# Consolidation of ground water data in Alberta within WCSB

For:
The Petroleum Technology Alliance Canada

By:

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# Consolidation of existing ground water data collected in western Canadian sedimentary basin

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## Abstract

Ground water is used in the upstream oil and gas industry for a variety of purposes including enhanced oil recovery injection, hydraulic fracturing, drilling and production. The ground water is primarily sourced from wells drilled by the oil and gas companies on both private and crown lands. In a few cases, private wells drilled by landowners are used as a water source.

The well drillers are required to submit a report for every well drilled which includes details of the wells depth, geology and development and testing details. In addition, an approval under the Water Act is required for the usage of water from the wells.

Information relating to the well reports filed by the drillers is recorded in the Groundwater Information Center (GIC)database. Information relating to the Water Act approval is recorded in the Environmental Management System (EMS) database and the Water Use Return (WUR) database. Information in the EMS database is not necessarily correlated to information in the GIC database. Information in the WUR database is correlated to information in the EMS database based on the Approval number.

This project correlates the information in GIC for approximately 1350 wells drilled for upstream oil and gas operations with approval and water use information in the EMS and WUR databases. Tables linking the Well ID in GIC to approval ID in EMS along with details of well location, drilling and completion, qualitative and quantitative testing is recorded in a tabular format suitable for review with spatial software applications.

In addition the Government of Alberta operates a groundwater observation well network consisting of 225 active wells. The network collects and records water level and water quality data for each well on a regular basis. The data for the active and inactive wells in the Ground Water Observation Well Network (GOWN) is available for public download via the internet. All of the active wells in GOWN are correlated with GIC.

This project provides a tabular summary of the active GOWN wells. The table includes geographic coordinates in order that the information can be used in spatial software applications.


## Executive Summary

In the process of oil and gas exploration and development proponents need to identify and understand local ground water resources either from the perspective of potential supply of water or from the perspective of monitoring impacts.

This project identifies wells across the province that have been developed by U/S oil and gas operators for upstream oil and gas activities that could potentially be used as a shared source of ground water information.

The types of information that is collected regarding these wells includes drilling information such as depth, lithology and logging; well completion information such as casing material, pump depth, screen depth, and plug and seal information; quantitative and qualitative information about the water including pump testing, chemical analysis and production volumes and water level records. This project identifies the types of information that may be available based on the correlation of the GIC, EMS, WURS databases.

A list of wells is compiled in tabular format that can be used in spatial applications. The tables include basic summaries of the wells identifiers and links in the various databases as well as some basic information about each well including owner, depth, Water Act Approval ID, and other sorts of information available.

This project examines the structure of each database to help understand the relationships of information as well as understand where additional non digital information about each well may be available.

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## Methodology

Water Act approvals to divert and use ground water, issued for upstream oil and gas operations were reviewed to determine a link between the Water Act approval ID and a well id in the Ground water Information Center (GIC) database. The scope of the review was limited to active long term approvals and temporary approvals issued since 2010

Both the EMS approval data and the GIC well data have attributes (geographic coordinates and legal land description) which facilitate viewing the data using spatial software (ESRI Arcgis). Approvals in EMS were expected to have a corresponding well in GIC on the same legal subdivision or quarter section parcel. When a Water Act approval and potentially matching well in the GIC records were identified based on location the two were then compared based on additional information. Well depth and owner/approval holder are fields in both databases. If these fields were found to be similar then a match was assumed. To further verify the match, production interval information from EMS was compared with finished depth and screen top information in GIC.

If no matching well in GIC was found for an approval well the scope of the search was expanded to include wells on adjacent land parcels. When a matching well in GIC was identified, the Well ID of that well was recorded as a link with the approval ID.

In many instances more than one possible record in GIC was a possible match. It appears that exploration companies often drill several holes before constructing a production well. Some of the other wells may end up being used for observation wells. While some observation wells are a record in EMS, not all are. When there were more than one possible well in GIC to link to an approved well in EMS the most likely well was chosen.

## Data

The Groundwater Information Center, water well data and the EMS and WUR Water Act approval databases are maintained by Alberta Environment and Parks. Downloads of this data up to date in June 2015 have been obtained from Alberta Environment and Parks.

Online access to some of the data and documents is available to the public. Complete well reports for individual wells in GIC can be viewed online. The well reports can be chosen via online map, legal land location or well id.

Copies of many of the Water Act approvals can be viewed via the online approval viewer maintained by Alberta Environment and Parks.

GOWN wells can be viewed in an online map or in tabular format at the GOWN wells website. This website provides links to available water level and water quality data that can be downloaded in a spreadsheet format. The online table was used to create a list of active and inactive GOWN wells.

## Results

Of the 1,210 temporary Water  Act approvals granted for upstream oil and gas exploration and production since 2010, 1,035 approvals were linked to wells in GIC. 165 temporary approvals could not be linked. Many of these were deep wells which may not have been reported to GIC.

1561 long term Water Act approvals were reviewed and 1073 were found to link to a GIC well. In total 2,108 approvals were linked to wells in the GIC database. A number of different Water Act approvals may be linked to the same well. Reactivating an expired approval or increasing the authorized diversion volumes are reasons for more than one approval to be associated with a distinct well. The total number of unique wells in GIC that are associated with one or more approval in EMS is 1354.

All active GOWN wells had a link to the GIC database.

Three shape files were created.  Each shapefile uses the geographic coordinates from the GIC well database plus a combination of attributes from the GIC and EMS database

The shapefile named “PTAC_Well_ID_Linked” has 1354 records, one for each GIC well ID that was identified in the review. The attribute fields of this file are all from the GIC database. They include well owner, legal land description, total well depth, pump depth, casing material and casing bottom. In a addition, several fields identify the presence of additional information in GIC such as  how many pump test reports, chemistry reports, lithologies and such information is available for each well. The additional information  is available in the GIC download or at the water well information website. In one attribute field in the shape file a url link has been created to enable opening the online well report from the Arcgis map.

The table named “PTAC_Approvals_Linked_WellID” contains 2108 records, one for each approval that could be linked. This table contains information about each approval including approval ID, Approval holder, dates of approval, specific purpose and sector ID for each approval and of course the Well ID in GIC that links to the approval. Since a well in GIC may be linked to more than one approval, some GIC well id’s appear more than once in this table. A field containing a link to the approval document viewer is also provided so the approval document may be opened easily.

The table “PTAC_Well_ID_Link_GOWN” contains 225 records, one for each Gown well. The attribute fields in this table are similar to the attribute field in the well id file.

## Analysis of Results

### Gown Wells

The 225 active GOWN wells are located mainly in the agricultural areas of Alberta.  According to the tables on the GOWN website, 166 of these wells have water quality data. The casing material for the majority of the wells is steel, while a few are plastic and a few are unknown or not specified. It is

assumed that all active wells have water level data which can be downloaded from the GOWN website.

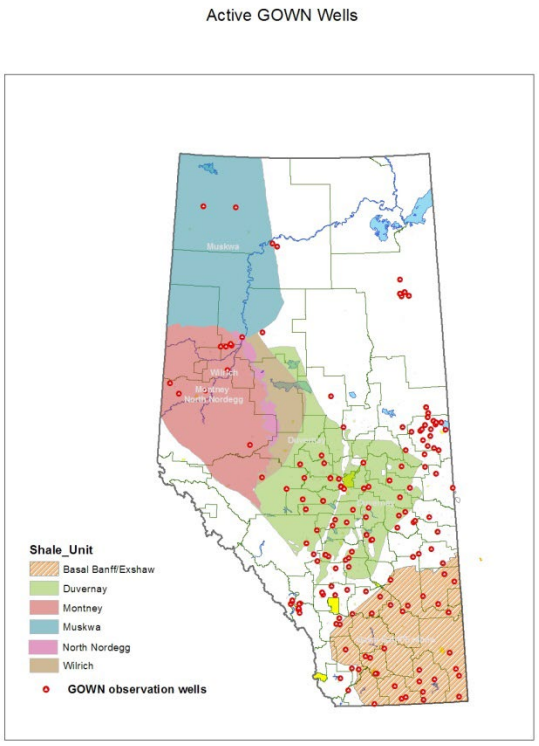


**Figure 1 The GOWN wells are located mainly in the agricultural and populated areas of Alberta**

There are 53 GOWN wells with depth of greater than 100 meters. The majority, 145 are less than 75 meters in depth. The actual depth of the formations being monitored for each well can be determined from studying the well completion details in the GIC reports.

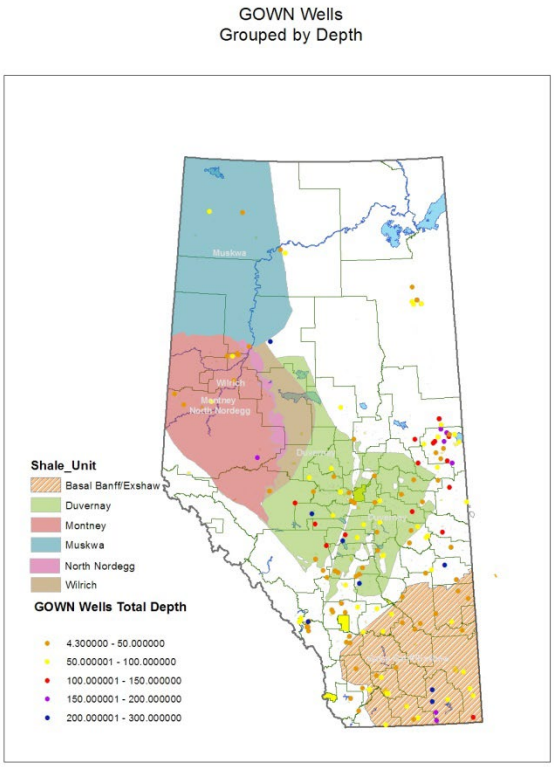


**Figure 2 The majority of GOWN well are less than 100 metres deep**

## GIC Wells Linked with Water Act Approvals

The 1354 wells that were linked to Water Act approvals aremainly located in NW Alberta  where shale gas development is occuring and in NE Alberta where the enhanced recovery of bitumen (thermal, cold and mining) is going on.

Of the 1354 identified wells, only 34 have one or more chemical analysis reports in GIC. Many of the 1354 wells may also have hard copy chemical analysis reports on file with Alberta Environment and Parks, either accompanying an approval application or as a reporting requirement, however, no digital chemical analysis data associated with any of these wells was found in the EMS or WUR databases.

All but 78 of the 1354 approval linked wells have one or more pump test reports in GIC.  Approximately 440 of these wells have at least one water use reports in WUR.

Of the 2108 approvasl associated with the 1354 wells, 532 approvals are for thermal bitumen projects, 502 are for hydraulic fracturing projects, and 491 are conventional enhance oil recovery, 279 are associated with gas and oil production operations and 250 are for well drilling. The remaining 54 are split between mining, cold bitumen EOR and Hydrostatic testing.

Of the 1354 wells in GIC that are associated with the 2108 different approvals, 223 have an abandoned report in GIC.

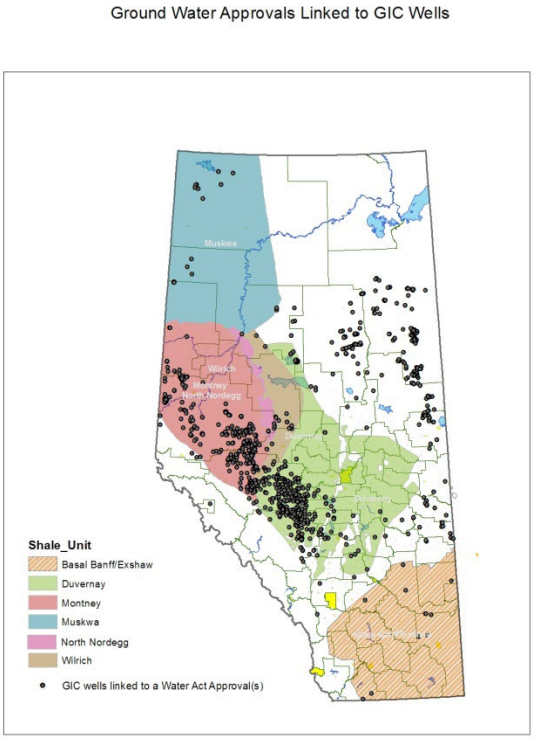


**Figure 3 The majority of approval wells are located in NW Alberta and NE Alberta**

# Conclusion

The project identifies 1,354 wells distributed across the province, that have been drilled and or used in upstream oil and gas activities. The project links these wells to Water Act Approval data in EMS and WUR as well as the drilling reports in GIC. Although there is a great deal of digital data available for each well in each of the databases there appears to only be a minimal amount of water quality and water level data in digital format . Additional hardcopy data regarding water quality, water levels and production volumes and rates for each well may very likely be available from approval files, though access to this data may be difficult due to confidentiality concerns.