

**Petroleum Technology
Alliance Canada (PTAC)**

Final Report: Review of Water Use Data Sources & Comparable Water Reporting

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Executive Summary

There is growing interest in environmental, social, and governance (ESG) reporting and pressure on industries to report on their ESG performance and risk management. In recognition of this, the Canadian Association of Petroleum Producers (CAPP) is developing an ESG strategy for reporting publicly on a number of metrics including water use performance of Canada's oil and gas industry. WaterSMART Solutions Ltd. (WaterSMART) has been retained by CAPP to explore the availability of water use data to prepare performance metrics, how well these metrics can be compared across sectors and regions within Canada, and how these metrics compare to those being reported in other oil and gas producing jurisdictions around the world. This work updates and expands the Water Use Data Sources for Western Canada report, commissioned by CAPP in 2016.

Updates to water use data reporting were identified throughout Western Canada. Minor changes include updates to Alberta's Directive 081: Water Disposal Limits and Reporting Requirements for Thermal In Situ Oil Sands Schemes to encourage the use of alternative water sources. In Saskatchewan, the Directive R01: Volumetric Valuation and Infrastructure Reporting in Petrinex was renumbered to Directive PNG032, but reporting requirements within the directive remain unchanged since 2016. More notably, both Manitoba and British Columbia (B.C.) have transitioned regulatory reporting to the Petrinex database, which is also utilized in Alberta and Saskatchewan. There is no evidence that the nature of reporting changed in either province as a result of the change in reporting system.

Water use data reported within Canada was assessed to determine whether water use performance metrics of interest to CAPP could be calculated and whether these could be compared across oil and gas sectors and regions within Canada. The data within subscription based databases was not reviewed, but associated metadata and training materials were considered.

Opportunities exist to compare water use performance metrics across oil and gas producing regions and sectors in Canada. However, caution should be exercised when comparing these metrics, since precise definitions and company inputs can vary. In regions with flexibility in regulatory reporting requirements, data inputs can be particularly variable.

In Alberta, Saskatchewan, and British Columbia (B.C.), the regulatory reporting requirements are quite structured and the Petrinex database is utilized, which encourages better reporting and enables comparison of water use performance metrics. Data to support calculation of water use performance metrics are not publicly available in Manitoba or the Northwest Territories.

Alberta and Saskatchewan use the same definition for non-saline water (< 4000 ppm total dissolved solids), meaning non-saline water make-up and intensity metrics can be compared across sectors in these regions, assuming production data is equivalent. B.C. does not apply the 4,000 ppm limit to differentiate water sources. In B.C., the base of fish scales geological marker (below 300-600 m depth) is applied to determine useable groundwater, but this limit is not explicitly applied to other water sources. Useable

groundwater data in B.C. may be comparable to data for Alberta water use below the base of groundwater protection, from a definitional perspective. However, water quality in these data sets may not be comparable.

Caution should also be exercised when comparing the alternative water use performance metric across regions. Even within a single region, such as Alberta, the definitions for alternative water sources may vary by sector. Furthermore, although Alberta, Saskatchewan, B.C., and Manitoba (as of May 2020) all use Petrinex, only Alberta mandates the reporting of alternative water use with distinctions between various alternative water sources. Companies may report on a voluntary basis, which would enable comparison to Alberta if reporting is extensive. The extent of voluntary reporting is unknown because Petrinex data access in all provinces requires separate subscriptions. The comparability of recycled water use is similar; Alberta and Saskatchewan mandate reporting on recycled water use for oil and gas, but B.C. and Manitoba do not, although voluntarily reported data may exist.

There are parallels between the availability and comparability of water use data across Canada and in oil and gas producing jurisdictions around the world. Several common themes exist globally, but each jurisdiction researched has unique definitions and reporting systems, with nuanced differences. The quality of reported water use data and transparency of the reporting process is generally a reflection of the reporting requirements in the legislative framework in each jurisdiction, together with the use of structured reporting systems and tools. Jurisdictions with the highest quality data and best availability tend to be those that give clear reporting direction to operators and use highly structured reporting tools, such as SONRIS in Louisiana and DISKOS in Norway. Public dissemination of water use data was found to be limited in most jurisdictions; data held in online databases is not always viewable by the public and regulators did not often release public reports using the data available.

There is an opportunity for CAPP to demonstrate leadership in water use performance reporting by working with industry, regulators, and policy makers to encourage and leverage the implementation of structured regulatory systems and the use of consistent and accessible reporting tools. CAPP can also engage with industry to explore and develop best practices for preparing data inputs, to encourage consistency across companies and understand more deeply potential variations amongst companies. Making the reported data more broadly available to the public should also be encouraged to increase transparency and build credibility as external parties utilize and vet the data. As the conversation evolves around ESG reporting, particularly for water use performance, it will be important to CAPP to continue staying abreast of global best practices in this space.

Contents

Disclaimer	i
Executive Summary	ii
List of Tables	iv
1.0 Introduction	1
2.0 Water Use Data Availability	2
2.1 Western Canada.....	3
2.1.1 Alberta.....	10
2.1.2 British Columbia	13
2.1.3 Saskatchewan	14
2.1.4 Manitoba.....	15
2.1.5 Northwest Territories	16
2.2 Offshore	16
3.0 Water Metrics in Other Oil & Gas Jurisdictions	17
3.1 Commonly reported metrics.....	17
3.2 Emerging best practices in water reporting.....	21
4.0 Conclusions & Recommendations	22

List of Tables

<i>Table 1-1 Water use performance metrics of interest, including definition and required inputs</i>	2
<i>Table 2-1 Canadian oil and gas producing regions and sectors which were investigated for water use data</i>	3
<i>Table 2-2 Water use data sources (update to 2016 Report Table 6)</i>	3
<i>Table 2-3 Availability of water use data in each region and sector to support calculation of water use performance metrics</i>	6
<i>Table 2-4 Comparability of metrics which can be calculated from available data in each region</i>	9
<i>Table 2-5 Definitions and categorization of water types as defined by the AER</i>	12
<i>Table 3-1 Commonly reported water use performance metrics in other oil and gas producing jurisdictions. Listed sources are hyperlinked to corresponding web pages</i>	19

1.0 Introduction

Policy makers, investors, members of the public, and operating companies are becoming increasingly interested in environmental, social, and governance (ESG) reporting. Organizations around the world are developing guidance, rules, and taxonomies for ESG reporting and sustainable financing more broadly, with much of the activity being driven by investors. In this context of mounting interest in ESG reporting, the Canadian Association of Petroleum Producers (CAPP) is developing a strategy for reporting publicly on a number of metrics, including water use performance of Canada’s oil and gas industry. WaterSMART Solutions Ltd. (WaterSMART) was retained by CAPP, under the Alberta Upstream Petroleum Research Fund (AUPRF), administered by the Petroleum Technology Alliance Canada (PTAC), to perform the following tasks in support of this initiative:

1. Improve understanding of the availability and comparability (using metrics) of water use data from Canada’s oil and gas industry, particularly in Western Canada; and
2. Identify water use performance metrics (also known as comparators) commonly reported in other oil and gas producing jurisdictions around the world.

Task 1 includes updating a previous report¹, which is appended (hereafter referred to as the 2016 Report). It is assumed the reader is familiar with the 2016 Report, including background information on water regulations and use in Canada’s oil and gas industry. Section 2.0 in WaterSMART’s report focuses on updating the research from the 2016 Report (particularly Table 6) so that CAPP is aware of the current data available for water use in oil and gas in Canada, how well the data can be compared across regions, and to what extent the available data will enable reporting on CAPP’s metrics of interest, given in Table 1-1. This includes a brief overview of available data in Canada’s offshore oil and gas industry, which is new compared to the 2016 Report.

Task 2 is novel work that was not included in the 2016 Report. Section 3.0 in WaterSMART’s report highlights common metrics for water use performance reported in other oil and gas producing jurisdictions, as well as emerging best practices for reporting on water use performance and water risk management. This Section leverages WaterSMART’s prior and ongoing projects in ESG reporting, our global network of Special Advisors, and our relationships with both oil and gas operators and investing bodies who are focused on water reporting.

¹ “Water Use Data Sources for Western Canada”, 2016-06-8, Ponderosa Environmental and Water Resources Inc.

Table 1-1 Water use performance metrics of interest, including definition and required inputs

Metric	Definition	Data input(s)
Non-saline make-up water use	Absolute volume of surface water and non-saline groundwater	- Total volume withdrawn from surface water and non-saline groundwater sources
Non-saline water use intensity	Expressed as a ratio (Bbl non-saline water : BOE)	- Total volume withdrawn from surface water and non-saline groundwater sources - Hydrocarbon production (barrels of oil equivalent)
Alternative make-up water use	Expressed as a % of total make-up water use (Non-saline make-up water use + Alternative make-up water use = Total make-up water use)	- Total volume withdrawn from surface water and non-saline groundwater sources - Total volume of water utilized from alternative sources (saline, treated wastewater from 3 rd party, etc.)
Recycled water	Expressed as % of total water use (Non-saline make-up water use + Alternative make-up water use + Recycled water use = Total water use)	- Total volume withdrawn from surface water and non-saline groundwater sources - Total volume of water utilized from alternative sources (saline, treated wastewater from 3 rd party, etc.) - Total volume of water recycled (re-used) by operator (i.e. not sent to 3 rd party site for treatment)

2.0 Water Use Data Availability

Building on the 2016 Report, water use data for several Canadian oil and gas producing regions were investigated. All oil and gas sectors within Alberta, British Columbia (B.C.), Saskatchewan, Manitoba, the Northwest Territories, and the Maritimes were considered. As summarized in Table 2-1, not all oil and gas sectors are represented in each region. The availability and comparability of data for Western Canada (i.e. all regions in Table 2-1 except the Maritimes) are analyzed in Section 2.1. The availability of water use data in the Maritimes, which is limited, is described separately in Section 2.2. The focus of analysis on onshore oil and gas activities within Western Canada reflects the availability of relevant data and the direction of CAPP project contacts.

Table 2-1 Canadian oil and gas producing regions and sectors which were investigated for water use data

Region	Oil sands mining	In situ	Oil conventional	Gas conventional	Hydraulic fracturing	Offshore
Alberta	Yes	Yes	Yes	Yes	Yes	No
B.C.	No	No	Yes	Yes	Yes	No
Saskatchewan	No	Yes	Yes	Yes	Yes	No
Manitoba	No	No	Yes	No	Yes	No
Northwest Territories	No	No	Yes	Yes	Yes	No
Maritimes	No	No	No	No	No	Yes

2.1 Western Canada

A review was undertaken to update the water use data availability information in the 2016 Report, focusing on any changes to regulatory instruments and associated reporting requirements in each region. Following this review, the available data was analyzed to determine the extent to which the metrics in Table 1-1 can be calculated and compared in each region and sector.

The 2016 Report identified nine potential water use data sources for oil and gas in Western Canada (summarized in Table 6 of that report). Table 2-2, below, indicates how each source has changed, if at all, since that report was issued. The first four columns are copied from Table 6 in the 2016 Report, with updates noted in the fifth (right hand) column. The most notable changes are the update to Alberta's Directive 081: Water Disposal Limits and Reporting Requirements for Thermal In Situ Oil Sands Schemes and the adoption of Petrinex reporting in B.C. and Manitoba, as of 2018 and May 2020, respectively. One new addition to the table is the Alberta Directive 059 database, which is maintained by the Alberta Energy Regulator (AER) and consists of water use data for hydraulic fracturing, on a well by well basis. Public reports of water use per well are released annually, with data collection having started on December 31st, 2012.

Table 2-2 Water use data sources (update to 2016 Report Table 6)

Water Use Data Source	What parties gather water usage	Province	Where is the water tracked?	Updates to data source since 2016
Alberta Environment and Parks (AEP) Water Use Reporting system (WURS)	AER (AB Water Act)	AB	By Source	No update

Water Use Data Source	What parties gather water usage	Province	Where is the water tracked?	Updates to data source since 2016
Alberta Directive 059 Database	AER	AB	Water data collected by well for hydraulic fracturing only	New addition to the table
Petrinex	AER (Directive 007) and SK Ministry of Economy (Directive R01) for volumetric production reporting	AB, SK	To and from well ID, source ID, and receiving facility ID	<p>AB - AER D081 was updated in 2019 – New inlet water types were introduced; definitions for high quality non-saline and three alternative water types were added</p> <p>Note: D007 is still in effect</p> <p>SK - Directive R01 renamed to Directive PNG032. Key reporting requirements remain the same</p> <p>B.C. - As of 2018, B.C. is using Petrinex as the primary oil and gas reporting database</p>
B.C. Short-term Approvals	BCOGC (B.C. Water Sustainability Act)	B.C.	By Source	Note: BCOGC still holds water data primarily around licensing and volume allocation, but Petrinex is now the primary database for reporting
B.C. Water Licenses	BCOGC (B.C. Water Sustainability Act)	B.C.	By Source	No update
B.C. Water Source Wells	BCOGC (Oil and Gas Act)	B.C.	By source well ID	No update
Manitoba Water Production	Manitoba Petroleum Branch for production reporting (Drilling and Production Regulations)	MB	By source well ID	Production reporting moving to Petrinex starting with the April 2020 monthly report (due May 4). Production reports expected to continue including well count and withdrawn, produced, injection, and disposal water volumes

Water Use Data Source	What parties gather water usage	Province	Where is the water tracked?	Updates to data source since 2016
WSA Water Use	Water Security Agency (Water Security Act)	SK	By Source	No update Note: minimal information on water usage is available online but data may be provided on request; only water withdrawal volumes found on this site
Mackenzie valley	Mackenzie Valley Land and Water Board as required by permit	NWT	By Source	No update
FracFocus.ca	Upstream oil and gas regulators submit hydraulic fracturing completion information for public transparency	AB, BC, NWT	At the point of use (wellhead)	No update to reporting methods or regions reporting to FracFocus

For each region, the available water use data sources and regulatory regime were analyzed to determine whether the desired water use performance metrics (Table 1-1) can be calculated. Table 2-3 indicates whether the sectors in each region have data available to produce the desired metrics. Only the sectors present in each region, per Table 2-1, are included in Table 2-3 for clarity. Until further guidance is provided on the nature of Manitoba's new reporting to Petrinex, it is assumed that only well count and produced water volumes will continue to be reported.

The available water use data sources in Table 2-2 include online databases and publicly available reports drawing on data reported to regulators. Data held in online databases requiring a subscription, such as Petrinex and WURS, were not reviewed in detail, since subscription access was unavailable. However, training manuals and metadata, such as column headings, were available for these systems. These were reviewed to identify parameters reported into the online databases.

For example, access to Petrinex data is limited without a subscription, and each region requires a unique subscription. Volumetric data for Alberta's conventional sectors is available for public download², but access to further Alberta data and all data from Saskatchewan and B.C. requires subscriptions. It is assumed access to Manitoba data, once reporting to Petrinex begins, will also require a subscription. Without access to complete Petrinex datasets, it is impossible to verify that the data outlined in Petrinex guidance and region specific regulatory requirements are indeed being reported consistently throughout

² Data are available for download in Alberta only. It can be accessed here: <https://www.petrinex.ca/PD/Pages/APD.aspx>

the industry.

The comparability of data reported to Petrinex is explored in greater detail below, but for the purposes of Table 2-3, it is assumed data are available in line with the guidance documents and reporting requirements of each region. For other databases, such as WURS and FracFocus, a similar assumption was used to prepare Table 2-3, with further analysis provided below.

Petrinex accounts provide access to data from a single province, so multiple accounts may be required to access all data. Instructions for setting up Petrinex accounts is provided on the Petrinex website³. In Alberta, access to WURS requires an Alberta Digital ID and an enrollment number. An enrollment number is obtained by contacting the AER directly. Instructions for initiating the WURS application process can be found on the AER website⁴.

Data aggregators, such as geoSCOUT, AccuMap, AbaData, and Petro Ninja, also provide access to oil and gas production and water use data, for a subscription fee. It is understood that these services utilize data reported to regulatory bodies and would therefore be redundant if CAPP develops an efficient way to aggregate data from regulators and databases in each region. Reviewing these services in detail was outside the scope of this report, but they are noted as potential sources for further information if required. Depending on CAPP’s planned approach for accessing Petrinex, WURS, and other data, it may be better to subscribe to a data aggregator.

Table 2-3 Availability of water use data in each region and sector to support calculation of water use performance metrics

Metric	Availability	Oil sands mining	In situ	Oil conventional	Gas conventional	Hydraulic fracturing
Non-saline make-up water use (Mm3)	Available	AB (WURS)	AB (Petrinex) SK (Petrinex)	AB (Petrinex) B.C. (BCOGC, Petrinex) SK (Petrinex)	AB (Petrinex) B.C. (BCOGC, Petrinex) SK (Petrinex)	AB (WURS) B.C. (BCOGC, Petrinex, FracFocus) SK (Petrinex)
	Not available			MB, NWT	NWT	NWT
Non-saline water use intensity (bbl:BoE)	Available	AB (WURS)	AB (Petrinex) SK (Petrinex)	AB (Petrinex) B.C. (BCOGC, Petrinex) SK (Petrinex)	AB (Petrinex) B.C. (BCOGC, Petrinex) SK (Petrinex)	AB (WURS) B.C. (BCOGC, Petrinex, FracFocus) SK (Petrinex)

³ Instructions for Petrinex account setup: <https://www.petrinex.ca/overview/Pages/Access.aspx>

⁴ Enrollment to WURS <https://www.alberta.ca/water-use-reporting-system.aspx#toc-3>

Metric	Availability	Oil sands mining	In situ	Oil conventional	Gas conventional	Hydraulic fracturing
	Not available			MB, NWT	NWT	NWT
Alternative make-up water use (% of make-up water use)	Available		AB (Petrinex) SK (Petrinex†)	AB (Petrinex) B.C. (Petrinex†) SK (Petrinex†)	AB (Petrinex) B.C. (Petrinex†) SK (Petrinex†)	AB (WURS, D059 database) B.C. (Petrinex, FracFocus†) SK (Petrinex†)
	Not available	AB (N/A)*		MB, NWT	NWT	NWT
Recycled water use (% of total water use)	Available	AB (direct reporting)**	AB (Petrinex) SK (Petrinex)	AB (Petrinex) B.C. (Petrinex†) SK (Petrinex)	AB (Petrinex) B.C. (Petrinex†) SK (Petrinex)	AB (WURS, D059 database) B.C. (Petrinex, FracFocus†)
	Not available			MB, NWT	NWT	NWT

*Note: Oil sands mining does not utilize material volumes of alternative water make-up.

**Note: The AER has indicated the recycled volume data are provided by operators directly, rather than through an online database/portal.

†Note: Saskatchewan does not require operators to differentiate alternative water use sources in Petrinex, although this may be done on a voluntary basis. Saline water use data may be available upon request, which may be useful in cases where operators voluntarily differentiate between alternative water sources. B.C. does not require reporting on alternative water or recycled water use volumes. Data submitted voluntarily may be available to calculate the corresponding metrics, but this was not reviewed due to lack of database access.

Table 2-3 summarizes what water use data are *expected* to be available for particular regions and sectors. As noted, the data held in subscription-based databases was not itself reviewed. Instead, database metadata and open reports were reviewed to assess the expected availability of data.

The comparability of reported data is sensitive to the submissions by operators. Through conversations and past experience with operators throughout many sectors in Alberta, WaterSMART is aware of the potential for variation in how individual companies prepare, store, and report their water use and production data.

As noted in guidance from the Government of Alberta⁵, there are numerous ways to measure water diversion volumes, with and without a flow meter. Hence, even with strict definitions in place (e.g. in Alberta), water diversions may not be measured consistently in all cases. In addition, companies may

⁵ The Water measurement guidebook is available online: <https://open.alberta.ca/publications/9780778585350>

record the volume of water injected per well without identifying in their internal systems whether the water was wholly non-saline or included alternative and recycled water. The volume reported therefore would not accurately depict the water use profile of that company.

Another example is production data, which is used for intensity calculations. Depending on the sector, specific play, age of asset, production technique, and specific hydrocarbon being produced, the BOE can vary. For example, compression ratios for comparing non-gas liquids and natural gas production have a large impact on BOE in hydraulic fracturing, but are not set consistently. Further analysis of BOE calculation methods were outside this report's scope, but it is worth noting the complexity inherent in the calculation.

As ESG reporting becomes more prevalent, it is understood that many operators are updating their approach for measuring and tracking water diversions and water use. Over time, this may reduce variability between individual companies in how they report water use data inputs. The challenge is expected to be exacerbated in regions without clear reporting requirements and definitions.

With the potential for inter-company variability in data inputs, a detailed review of the databases and regulations in each region was undertaken to assess what data are actually reported in each case and whether the resultant metrics can be compared across sectors and regions. Comparability depends on the precise definitions used in each case, such as whether water use volumes reflect total diversions or only injection volumes, and how alternative water is defined. It also depends on the nature of the databases operators are required to report to. It is critical to understand whether a data source is showing volumes allocated (licenced), diverted, used (including for ancillary activities), or injected, or a combination thereof.

Based on the data available in Table 2-3, Table 2-4 summarizes the extent to which metrics calculated in each region and sector can be compared to each other. Table 2-4 is followed by detailed discussion for each region. The highest degree of expected metric comparability is found in regions which clearly outline reporting requirements and key terms in their regulatory regimes. Comparability between metrics is also aided by regions and sectors using the same reporting systems, such as Petrinex.

It was assumed that if there was no requirement to report certain metrics, then the data are not normally available. However, it is possible voluntary reporting of certain metrics is extensive enough to make comparisons between sectors, particularly as pressure increases on operators to improve ESG performance and disclosures. In cases where voluntary reporting is done extensively to clear reporting systems, it may be possible to calculate and compare water use performance metrics. These cases have been noted.

Table 2-4 Comparability of metrics which can be calculated from available data in each region

Metric	Comparability	Comments
Non-saline make-up water use (Mm3)	AB (WURS/Petrinex)	AB and SK use the same definition of non-saline water. B.C. groundwater data may be comparable with Alberta based on depth, but not quality. Caution should be used to ensure water from similar sources is being compared.
	SK (Petrinex) B.C. (Petrinex/BCOGC) <i>with caution</i>	There may be some differences in the data reported to each system, impacting comparability. In AB, total diversion is reported through WURS, while injection, production, recycled, and alternative water volumes are reported to Petrinex; in SK, volumes injected, recovered, stored, and recycled are reported to Petrinex*; in B.C., produced water and total injection volumes are reported to Petrinex. Total injection volume does not distinguish between non-saline, alternative, and recycled water sources. Surface water withdrawals are available via water licence quarterly reports**, so freshwater make-up could potentially be estimated and compared with caution
Non-saline water use intensity (bbl:BoE)	AB (WURS/Petrinex) SK (Petrinex) B.C. (Petrinex/BCOGC) <i>with caution</i>	As above regarding the definition of non-saline water and availability of water diversion and injection data. Caution is advised when comparing production data even within sectors as reporting can differ depending on various factors including product type and age of well
Alternative make-up water use (% of total water use)	AB (WURS/Petrinex/D059 database) SK (Petrinex) <i>with caution</i> B.C. (Petrinex) <i>with caution</i>	SK - Surface water sources are given unique ID codes in Petrinex. With access to the data it would be possible to identify volumes attributed to certain codes B.C. - There is a reporting code for surface water location; it is not clear if this connects to a water volume AB - alternative water sources are reported under Directive 59 If the B.C. surface water volumes in Petrinex are attributable to water sources, then AB, SK, and B.C. data can be compared across all sectors, providing reporting is extensive enough. It is not mandatory in B.C. nor SK AB WURS data can potentially be compared as long as only like water sources are compared together. Only hydraulic fracturing data are included in the D059 database. Alternative water is reported by source

Metric	Comparability	Comments
Recycled water use (% of total water use)	AB	SK - Injection facilities (including in situ and conventional) are obligated to report recycle volumes as per PNG032
	(WURS/Petrinex/ D059 database)	AB - Directive 007 obligates facilities to report recycled volumes. Only hydraulic fracturing data are included in the AB D059 database. Well ID is used to report water volumes
	SK (Petrinex) <i>with caution</i>	BC - No legislation obligates this reporting, but some voluntary reporting to Petrinex is observed in B.C.
	BC (Petrinex) <i>with caution</i>	If B.C. reporting is comprehensive enough, then AB, SK, and B.C. could be compared across sectors

* Directive PNG032 Section 6.11

** BCOGC oil and gas withdrawal quarterly reports

2.1.1 Alberta

In Alberta, reporting requirements are outlined in Directive 007: Volumetric and Infrastructure Requirements and Directive 059: Well Drilling and Completion Data Filing Requirements. Further direction on reporting is provided by the AER Manual 011: How to submit volumetric data to the AER. Under this regulatory framework, the following databases are utilized in Alberta:

- Water allocation data are stored by AEP in their Environmental Management System (EMS);
- Water diversions, which are typically significantly less than the allocated volume, are submitted to AEP through WURS, which the AER accesses. Not all diverted water is used for hydrocarbon extraction, or is necessarily utilized at all:
 - Ancillary activities (e.g. ice road construction, dust suppression, rig cleaning) require water diversions;
 - Water can be lost through evaporation and seepage from storage;
 - In some situations, water is diverted without being used⁶. These situations are more common in hydraulic fracturing due to the flexible nature of drilling programs;
- Water injection (i.e. water sent down a well) and recovery are reported to Petrinex; and
- Hydraulic fracturing operators also report water volumes on a well by well basis directly to the AER under Directive 059. This is denoted as the D059 database in Table 2-3 and Table 2-4.

Hence, water use data will vary depending on the database referenced. It is expected that ancillary activities are a small fraction of overall water use on a sector-wide scale and therefore WURS and Petrinex

⁶ Depending on the situation, unused water may be returned to the environment (upon meeting certain criteria) or deep-well disposed (e.g. if it has been mixed with chemicals in anticipation of use, but then not used). In some cases, it may be moved to another well site or application, which makes accounting for the water use challenging.

non-saline water use data may be fairly comparable. This was not confirmed through detailed analysis of reported data, which is not publicly available.

Water data reported to Petrinex in Alberta can be compared with data reported to Petrinex in other regions, assuming the water source tags denoting recycled, alternative, saline and non-saline waters in Petrinex are aligned between jurisdictions. Comparisons can also be made between data from other reporting systems that use similar definitions and only report well injection and production volumes.

Data reported to WURS, which includes water volumes used for ancillary activities, can be compared with other reporting systems which include ancillary activities, such as the BCOGC diversions data. Where the volume of water used for ancillary activities is negligible compared to the water injection volume, comparisons can also be made with systems reporting only injection and production water volumes.

Water use data reported directly to the AER under Directive 059 provides water use information on a well by well basis for hydraulic fracturing only. Comparability with hydraulic fracturing data from outside Alberta may be possible for some metrics, as noted in Table 2-4. However, comparisons may be limited if other regions have data collected on a basis other than well by well (e.g. by battery or water source). Total water volumes per well are reported annually on the AER website⁷, and more data may be available directly from the AER by request.

Saline and non-saline water volumes must be reported across all sectors, where non-saline water is defined as < 4000 ppm total dissolved solids (TDS). Because this aligns with the definitions provided in Saskatchewan, meaningful comparisons between the non-saline make-up water use and non-saline water use intensity metrics may be possible. Comparing the intensity metric requires that the methodology for reporting oil and gas production volumes (BOE) is aligned between regions.

Alternative water sources are reported per requirements in Directive 059. Definitions of alternative waters are provided by Directive 081, which includes three alternative water types. Appendix 2 of Directive 081 details the Petrinex tags applicable to each alternative water type, which often depends on the activity the operator is undertaking. This leads to some variation across sectors and between WURS and Petrinex. There is an opportunity for increased clarity in this area through new policy, such as the Draft Water Conservation Policy for Upstream Oil and Gas Operations. The variation between alternative water types based on activity may limit meaningful comparisons with other jurisdictions, as Alberta is the only jurisdiction currently using this methodology for alternative water reporting.

Recycled water volumes are reported under Directive 007. In Alberta, recycling of water refers to the reuse of produced and flowback water, typically by an operator without transmission of the water to a third party. In cases where produced or flowback water is treated at a third party, or centralized, facility,

⁷ Hydraulic fracturing water volume reporting - <http://www1.aer.ca/ProductCatalogue/530.html>

the resultant water is classified as alternative water. Comparisons can be made with other regions provided the same definitions are used consistently.

The AER provides definitions for key terms, including alternative water and recycled water, for each reporting tool on their website, listed in Table 2-5. More detailed definitions are detailed in Directive 081 and Petrinex reporting guidelines can be found in Appendix 2 of Directive 081. The definitions, particularly for alternative water and recycled water, vary slightly across the sectors. Therefore, comparing alternative and recycled water use metrics between sectors within Alberta and across regions should be done with caution and requires clear communication regarding the definitions in each sector. The Reporting Tool column indicates the primary source of data utilized by the AER for their water performance reporting, but data for each sector is still available from other databases, per Table 2-3. Other jurisdictions using the Petrinex system may use different tags to classify alternative, recycled and non-saline water data.

Table 2-5 Definitions and categorization of water types as defined by the AER⁸

Sector	Reporting Tool	Term	AER Definition
Oil Sands Mining	WURS	Non-saline water	Non-saline water includes surface river or runoff water and non-saline groundwater
		BOE	The barrel of oil equivalent (BOE) calculation for mining includes bitumen
Enhanced Oil Recovery (EOR)	Petrinex	Non-saline water	Non-saline water is "freshwater"
		Alternative water	Alternative water is "brackish" and water"
		Recycled water	Recycled water refers to water production from enhanced oil recovery wells minus wastewater injected into disposal wells and off-site dispositions of wastewater
		BOE	The BOE calculation for enhanced oil recovery includes natural gas; condensates; bitumen; and light, light-medium, medium, heavy, or ultra-heavy crude

⁸ Definitions and categorization of water types per system can be found at: <https://www.aer.ca/protecting-what-matters/holding-industry-accountable/industry-performance/data.html>

Sector	Reporting Tool	Term	AER Definition
In Situ	Petrinex	Non-saline water	Non-saline water is "freshwater"
		Alternative water	Alternative water is "brackish" (if not stated otherwise by Directive 081)
		Oil sands process affected water (OSPW)	Oil sands process-affected water refers to fresh water and water received from an oil sands mine
		Recycled water	Recycled water is water produced from thermal in situ oil sands wells minus wastewater injected into disposal wells and off-site dispositions of wastewater
		BOE	The BOE calculation for in situ recovery includes bitumen
Hydraulic Fracturing	Petrinex/WURS	Non-saline water	Non-saline water includes central distribution facility water, non-saline groundwater (below/above 150 m), municipal water, surface water (lake, river, or runoff), and waste water (industrial, municipal, oilfield)
		Alternative Water	Alternative water refers to saline groundwater, oilfield produced water, and recycled fracturing water (treated at an independent standalone facility)
		Recycled water	Recycled water refers to recycled fracturing water treated at a well site
		BOE	The BOE calculation for hydraulic fracturing includes natural gas, condensates, and light-medium crude

2.1.2 British Columbia

Volumetric well data are reported to the British Columbia Oil and Gas Commission (BCOGC) under the *Oil and Gas Activities Act*. Under the General Regulation of this Act, operators must report all fluid injection and production volumes to the BCOGC. Since 2018, the BCOGC has used Petrinex as a singular reporting tool for this data across all oil and gas sectors.

British Columbia does not define saline and non-saline water across all water sources, as Alberta and

Saskatchewan do. Instead, the BCOGC defines usable groundwater as groundwater which lies 300-600 m below the ground surface, which is below the base of the fish scales geological marker⁹. Freshwater diversion data are reported on a quarterly basis by the BCOGC on their website¹⁰. As indicated in Table 2-3, these data sources could be used to estimate non-saline makeup water use and intensity, including ancillary activities. Caution should be exercised when comparing the data with other jurisdictions; Alberta uses the base of groundwater protection (BGWP) to determine groundwater that can be used by industry. The BGWP depth from ground level is variable throughout Alberta but usually lies 600 m below ground level. In theory, BGWP data from Alberta could be compared with water withdrawn from the base of fish scales in B.C., based on how each water source is defined and practically used. However, water quality may differ between the two data sets.

As noted above, a paid subscription to Petrinex is required to review the data reported to the system. Metadata and training materials are available without subscription and these were reviewed in lieu of access to the data itself. According to the Petrinex training materials for B.C., water sources are identified by location, which also indicates the nature of the source. Hence, data for alternative water sources could be derived for comparison with Saskatchewan and Alberta, where Petrinex is also used and the same water source tags are available. Reporting water volumes from alternative sources is not mandatory under B.C., legislation so this comparison would only be meaningful if there are extensive voluntary submissions available in Petrinex.

Similarly, recycled water volume reporting is not mandatory in B.C., but it is possible to report this data to the Petrinex system. Should the oil and gas industry widely submit this data voluntarily, then meaningful comparisons can be made with recycled water use data from Saskatchewan and Alberta.

2.1.3 Saskatchewan

Volumetric reporting in Saskatchewan is governed by Directive PNG032: Volumetric, Valuation and Infrastructure Reporting in Petrinex. Under this directive, it is mandatory for operators to report produced, recycled, and injected water volumes, as well as saline and non-saline water use, where non-saline water is defined as < 4000 ppm TDS. Directive PNG032 states:

“In addition to normal volumetric reporting on Petrinex, operators of an Injection Facility (IF) with the subtype of either 501, 505, 506, 516, 517, and 519 must submit volumetric information related to storage activities on a monthly basis, for specific products injected, stored, recovered and recycled (if applicable)”

The subtypes listed correspond to thermal in situ, enhanced recovery (i.e. conventional), and

⁹ BCOGC Technical Guidance for Determining Usable Groundwater: <https://www.bcogc.ca/files/operations-documentation/Oil-and-Gas-Operations-Manual/ogaom-appendix-e.pdf>

¹⁰ BCOGC water reports are released quarterly and are available at: <https://www.bcogc.ca/public-zone/water-information>

underground storage facilities storing gas, oil, non-gas liquids, or CO₂. A definition of recycled products is not provided in the Directive. Water volume reporting under Directive PNG032 does not include water used for ancillary activities, such as dust suppression.

All volumetric data in Saskatchewan is reported through Petrinex. While it was not possible to view the data without a subscription, reporting metadata and training materials were reviewed. Although saline water use volumes must be reported, there is no indication that the Saskatchewan regulatory environment requires operators to differentiate between alternative water sources using Petrinex source tags. However, training materials indicate that it is possible to report water volumes per source within Petrinex, so alternative water use metrics could be derived if voluntary reporting of alternative water sources is extensive. This data would be comparable to data reported to Petrinex in B.C. (voluntarily) and Alberta.

Saskatchewan uses definitions of saline and non-saline water which are the same as Alberta. Therefore, there is an opportunity to compare non-saline make-up and water use intensity between Saskatchewan and Alberta using Petrinex data, assuming the reporting of production data aligns.

Water recycling volume reporting is mandatory for thermal in situ and enhanced recovery facilities. Data for these are available through Petrinex and are likely comparable to recycled data from other regions.

2.1.4 Manitoba

In Manitoba, water data are reported to the Manitoba Petroleum Branch. Under the Manitoba Drilling and Production Regulation, operators are obligated to report the total volumes of withdrawn, injected, produced, and flowback water. However, it appears there is no obligation to differentiate between non-saline and saline water use, water recycling, or water sources. Water licencing and diversion data are not made publicly available in Manitoba, nor was data provided upon requests made through a separate project due to concerns regarding public release. It may be possible for CAPP to access more data by request.

There is currently no direct access to water use data reported by operators in Manitoba. The Petroleum Branch releases an annual data report for a fee. Some metadata is available from the annual report, including a list of data tags. This list confirms the wording in the Drilling and Production Regulation, that the only water data reported are produced and flowback water volumes. As such, a comparison cannot be made between other jurisdictions for the metrics noted in Table 1-1. As noted in the 2016 Report, a workaround could be used to estimate water use by multiplying well counts, which are reported, by a nominal water consumption per well. However, this estimate would be of little value for comparing metrics.

From May 2020, volumetric reporting in Manitoba will be moved to the Petrinex system. However, there

is no indication that the nature of the reporting will change¹¹.

2.1.5 Northwest Territories

Injection and production volumes for all fluids are reported under the Oil and Gas Drilling Production Regulation in the Northwest Territories. Saline and non-saline fluids are not defined under this regulation and there is no requirement to report recycled or alternative water use.

It was noted that there is a federal requirement to report estimates of saline and non-saline water use for well completions to the National Energy Board as part of the environmental requirements for well approval in the Northwest Territories. Water data reported in this way is not publicly available and does not constitute continuous reporting of actual water use, making it less useful for comparing to other regions. It is also unclear whether these estimates would include ancillary water uses, which are accounted for in other regions.

The Northwest Territories does not use an online database, such as Petrinex, to store data and, as of May 2020, no water use data has been made publicly available. As such, it is not possible to assess the extent of voluntary reporting for recycled and alternative water use and it does not appear possible to create the metrics listed in Table 2-3 for any sector operating in the Northwest Territories.

2.2 Offshore

WaterSMART reviewed available water use data in Canada's offshore oil and gas sector (i.e. Newfoundland and Labrador and Nova Scotia). No data was identified which could support reporting on the water use performance metrics of interest in Table 1-1.

The Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) regulates the offshore sector in Newfoundland and Labrador. The C-NLOPB has some public releases of geological and geophysical information, including the volume of water produced by a well per month. However, there is no publicly accessible data for make-up water use, water intensity, alternative water use, or water recycling.

The Canada-Nova Scotia Offshore Petroleum Board (C-NSOPB) regulates offshore activities in Nova Scotia. The C-NSOPB keeps a data management system that houses logs and reports from each offshore well. However, this database does not appear to have water quantity information. Instead, it has some historical produced water quality data, outlining various analytical parameters, such as oil in water content for discharge waters.

WaterSMART also investigated relevant regulations under the *Canada–Newfoundland and Labrador*

¹¹ Notification of Petrinex reporting from Manitoba government:
<https://www.gov.mb.ca/iem/petroleum/infonotes/20-02.pdf>

Atlantic Accord Implementation Act to identify any industry water reporting requirements. None were identified.

3.0 Water Metrics in Other Oil & Gas Jurisdictions

Given the global movement towards ESG reporting, there are numerous oil and gas producing jurisdictions around the world which report water metrics. Targeted research was conducted into water metrics reported in five of these locations. This research, summarized in Section 3.1, is meant to give CAPP a sense of common approaches to water reporting as they progress their own reporting approach. Supplementary discussion of emerging best practices in water reporting is provided in Section 3.2 for further consideration. This discussion is based on WaterSMART's extensive work in this area with our global network of clients, advisors, and partners to identify and develop best practices for water reporting.

3.1 Commonly reported metrics

A review was undertaken of five oil and gas producing jurisdictions around the world to identify commonly reported metrics for water use performance. They were selected for their parallels to the Canadian oil and gas industry, from the perspectives of operations, regulations, and public expectations for disclosure. These jurisdictions, which also align with CAPP's interests for the research, are considered leaders in water reporting.

The reporting approach and commonly reported metrics for Texas, Norway, Pennsylvania, Louisiana, and California are summarized in Table 3-1 below. This research focused on reporting done by a centralized body to best identify parallels to CAPP's planned reporting. It is acknowledged that many companies conduct their own water reporting (e.g. via their website, annual reports, and/or ESG reports) in addition to regulatory reporting. However, this reporting, which can vary widely in content, style, and intent between companies, was considered outside the scope of this report.

It should also be noted that although Texas, Louisiana, and California are home to offshore oil and gas activities, only onshore sectors (i.e. conventional and hydraulic fracturing [HF]) are included in Table 3-1 for these jurisdictions. This reflects the focus of discussion in Section 2.0 on Canada's onshore oil and gas sectors and that Norway was considered sufficiently representative of reporting best practices for offshore production.

Table 3-1 was completed by first identifying the regulators in each jurisdiction, and whether a publicly accessible data management system was operated by the regulator. Where no obvious data management system was found, a deeper search into the regulator website was conducted to identify reporting guidance or annual regulatory reports containing water metrics. Where the regulator webpage did not yield useful information, the regulatory framework of the jurisdiction was investigated to identify industry reporting requirements.

The majority of jurisdictions support online reporting by operators in some capacity. However, the public

availability of the data varies widely. Within some jurisdictions, volumetric water data are available through a single online data bases, such as SONRIS in Louisiana. In California, it is not clear how data are collected or stored, but data files and reports are available through the energy regulator, CalGem. Other jurisdictions, such as Texas, use a combination of reporting tools, such as FracFocus, to collect volumetric data.

The quality and transparency of the reported data varies widely between the jurisdictions. Where jurisdictions do have publicly available databases, the data can be difficult to locate and utilize. For example, Pennsylvania gathers data through well completion reports, where water volumes are recorded, but each report is stored individually in the data dictionary, making it difficult to gather. In addition, some older data within the Pennsylvania database is only available as scanned handwritten records.

Table 3-1 Commonly reported water use performance metrics in other oil and gas producing jurisdictions. Listed sources are hyperlinked to corresponding web pages

Location	Sector	Reporting approach	Reported metrics	Comments	Sources
Texas	HF Conventional	Submitted to the Railroad Commission (RRC) and FracFocus website	<ul style="list-style-type: none"> - Total water volume per well (all sectors) - Total volume of produced water (all sectors) - Percentage of chemical ingredients in frac fluid (HF only) 	Data does not appear to be reported publicly	<ul style="list-style-type: none"> - Groundwater Regulations and Hydraulic Fracturing - FracFocus - Railroad Commission - Railroad Commission Data Dictionary
Norway	Offshore	Submitted to the Norwegian Petroleum Directorate	<ul style="list-style-type: none"> - Total injection volume - Total produced water volume - Produced water discharged to the ocean - Discharges of chemicals (into the sea) 	Data stored in online DISKOS database. High level data are publicly available; more detailed datasets are available with membership	<ul style="list-style-type: none"> - Norwegian Petroleum Directorate - Norwegian Petroleum
Pennsylvania	HF Conventional	Reported through Pennsylvania Department of Environmental Protection	<ul style="list-style-type: none"> - Total water volume for completion per well (all sectors) - Total volume fresh water used per well (all sectors) - Total volume of recycled water used per well (all sectors) 	Reports are submitted without contextual explanation Data is publicly available	<ul style="list-style-type: none"> - Department of Environmental Protection Data Dictionary - Reporting database

Location	Sector	Reporting approach	Reported metrics	Comments	Sources
Louisiana	Conventional HF	Reported through Louisiana Department for Natural Resources SONRIS database	<ul style="list-style-type: none"> -Total water volume per well (all sectors) -Volume of wastewater produced per well (all sectors) 	Data is not easily accessible by the public	<ul style="list-style-type: none"> - SONRIS - Department of natural resources
California	HF Conventional	Regulatory reporting through California Geologic Energy Management Division (CalGEM)	<ul style="list-style-type: none"> - Volume of produced water per well (all sectors) - Volume of water used from each water source (including point of diversion) (all sectors) - Volumes of treated and recycled water (all sectors) - Volume of water disposed (all sectors) 	Data are not reported with contextual information. Raw data are publicly available as .csv download	<ul style="list-style-type: none"> - CalGEM data dictionary

3.2 Emerging best practices in water reporting

WaterSMART has been engaged in water risk and sustainability reporting through consulting our global network of Special Advisors and working locally with our clients and colleagues. This includes conducting comprehensive research into global water reporting and assessment approaches, as well as hosting a workshop in Calgary in 2019 for investors and operating companies to discuss water reporting best practices.

This work has revealed misalignment between metrics that are desirable for investment groups and those which an operating company may use to manage performance and risk. This misalignment, or gap, can be detrimental to the investment groups because they are not necessarily getting accurate and complete information needed to assess water-related risks facing a company. For companies, this gap is detrimental because it can be time and resource-consuming to report metrics, and the metrics may not be useful to drive meaningful decision making and change, or to track progress towards the company's strategy and goals.

Several key drivers of the gap between investors and operating companies when it comes to water reporting can be summarized:

- Water challenges are local and must be reported with adequate context;
- Local water risk data are inconsistent and incomplete;
- There is no “golden metric” to enable company comparisons;
- Existing approaches for water reporting can be burdensome for operating companies and are disconnected from strategic priorities; and
- There are many approaches for reporting on water, with no clear winner.

The evolving field of water reporting best practices is concerned with bridging this gap. WaterSMART is developing a set of context-based metrics which are widely applicable across industries and geographies, while being clearly linked to corporate water strategies. By linking metrics to corporate water strategies and local and temporal context, WaterSMART is working to develop an optimal water reporting framework in which reporting is consistent with, and supportive of, operational priorities, while corporate water risk and its management are adequately described. The resulting framework will have a light reporting burden relative to its strategic value and enable intra- and inter-industry comparisons of water performance, on a global scale.

Water reporting best practices are evolving quickly, driven in large part by the investor community. CAPP is to be commended for staying abreast of evolving developments and seeking out opportunities to engage in the discussions. Providing adequate context and ensuring comparability across industries (and sectors) and geographies are good water reporting practices which should be enabled by this report.

4.0 Conclusions & Recommendations

Globally, there are many different systems for water use data reporting for the oil and gas industry. The jurisdictions that provide the most comprehensive data and the best data availability are those which use highly structured databases for reporting. These structured systems aid consistent reporting across oil and gas sectors and facilitate public release of data. Comparing data from online systems still requires caution as they only reflect the data operators enter into the system. It is still possible for companies to use different methods to report production data or water use volumes, which can limit the comparability of data across sectors and jurisdictions.

Jurisdictions with the most transparent and consistent reporting are those which combine the use of structured reporting systems with a regulatory structure that clearly outlines reporting requirements and clearly defines key terms, such as alternative water and water recycling. A structured regulatory system limits the different ways reporting requirements can be interpreted by oil and gas operators, which improves reporting consistency. Regulations can also be used to mandate public release of data, which further improves data availability and transparency.

In Canada, the availability and quality of water use data varies widely across regions. Water use data are generally available for oil and gas activities in Western Canada that will allow the creation of water metrics of interest to CAPP. In Saskatchewan, Alberta, and B.C., structured reporting systems are in place which allow access to the data. There is room for improvement, as reporting requirements are not always clear in these regions. For example, the draft Water Conservation Policy for Upstream Oil and Gas Operations in Alberta provides consistent definitions for alternative water sources and is expected to improve reporting clarity once implemented.

Farming data from individual data repositories can be laborious and potentially requires multiple subscriptions to provincial databases. Data aggregators, such as Petro Ninja, geoSCOUT, and AccuMap are subscription-based repositories that house data from multiple jurisdictions. If CAPP does not have existing relationships with regulators or existing accounts with centralized databases like Petrinx to access data directly, then data aggregators are likely a good source of data for CAPP's reporting efforts. However, the data held within data aggregators has not been reviewed as part of this study.

Comparison of water use data between regions and sectors is possible, but not straightforward. Definitions of alternative, saline, and non-saline waters can vary, not only between regions but also between sectors. Caution is also advised when using production data for water use intensity metrics, as reporting of oil and gas production data may not always consistent between companies.

To improve reporting and availability of water use data in the oil and gas industry throughout Canada, CAPP can work with regulators and operators in several areas:

- Regulators in all regions can be encouraged to provide clear reporting guidance and definitions

- within their regulatory frameworks;
- The utilization of a digital reporting database, particularly Petrinex, can be encouraged for the Northwest Territories, which currently lacks an online reporting tool;
 - CAPP can engage with operators to explore current techniques and best practices for measuring water use and hydrocarbon production. This will help promote consistency in the inputs to databases; and
 - CAPP can engage regulators to encourage the public disclosure of water use data across oil and gas sectors, allowing external entities to use and validate the data available. This will lead to more comprehensive and consistent reporting as well as a greater degree of transparency throughout the oil and gas industry.

As the world of ESG reporting, particularly water use and water risk management reporting, continues to evolve, it is recommended that CAPP continues to stay up to date with emerging water reporting best practices and encourages public reporting of metrics that are valuable to operating companies, the investor community, policy makers, and the public.