



White Paper Series

Decoding Flowback and Produced Water Management



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Executive Summary

For some oil and gas operators, especially those in the unconventional sector, sourcing, transporting, and disposing of water is an economic and logistical challenge. Reusing water can alleviate some of these economic and logistical challenges under certain circumstances, and can create a positive impact on the environment and social licence to operate. Recently, there has been tremendous progress in the innovation of storage for producers in Alberta. This progress is the result of producers finding solutions outside of the trends in Alberta, and the Alberta Energy Regulator (AER) releasing guidance documents and issuing pilot approvals for new storage solutions.

In order to effectively reuse water, operators will require reliable, safe, and economical storage and treatment options. This paper is the first of a series that describes the framework for the reuse of produced water and fracture flowback fluid in the hydraulic fracturing industry in Alberta. The current water use and challenges in the industry, storage options for reuse water, government policy and regulatory approvals, and next steps for the reuse of water are discussed herein.

Subsequent papers in this series will include:

- 1 A conceptual strategy to consider for treatment and reuse of flowback and produced water
- 2 An economic analysis of the current options available in the market for water management including a scalability assessment
- 3 The siting, design and management of storage ponds to effectively store reuse water and mitigate risks

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Water Demand and Hydraulic Fracturing in Western Canada

Effectively managing water in the oil and gas industry is vital to establishing a sustainable industry, a healthy economy, and protecting one of our most valuable resources.

Hydraulic fracturing to stimulate unconventional oil and gas (UCOG) wells currently requires a significant amount of water, frequently **tens of thousands of cubic meters (m³) per well** (CSUR 2011). A portion of the water that is injected into the well and formation flows back to the surface, along with produced water from the formation.

Water Source Options

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Current sourcing of water for hydraulic fracturing operations mainly includes:

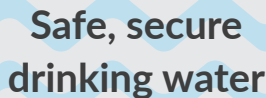
- Surface water (rivers, streams, lakes, surface runoff),
- Beneficial reuse (municipal wastewater, industrial treated effluent),
- Saline groundwater (greater than 4000 milligrams per litre (mg/L) total dissolved solids (TDS)), and
- Non-saline groundwater (4000 mg/L TDS and less).

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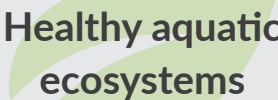
Water Policy and Conservation in Alberta

Water is owned by the Crown, and is regulated under the *Water Act* in the province of Alberta. Industry and provincial government strategies are targeting a reduction of non-saline water use to support operations in the UCOG sector.

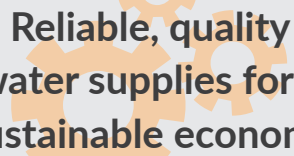
In 2003, the Government of Alberta published the *Water For Life Strategy* with the goals of helping to ensure:



**Safe, secure
drinking water**



**Healthy aquatic
ecosystems**



**Reliable, quality
water supplies for a
sustainable economy**

In support of the Water for Life Strategy, the Government of Alberta released the *Water Conservation and Allocation Guideline for Oilfield Injection* in 2006. The intended outcome of this Guideline is to “enhance the conservation and protection of Alberta’s water; and to reduce, or eliminate, on a case-by-case basis, the use of non-saline water resources for oilfield injection purposes.”

It is anticipated that the Government of Alberta will release a newly crafted policy for water conservation in hydraulic fracturing operations, titled the *Water Conservation Policy for Upstream Oil and Gas Operations*. As stated by the provincial Government in *Our Water, Our Future: A Plan For Action*, a focus of this policy is to reduce the use of fresh water in hydraulic fracturing (Government of Alberta 2014).

Freshwater Use Challenges

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In August 2015, the Alberta Energy Regulator (AER) restricted the use of temporary diversion licences, which allow for the use of non-saline water, in some regions due to dry weather and low flow in rivers (AER 2015a).

The AER also requested that oil and gas operators voluntarily reduce their water use in dry areas where restrictions were not enforced (AER 2015a). On May 6, 2016 the BC Oil and Gas Commission (Commission) issued a water supply warning encouraging operators with valid water licences to store water for use at a later date, in anticipation of another summer with challenging water supply (Commission 2016).

In a time of social awareness, low oil and gas prices, and economic uncertainty for the UCOG sector, producers require sustainable, secure, and economical water sourcing and management strategies.

5 Reuse Opportunity

The improved reuse of flowback and produced water in hydraulic fracturing operations can reduce requirements on non-saline water sources, and can result in reduced environmental and economic pressure. Due to the rate of flowback generation, water storage is required to safely contain the water until it can be treated and re-used. **The costs associated with water sourcing and disposal can be significant to an operator**, and opportunities to reuse water and reduce trucking and disposal fees may be a feasible option, especially in a constrained market with low commodity prices and the need for water conservation. Additional benefits to storing and reusing water include a lower carbon footprint and increased safety associated with trucking.

To successfully reuse water and limit liability, the reuse water must be compatible with the formation. Treatment plays an important role in reuse and will be discussed in a subsequent paper in this series.

Storage Options 6

An efficient way to reduce the use of fresh water, or non-saline water, in hydraulic fracturing is to **capture and store flowback and produced water for reuse through storage**. Storage options include:

- Above ground synthetically-lined wall storage systems (AWSS), also referred to as lined C-rings
- Tanks
- Engineered containment pond (Storage Pond)

To date AWSS' have been considered relatively small and temporary storage options. Tank installation and storage pond construction are considered more long-term, however, they are still temporary developments. Tanks and storage ponds will likely only be operational when the producer is fracturing nearby wells, they will not be permanent infrastructure like landfills or gas plants.

7 Current Regulations and AWSS

Currently, most producers use AWSS for storage. This trend may be driven from regulations opposed to the desired option for each producer. The use of AWSS technology is limited to a maximum of one year and 3000 m³ capacity per unit, unless the applicant receives approval for a variance, or alternative storage from the AER.

The requirements for the use of AWSS are included in the AER *Directive 055 - Addendum: Interim Requirements for Aboveground Synthetically-Lined Wall Storage Systems, Updates to Liner Requirements, and Optional Diking Requirements for Single-Walled Aboveground Storage Tanks* (Directive 055 Addendum). **With the parameters established in the Directive 055 Addendum, some sites require multiple AWSS to contain a substantial volume of water to eliminate the need for fresh water.** The application requirements for alternative storage are outlined in the Alternate Storage Application Guideline (AER 2015b), which was released in 2015. Since the release of the Alternate Storage Application Guideline there have been a number of producers applying, and receiving approval, to store larger volumes of fluid and/or for longer periods of time. **This is a significant opportunity for producers, to customize storage to best meet their needs.**



Current Regulations and Storage Ponds 8

The operation of flowback and produced water storage ponds and associated regulations, have already been implemented in British Columbia. Alberta producers, along with the Government of Alberta, have shown interest in the recycling and reuse of flowback and produced water, however, implementation has had some challenges.

In May 2016, the AER issued the first and only approval for a Brine Storage Pond/Engineered Containment Pond (ECP), for the purpose of storing flowback and produced water for reuse in hydraulic fracturing operations. Siting, design, environmental monitoring and closure were major components of the application, and the approvals included robust monitoring and reporting requirements. This is a significant milestone in the use of storage ponds for reuse, with an established approval process, operators now have the opportunity to apply for a storage pond with more certainty.

To store flowback and produced water in a pond, an approval is required from the AER under *Directive 058 - Oilfield Waste Management Requirements for the Upstream Petroleum Industry* (Directive 058). Directive 058 is divided into sections that describe the siting, reporting, operational, closure, and application requirements based on the type of waste facility. A flowback and produced water storage pond does not directly align with the types of waste facilities described in Directive 058, and an application for such a containment structure must meet the requirements of an Oilfield Waste Management Facility, Waste Storage Areas/Facilities and Waste Transfer Stations and Oilfield Landfills.

In addition to Directive 058, the AER has requested that applicants meet the siting requirements of the Standards for Landfills in Alberta, and to submit an application for authorization under the *Environmental Protection and Enhancement Act* (EPEA) if the fluid being stored is considered brine (>5000 mg/l chlorides). Also, if the storage pond exceeds 30,000 m³ of capacity and has a height of 2.5 m or greater above ground, applicants need to meet the requirements of Dam and Canal Safety in accordance with the *Water (Ministerial) Regulation*.

Integrated Sustainability supported the application and construction of the first and only approved produced water and flowback storage pond in Alberta.

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Social Perception and Risks

The use of storage facilities for large above ground tanks or storage ponds to support water re-use and recycling creates large footprints and presents a significant, though different, social perception of risks and challenges (e.g. aesthetics) than the use of AWSS on well sites. However, this perception may be balanced by recognizing industry's efforts towards reduced water use and trucking, carbon emissions, and environmental impacts. **Moreover, multiple storage options provide the producer with the opportunity to select the best option for their development plans.** For example, if the producer will be servicing multiple wells within a certain region for the next 5-10 years, and will require a substantial volume of re-use water, a pond central to those wells may be the best option. This can ultimately reduce freshwater consumption and disposal needs. Water re-use and recycling has become pivotal in industry as producers continue to improve their water management strategies while striving to maintain the highest safety standards.

A non-permanent storage pond, with the appropriate risk mitigation and environmental controls, such as liner containment systems (double or triple), leak detection, and groundwater monitoring would allow for a safe and reliable method for storage and reuse of flowback and produced water.

Using a single pond allows for containment of larger amounts of water in one system rather than relying on several AWSS systems that would each require their own management system.

Proper planning and consideration of all development constraints will be key in achieving quality and reliable containment.



NEXT STEPS for

WATER REUSE

We believe that a comprehensive regulatory process, specific to the storage and reuse of flowback and produced water would encourage improved water reuse and recycling in Alberta and achieve the goals of the *Water for Life Strategy*.

Reducing surface water diversion will improve the security and safety of drinking water, improve the health of the aquatic ecosystem and improve the reliability of quality water supplies for a sustainable economy.

It will also directly support the anticipated Water Conservation Policy for Upstream Oil and Gas Operations, which aims to reduce the use of high quality non-saline water in hydraulic fracturing operations (Government of Alberta, 2014). The Canadian Association of Petroleum Producers – “Reducing Water Withdrawal – Challenges and Opportunities”, states that **one operator in British Columbia who is designing a water hub to accommodate flowback, produced water, and saline groundwater will reduce their surface water use in the area by 50-75%** (CAPP n.d.).

The recent approval of a storage pond and alternative storage methods is encouraging and will potentially shift the current storage trends in Alberta. As technology and innovation progresses, new storage methods may emerge and policies, regulations, and directives specific to the storage and reuse of fracture flowback fluid and produced water will allow producers to reduce their reliance on, and use of, fresh surface water and non-saline groundwater resources. Alberta Environment and Parks (AEP) is pursuing a draft policy pilot in the Duvernay and Montney play areas of Alberta that will address all aspects of development, including water use and management. Directives and guidelines will be implemented following this policy. In the meantime, we believe that clear and regular communication between regulators and industry can guide the current approval process, and future advances in this field.



This paper is the **first in a series** that intends to discuss water use and hydraulic fracturing in Alberta.

Further discussion on:

A conceptual strategy to consider for treatment and reuse of flowback and produced water

An economic analysis of the current options available in the market for water management including a scalability assessment

The siting, design and management of storage ponds to effectively store reuse water and mitigate risks

These topics will be discussed in subsequent papers as part of this series.

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