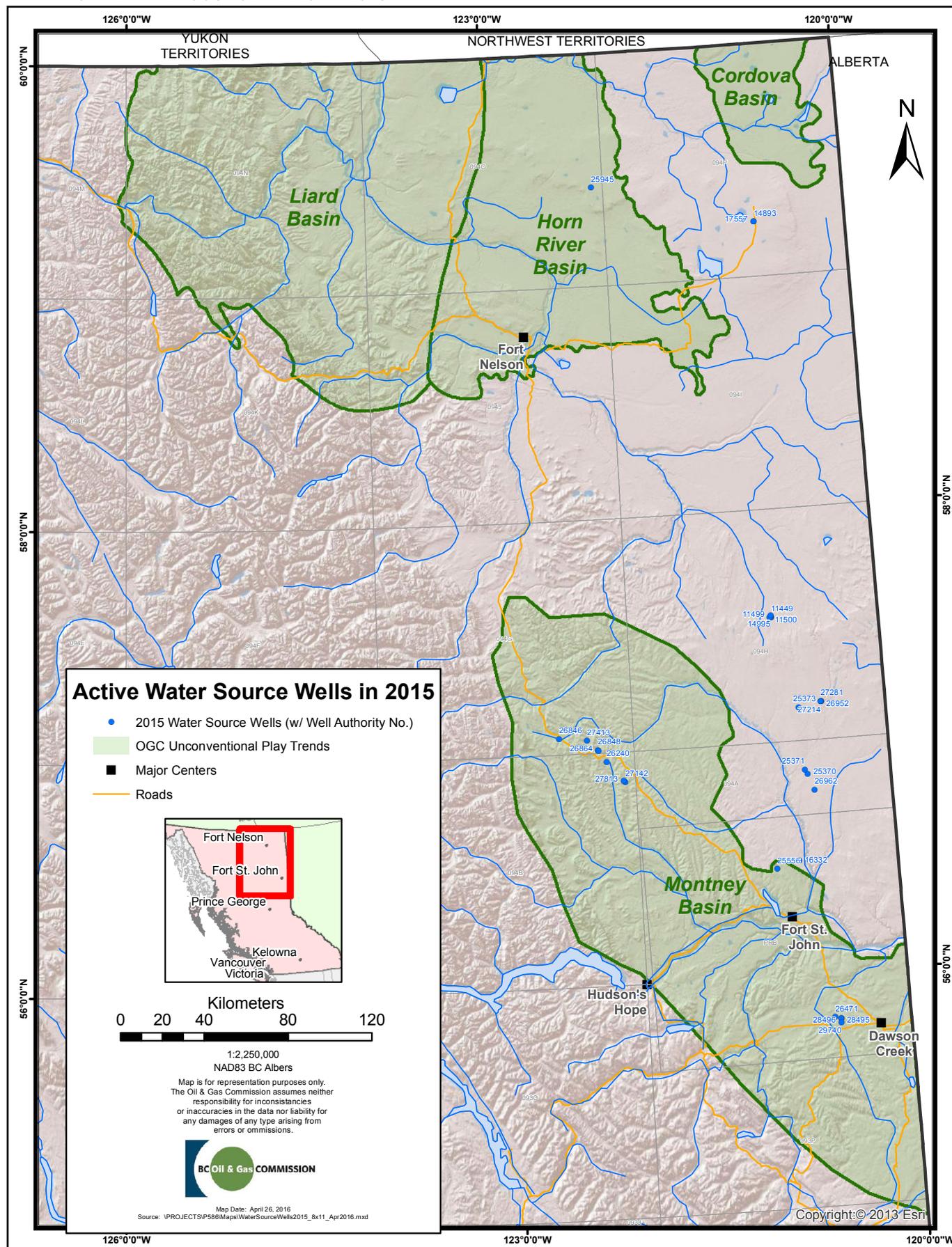
**Water Act:** The provincial legislation that establishes the provincial government as the "owner" of the water. Rights to use the water are established under licences or approvals issued under the Act.

**Water Licence:** The long-term authority to divert and use surface water in accordance with the statutory requirements of the Water Act.

**Water Source Wells:** A hole in the ground drilled to obtain water for the purpose of injecting water into an underground formation in connection with the production of petroleum or natural gas.

# APPENDIX 1

## MAP - ACTIVE WATER SOURCE WELLS IN 2015



# APPENDIX 2

## WATER ALLOCATION AND USE FOR OIL AND GAS ACTIVITIES, ORGANIZED BY OGC WATER MANAGEMENT BASIN, IN 2015

Page 1 of 5



MAJOR and Sub-Basin Name	SHORT-TERM WATER USE APPROVALS BC OIL AND GAS COMMISSION					OIL AND GAS RELATED WATER LICENCES					NON OIL AND GAS WATER LICENCES - FLNRO AS OF OCT. 2014				WATER SOURCE WELLS		HYDRAULIC FRACTURING	
	NUMBER OF APPROVED WITHDRAWAL LOCATIONS	TOTAL VOLUME APPROVED (m³)	TOTAL VOLUME APPROVED AS % of MEAN ANNUAL RUNOFF	TOTAL VOLUME WITHDRAWN (m³)	TOTAL VOLUME WITHDRAWN AS % OF MEAN ANNUAL RUNOFF	NUMBER OF LICENCED WITHDRAWAL LOCATIONS	TOTAL VOLUME LICENCED (m³)	TOTAL VOLUME LICENCED AS % of MEAN ANNUAL RUNOFF	TOTAL VOLUME WITHDRAWN (m³)	TOTAL VOLUME WITHDRAWN AS % OF MEAN ANNUAL RUNOFF	NUMBER OF LICENCED WITHDRAWAL LOCATIONS	TOTAL VOLUME LICENCED (m³)	TOTAL VOLUME LICENCED as % of MEAN ANNUAL RUNOFF	MEAN ANNUAL RUNOFF (m³)	NUMBER OF WELLS	TOTAL VOLUME WITHDRAWN (m³)	NUMBER OF WELLS	TOTAL VOLUME INJECTED (m³)
<b>BEATTON RIVER</b> (sub-basin of Peace River)																		
Upper Beatton River	38	2,017,290	0.404%	489,250	0.098%	0					0			499,408,440	4	52,256	86	1,333,110
Middle Beatton River	13	160,800		34,661		0					0			249,152,995	0		3	15,787
<b>Middle Beatton Total</b> (incl. Upper Beatton)	<b>51</b>	<b>2,178,090</b>	<b>0.291%</b>	<b>523,911</b>	<b>0.070%</b>	<b>0</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0</b>	<b>0.000%</b>	<b>748,561,435</b>	<b>4</b>	<b>52,256</b>		
Milligan Creek	9	170,340	0.089%	2,208	0.001%	0					0			191,536,686	6	121,125	0	
Blueberry River	46	1,080,874	0.369%	49,197	0.017%	0					33	154,631	0.053%	293,278,540			38	482,963
Doig River	1	3,000	0.001%	0	0.000%	0					18	25,929	0.008%	323,069,523	0		0	
Lower Beatton River	0			0		1	394,000		54,212		96	4,530,328		138,262,629	3	45,223	2	166
<b>BEATTON TOTAL</b>	<b>107</b>	<b>3,432,304</b>	<b>0.203%</b>	<b>575,316</b>	<b>0.034%</b>	<b>1</b>	<b>394,000</b>	<b>0.023%</b>	<b>54,212</b>	<b>0.003%</b>	<b>147</b>	<b>4,710,888</b>	<b>0.278%</b>	<b>1,694,708,813</b>	<b>13</b>	<b>218,604</b>	<b>129</b>	<b>1,832,026</b>
<b>HALFWAY RIVER</b> (sub-basin of Peace River)																		
Chowade River	0					0					0			327,027,527	0		0	
Upper Halfway River	6	222,550		0		0					15	141,983		795,962,409	0		0	
<b>Upper Halfway Total</b> (includes Chowade)	<b>6</b>	<b>222,550</b>	<b>0.020%</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0.000%</b>	<b>15</b>	<b>141,983</b>	<b>0.013%</b>	<b>1,122,989,936</b>				
Graham River	3	1,416,800	0.165%	34	0.000%	0					4	3,319	0.000%	860,627,172	0		3	39,087
Cameron River	31	2,086,681	0.933%	358,262	0.160%	0					3	7,467	0.003%	223,679,567	3	33,378	52	998,295
Lower Halfway River	19	2,088,372		22,473		0					23	1,040,390		151,526,991	0		12	309,075
<b>HALFWAY TOTAL</b>	<b>59</b>	<b>5,814,403</b>	<b>0.246%</b>	<b>380,769</b>	<b>0.016%</b>	<b>0</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0.000%</b>	<b>45</b>	<b>1,193,159</b>	<b>0.051%</b>	<b>2,358,823,666</b>	<b>3</b>	<b>33,378</b>	<b>67</b>	<b>1,346,457</b>
<b>MOBERLY RIVER</b> (sub-basin of Peace River)																		
Moberly River	0			0		0					21	83,165	0.021%	391,714,995	0		3	32,800
<b>MOBERLY TOTAL</b>	<b>0</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0.000%</b>	<b>21</b>	<b>83,165</b>	<b>0.021%</b>	<b>391,714,995</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>32,800</b>
<b>PINE RIVER</b> (sub-basin of Peace River)																		
Burnt River	3	23,080	0.003%	0	0.000%	0					5	35,038	0.005%	737,930,022	0		0	
Sukunka River	0					0					11	72,163		1,047,282,572	0		0	
<b>Sukunka River Total</b> (includes Burnt)	<b>3</b>	<b>23,080</b>	<b>0.001%</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0.000%</b>	<b>16</b>	<b>107,201</b>	<b>0.006%</b>	<b>1,785,212,594</b>				
Upper Pine River	2	19,000	0.001%	0	0.000%	0					27	2,455,557	0.167%	1,466,884,035	0		0	
Murray River	12	116,794	0.004%	120	0.000%	7	25,000	0.001%	0	0.000%	70	32,313,720	1.198%	2,698,285,017	0		0	
Lower Pine River	36	2,165,971		239,341		0					36	5,576,562		137,619,889	0		61	644,395
<b>PINE TOTAL</b>	<b>53</b>	<b>2,324,845</b>	<b>0.038%</b>	<b>239,461</b>	<b>0.004%</b>	<b>7</b>	<b>25,000</b>	<b>0.000%</b>	<b>0</b>	<b>0.000%</b>	<b>149</b>	<b>40,453,040</b>	<b>0.664%</b>	<b>6,088,001,535</b>	<b>0</b>	<b>0</b>	<b>61</b>	<b>644,395</b>

WATER ALLOCATION AND USE FOR OIL AND GAS ACTIVITIES, ORGANIZED BY OGC WATER MANAGEMENT BASIN, IN 2015



MAJOR and Sub-Basin Name	SHORT-TERM WATER USE APPROVALS BC OIL AND GAS COMMISSION					OIL AND GAS RELATED WATER LICENCES					NON OIL AND GAS WATER LICENCES - FLNRO AS OF OCT. 2014				WATER SOURCE WELLS		HYDRAULIC FRACTURING	
	NUMBER OF WITHDRAWAL LOCATIONS	TOTAL VOLUME APPROVED (m³)	TOTAL VOLUME APPROVED AS % of MEAN ANNUAL RUNOFF	TOTAL VOLUME WITHDRAWN (m³)	TOTAL VOLUME WITHDRAWN AS % OF MEAN ANNUAL RUNOFF	NUMBER OF LICENCED WITHDRAWAL LOCATIONS	TOTAL VOLUME LICENCED (m³)	TOTAL VOLUME LICENCED AS % of MEAN ANNUAL RUNOFF	TOTAL VOLUME WITHDRAWN (m³)	TOTAL VOLUME WITHDRAWN AS % OF MEAN ANNUAL RUNOFF	NUMBER OF WITHDRAWAL LOCATIONS	TOTAL VOLUME LICENCED (m³)	TOTAL VOLUME LICENCED as % of MEAN ANNUAL RUNOFF	MEAN ANNUAL RUNOFF (m³)	NUMBER OF WELLS	TOTAL VOLUME WITHDRAWN (m³)	NUMBER OF WELLS	TOTAL VOLUME INJECTED (m³)
<b>KISKATINAW RIVER</b> (sub-basin of Peace River)																		
West Kiskatinaw River	1	9,000	0.008%	0	0.000%	0					0			117,515,115	0		0	
East Kiskatinaw River	17	110,100	0.104%	0	0.000%	0					8	4,530,497	4.296%	105,452,962	0		0	
Middle Kiskatinaw River	12	161,072		38,838		0					21	2,060,382		56,347,972	1	28,308	8	115,482
<b>Middle Kiskatinaw Total</b> (incl. West & East)	<b>30</b>	<b>280,172</b>	<b>0.100%</b>	<b>38,838</b>	<b>0.014%</b>	<b>0</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0.000%</b>	<b>29</b>	<b>6,590,879</b>	<b>2.360%</b>	<b>279,316,049</b>	<b>1</b>	<b>28,308</b>		
Lower Kiskatinaw River	6	71,203		4,264		1	400,000		0		38	966,567		89,659,847	3	96,656	120	1,366,069
<b>KISKATINAW TOTAL</b>	<b>36</b>	<b>351,375</b>	<b>0.095%</b>	<b>43,102</b>	<b>0.012%</b>	<b>1</b>	<b>400,000</b>	<b>0.108%</b>	<b>0</b>	<b>0.000%</b>	<b>67</b>	<b>7,557,446</b>	<b>2.048%</b>	<b>368,975,896</b>	<b>4</b>	<b>124,964</b>	<b>128</b>	<b>1,481,551</b>
<b>PEACE RIVER</b>																		
Peace Arm	1	42,000		0		2	7,300,000	N/A	403,087	N/A	12	52,468	N/A	N/A	0		0	
Upper Peace River	1	60,000		0		0					47	1,677,242	0.005%	36,423,413,429	0		0	
Lynx Creek	0					0					8	259,970	0.854%	30,436,635	0		0	
Farrell Creek	7	206,412	0.227%	150	0.000%	0					15	7,466	0.008%	91,018,843	0		15	238,281
Cache Creek	2	45,500	0.061%	0	0.000%	1	185,000	0.248%	0	0.000%	11	1,793,664	2.404%	74,603,546	0		7	99,121
Pouce Coupe River	0	0	0.000%	0	0.000%	1	2,000	0.001%	0	0.000%	92	3,135,158	1.226%	255,686,202	0		25	301,495
Lower Peace River	1	37,500		9,323		3	3,067,469		534,947		55	123,641,300		114,470,012	0		25	502,463
<b>PEACE TOTAL</b> (incl. Kisk/Pine/Mob/Half/Beatt)	<b>267</b>	<b>12,314,339</b>	<b>0.026%</b>	<b>1,248,121</b>	<b>0.003%</b>	<b>16</b>	<b>11,373,469</b>	<b>0.024%</b>	<b>992,246</b>	<b>0.002%</b>	<b>669</b>	<b>184,564,966</b>	<b>0.385%</b>	<b>47,891,853,572</b>	<b>20</b>	<b>376,946</b>	<b>460</b>	<b>6,478,589</b>
<b>SMOKY RIVER</b>																		
Smoky River	33	255,700	0.010%	0	0.000%	1	2,500		0		9	69,944	0.003%	2,669,506,123	0		0	
<b>SMOKY TOTAL</b>	<b>33</b>	<b>255,700</b>	<b>0.010%</b>	<b>0</b>	<b>0.000%</b>	<b>1</b>	<b>2,500</b>	<b>0.000%</b>	<b>0</b>	<b>0.000%</b>	<b>9</b>	<b>69,944</b>	<b>0.003%</b>	<b>2,669,506,123</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>MUSKWA RIVER</b> (sub-basin of Fort Nelson River)																		
Upper Muskwa River	0		0.000%			0					0			1,725,201,511	0		0	
Middle Muskwa River	0			0		0					1	830		1,973,711,816	0		0	
<b>Middle Muskwa Total</b> (incl. Upper Muskwa)	<b>0</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0.000%</b>	<b>1</b>	<b>830</b>	<b>0.000%</b>	<b>3,698,913,327</b>				
Lower Muskwa River	0	0		0		0					10	1,839,377	0.280%	646,841,560	0		0	
<b>MUSKWA TOTAL</b>	<b>0</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0.000%</b>	<b>11</b>	<b>1,840,207</b>	<b>0.042%</b>	<b>4,345,754,887</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

# WATER ALLOCATION AND USE FOR OIL AND GAS ACTIVITIES, ORGANIZED BY OGC WATER MANAGEMENT BASIN, IN 2015

Page 3 of 5

MAJOR and Sub-Basin Name	SHORT-TERM WATER USE APPROVALS BC OIL AND GAS COMMISSION					OIL AND GAS RELATED WATER LICENCES					NON OIL AND GAS WATER LICENCES - FLNRO AS OF OCT. 2014				WATER SOURCE WELLS		HYDRAULIC FRACTURING	
	NUMBER OF WITHDRAWAL LOCATIONS	TOTAL VOLUME APPROVED (m <sup>3</sup> )	TOTAL VOLUME APPROVED AS % of MEAN ANNUAL RUNOFF	TOTAL VOLUME WITHDRAWN (m <sup>3</sup> )	TOTAL VOLUME WITHDRAWN AS % OF MEAN ANNUAL RUNOFF	NUMBER OF LICENCED WITHDRAWAL LOCATIONS	TOTAL VOLUME LICENCED (m <sup>3</sup> )	TOTAL VOLUME LICENCED AS % of MEAN ANNUAL RUNOFF	TOTAL VOLUME WITHDRAWN (m <sup>3</sup> )	TOTAL VOLUME WITHDRAWN AS % OF MEAN ANNUAL RUNOFF	NUMBER OF LICENCED WITHDRAWAL LOCATIONS	TOTAL VOLUME LICENCED (m <sup>3</sup> )	TOTAL VOLUME LICENCED as % of MEAN ANNUAL RUNOFF	MEAN ANNUAL RUNOFF (m <sup>3</sup> )	NUMBER OF WELLS	TOTAL VOLUME WITHDRAWN (m <sup>3</sup> )	NUMBER OF WELLS	TOTAL VOLUME INJECTED (m <sup>3</sup> )
<b>PROPHET RIVER</b> (sub-basin of Fort Nelson River)																		
Upper Prophet River	6	106,580	0.007%	31,623	0.002%	0					0		1,470,271,289	0		5	107,353	
Middle Prophet River	5	29,250		765		0				0		621,428,680	0		0			
<b>Middle Prophet Total</b> (incl. Upper Prophet)	<b>11</b>	<b>135,830</b>	<b>0.006%</b>	<b>32,388</b>	<b>0.002%</b>	<b>0</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0</b>	<b>0.000%</b>	<b>2,091,699,969</b>				
Lower Prophet River	10	55,550		684		0				0		272,262,427	0		0			
<b>PROPHET TOTAL</b>	<b>21</b>	<b>191,380</b>	<b>0.008%</b>	<b>33,072</b>	<b>0.001%</b>	<b>0</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0</b>	<b>0.000%</b>	<b>2,363,962,396</b>	<b>0</b>	<b>0</b>	<b>5</b>	<b>107,353</b>
<b>SIKANNI CHIEF RIVER</b> (sub-basin of Fort Nelson R.)																		
Upper Sikanni Chief River	1	75,000	0.009%	33,165	0.004%	1	2,993,000	0.371%	1,269,189	0.157%	2	64,488	0.008%	807,771,692	0		5	64,571
Middle Sikanni Chief River	39	609,461		15,418		0					2	5,808		949,755,794	0		52	864,315
<b>Middle Sikanni Chief Total</b> (incl. Upper Sikanni)	<b>40</b>	<b>684,461</b>	<b>0.039%</b>	<b>48,583</b>	<b>0.003%</b>	<b>1</b>	<b>2,993,000</b>	<b>0.170%</b>	<b>1,269,189</b>	<b>0.072%</b>	<b>4</b>	<b>70,296</b>	<b>0.004%</b>	<b>1,757,527,486</b>				
Lower Sikanni Chief	10	21,733		1,275		0					0		875,678,142	4	140,067	0		
<b>SIKANNI CHIEF TOTAL</b>	<b>50</b>	<b>706,194</b>	<b>0.027%</b>	<b>49,858</b>	<b>0.002%</b>	<b>1</b>	<b>2,993,000</b>	<b>0.114%</b>	<b>1,269,189</b>	<b>0.048%</b>	<b>4</b>	<b>70,296</b>	<b>0.003%</b>	<b>2,633,205,628</b>	<b>4</b>	<b>140,067</b>	<b>57</b>	<b>928,886</b>
<b>FORT NELSON RIVER</b>																		
Kahntah River	20	58,374	0.015%	565	0.000%	0					0		400,582,903	0		0		
Fontas River	19	76,630		573		0					0		591,531,903	0		0		
<b>Fontas Total (includes Kahntah)</b>	<b>39</b>	<b>135,004</b>	<b>0.014%</b>	<b>1,138</b>	<b>0.000%</b>	<b>0</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0</b>	<b>0.000%</b>	<b>992,114,806</b>	<b>0</b>	<b>0</b>		
Klua Creek	13	117,941	0.029%	17,990	0.004%	0					0		402,135,448	0		3	16,630	
Upper Fort Nelson River	23	88,036		16,139		0					0		276,181,026	0		5	15,402	
<b>Upper Fort Nelson Total</b> (incl. Sikanni Chief Total, Kahntah, Fontas, Klua)	<b>125</b>	<b>1,047,175</b>	<b>0.024%</b>	<b>85,125</b>	<b>0.002%</b>	<b>1</b>	<b>2,993,000</b>	<b>0.070%</b>	<b>1,269,189</b>	<b>0.029%</b>	<b>4</b>	<b>70,296</b>	<b>0.002%</b>	<b>4,303,636,908</b>	<b>4</b>	<b>140,067</b>		
Snake River	11	36,567	0.012%	2,065	0.001%	0					0		310,763,522	0		0		
Sahtaneh River	50	310,700	0.065%	9,513	0.002%	2	40,000	0.010%	0	0.000%	0		474,904,729	0		2	2,131	
Middle Fort Nelson River	10	288,700		123		0			0		6	1,001,848		515,348,901	0		0	
<b>Mid Ft Nelson Total</b> (incl. Upper Ft. Nelson total, Muskwa Total, Prophet Total, Snake, Sahtaneh)	<b>217</b>	<b>1,874,521</b>	<b>0.015%</b>	<b>129,898</b>	<b>0.001%</b>	<b>3</b>	<b>3,033,000</b>	<b>0.025%</b>	<b>1,269,189</b>	<b>0.010%</b>	<b>21</b>	<b>2,912,350</b>	<b>0.024%</b>	<b>12,314,371,343</b>	<b>4</b>	<b>140,067</b>		
Kiwigana River	25	134,267	0.030%	9,395	0.002%	5	42,500	0.010%	0	0.000%	5	128,480	0.029%	441,657,543	0		0	
Lower Fort Nelson River	20	202,084		14,851		0					0		312,768,938	0		0		
<b>FORT NELSON TOTAL</b>	<b>262</b>	<b>2,210,873</b>	<b>0.017%</b>	<b>154,144</b>	<b>0.001%</b>	<b>8</b>	<b>3,075,500</b>	<b>0.024%</b>	<b>1,269,189</b>	<b>0.010%</b>	<b>26</b>	<b>3,040,830</b>	<b>0.023%</b>	<b>13,068,797,824</b>	<b>4</b>	<b>140,067</b>	<b>72</b>	<b>1,070,402</b>

WATER ALLOCATION AND USE FOR OIL AND GAS ACTIVITIES, ORGANIZED BY OGC WATER MANAGEMENT BASIN, IN 2015



MAJOR and Sub-Basin Name	SHORT-TERM WATER USE APPROVALS BC OIL AND GAS COMMISSION					OIL AND GAS RELATED WATER LICENCES					NON OIL AND GAS WATER LICENCES - FLNRO AS OF OCT. 2014				WATER SOURCE WELLS		HYDRAULIC FRACTURING	
	NUMBER OF APPROVED WITHDRAWAL LOCATIONS	TOTAL VOLUME APPROVED (m³)	TOTAL VOLUME APPROVED AS % of MEAN ANNUAL RUNOFF	TOTAL VOLUME WITHDRAWN (m³)	TOTAL VOLUME WITHDRAWN AS % OF MEAN ANNUAL RUNOFF	NUMBER OF LICENCED WITHDRAWAL LOCATIONS	TOTAL VOLUME LICENCED (m³)	TOTAL VOLUME LICENCED AS % of MEAN ANNUAL RUNOFF	TOTAL VOLUME WITHDRAWN (m³)	TOTAL VOLUME WITHDRAWN AS % OF MEAN ANNUAL RUNOFF	NUMBER OF LICENCED WITHDRAWAL LOCATIONS	TOTAL VOLUME LICENCED (m³)	TOTAL VOLUME LICENCED as % of MEAN ANNUAL RUNOFF	MEAN ANNUAL RUNOFF (m³)	NUMBER OF WELLS	TOTAL VOLUME WITHDRAWN (m³)	NUMBER OF WELLS	TOTAL VOLUME INJECTED (m³)
<b>LIARD RIVER</b>																		
Muncho River	0					0							551,551,360					
Upper Liard River	0					0					3	6,829	33,125,817,465	0		0		
<b>Upper Liard Total (incl. Muncho)</b>	<b>0</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0.000%</b>	<b>3</b>	<b>6,829</b>	<b>0.000%</b>	<b>33,677,368,825</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
Grayling River	0					0					0		630,833,914	0		0		
Upper Toad River	0					0					0		1,521,055,576	0		0		
Racing River	0					0					0		1,488,336,681	0		0		
Lower Toad River	0					0					0		419,472,722	0		0		
Beaver River	0					0					0		10,862,659,426	0		0		
Middle Liard River	0					0					0		463,652,312	0		0		
<b>Middle Liard</b> (incl. Upper Liard Total, Grayling, Upper Toad, Racing, Lower Toad, Beaver)	<b>0</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0.000%</b>	<b>3</b>	<b>6,829</b>	<b>0.000%</b>	<b>49,063,379,456</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
Capot-Blanc Creek	35	1,071,204	0.583%	247,794	0.135%	0					0		183,879,851	0		1	91,243	
Dunedin River	23	249,600	0.030%	0	0.000%	0					0		820,464,167	0		0		
Lower Liard River	27	1,009,168		287,997		0					0		1,236,634,664	0		1	95,384	
<b>LIARD TOTAL</b> (incl. Fort Nelson)	<b>347</b>	<b>4,540,845</b>	<b>0.007%</b>	<b>689,935</b>	<b>0.001%</b>	<b>8</b>	<b>3,075,500</b>	<b>0.005%</b>	<b>1,269,189</b>	<b>0.002%</b>	<b>29</b>	<b>3,047,659</b>	<b>0.005%</b>	<b>64,373,155,962</b>	<b>4</b>	<b>140,067</b>	<b>74</b>	<b>1,257,029</b>
<b>PETITOT RIVER</b>																		
Sahdoanah River	23	65,969	0.026%	6,095	0.002%	0					1	830	0.000%	252,625,362	2	58,277	0	
Upper Petitot River	54	158,078	0.011%	5,500	0.000%	0					0		1,476,579,488	0		0		
Tsea River	27	74,418	0.017%	5,235	0.001%	2	20,000	0.005%	0	0.000%	0		434,062,484	1	143	0		
Middle Petitot River	19	77,407		2,217		2	26,666		0		0		698,562,753	0		0		
<b>Middle Petitot Total</b> (incl. Sahdoanah, Upper Petitot, Tsea)	<b>123</b>	<b>375,873</b>	<b>0.013%</b>	<b>19,047</b>	<b>0.001%</b>	<b>4</b>	<b>46,666</b>	<b>0.002%</b>	<b>0</b>	<b>0.000%</b>	<b>1</b>	<b>830</b>	<b>0.000%</b>	<b>2,861,830,087</b>	<b>3</b>	<b>58,420</b>		
Lower Petitot River	39	611,557		14,017		2	50,000		0		0		904,314,069	0		0		0
<b>PETITOT TOTAL</b>	<b>162</b>	<b>987,430</b>	<b>0.026%</b>	<b>33,064</b>	<b>0.001%</b>	<b>6</b>	<b>96,666</b>	<b>0.003%</b>	<b>0</b>	<b>0.000%</b>	<b>1</b>	<b>830</b>	<b>0.000%</b>	<b>3,766,144,156</b>	<b>3</b>	<b>58,420</b>	<b>0</b>	<b>0</b>



MAJOR and Sub-Basin Name	SHORT-TERM WATER USE APPROVALS BC OIL AND GAS COMMISSION					OIL AND GAS RELATED WATER LICENCES					NON OIL AND GAS WATER LICENCES - FLNRO AS OF OCT. 2014				WATER SOURCE WELLS		HYDRAULIC FRACTURING	
	NUMBER OF APPROVED WITHDRAWAL LOCATIONS	TOTAL VOLUME APPROVED (m³)	TOTAL VOLUME APPROVED AS % of MEAN ANNUAL RUNOFF	TOTAL VOLUME WITHDRAWN (m³)	TOTAL VOLUME WITHDRAWN AS % OF MEAN ANNUAL RUNOFF	NUMBER OF LICENCED WITHDRAWAL LOCATIONS	TOTAL VOLUME LICENCED (m³)	TOTAL VOLUME LICENCED AS % of MEAN ANNUAL RUNOFF	TOTAL VOLUME WITHDRAWN (m³)	TOTAL VOLUME WITHDRAWN AS % OF MEAN ANNUAL RUNOFF	NUMBER OF LICENCED WITHDRAWAL LOCATIONS	TOTAL VOLUME LICENCED (m³)	TOTAL VOLUME LICENCED as % of MEAN ANNUAL RUNOFF	MEAN ANNUAL RUNOFF (m³)	NUMBER OF WELLS	TOTAL VOLUME WITHDRAWN (m³)	NUMBER OF WELLS	TOTAL VOLUME INJECTED (m³)
<b>HAY RIVER</b>																		
Upper Kotcho River	5	21,600	0.007%	930	0.000%	0					0		311,519,217	0		0	0	
Kyklo River	39	208,500	0.143%	2,005	0.001%	0					1	5,808	0.004%	145,897,691	0		0	0
Shekilie River	28	192,180	0.043%	2,089	0.000%	0					0		450,747,494	0		0		
Lower Kotcho River	3	8,250		660		0					0		311,519,217	0		0		
<b>Lower Kotcho Total</b> (includes Upper Kotcho, Kyklo, Shekilie)	<b>75</b>	<b>430,530</b>	<b>0.035%</b>	<b>5,684</b>	<b>0.000%</b>	<b>0</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0.000%</b>	<b>1</b>	<b>5,808</b>	<b>0.000%</b>	<b>1,219,683,619</b>				
Hay River	31	368,590		12,144		0					0		538,672,352	0		0	0	
<b>HAY TOTAL</b>	<b>106</b>	<b>799,120</b>	<b>0.045%</b>	<b>17,828</b>	<b>0.001%</b>	<b>0</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0.000%</b>	<b>1</b>	<b>5,808</b>	<b>0.000%</b>	<b>1,758,355,971</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>CHINCHAGA RIVER</b>																		
Chinchaga River	1	15,000		312	0.000%	0					0		109,492,680	0		0	0	
<b>CHINCHAGA TOTAL</b>	<b>1</b>	<b>15,000</b>	<b>0.014%</b>	<b>312</b>	<b>0.000%</b>	<b>0</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0.000%</b>	<b>0</b>	<b>0</b>	<b>109,492,680</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	
<b>OTHER (outside northeast B.C.)</b>	<b>111</b>	<b>99,868</b>		<b>3,202</b>		<b>0</b>	<b>0</b>				<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>GRAND TOTAL</b>	<b>1,027</b>	<b>19,012,301</b>	<b>0.016%</b>	<b>1,992,462</b>	<b>0.002%</b>	<b>31</b>	<b>14,548,135</b>	<b>0.012%</b>	<b>2,261,435</b>	<b>0.002%</b>	<b>708</b>	<b>187,689,207</b>	<b>0.156%</b>	<b>120,568,508,464</b>	<b>27</b>	<b>575,433</b>	<b>534</b>	<b>7,735,618</b>