

June 10, 2016

3600-2800/2850-32640-02

Nicholas Haddow, Regulatory Specialist
Aqua Terra Water Management Inc.
#108, 32 Burnt Lake Crescent
Red Deer, AB T4S 0K6

Dear Mr. Haddow:

**RE: PRODUCED WATER AND NON-HAZARDOUS WASTE DISPOSAL
SPECIAL PROJECT APPROVAL; AMENDMENT #2
AQTWM FT ST JOHN 6-24-084-19 W6M; WA# 3060
FORT ST JOHN FIELD – CADOMIN AND NIKANASSIN FORMATIONS**

Approval for produced water and non-hazardous waste disposal into the Cadomin formation of the subject well was issued February 3, 2010, under Order 10-02-001. Disposal occurred between January 2010 and August 2011, at which point the well was shut in. On December 5, 2014, Order 10-02-001 Amendment #1 was issued to bring the well up to current standards prior to restarting disposal. Due to a number of identified risk factors, a groundwater monitoring program was included as part of the Order, with a requirement for monthly sampling once disposal activities resumed.

In a letter dated April 28, 2016, Aqua Terra requested monitoring well sampling frequency be altered from monthly to quarterly. Based on groundwater reports provided for the first four months of 2016, the Commission is in agreement that the water chemistry has remained consistent and quarterly sampling will provide appropriate monitoring.

During a re-examination of the disposal formation, it was determined that the perforated interval actually extends over both the Cadomin and Nikanassin formations. Because of this, historical monthly disposal volumes have been split over the two formations, 40% to the Cadomin and 60% to the Nikanassin, based on formation parameters and temperature log results. Going forward, report monthly S-18 form volumes on the basis of Cadomin 40% and Nikanassin 60%.


Attached please find **Order 10-02-001 Amendment #2**, designating an area in the Fort St John field – Cadomin and Nikanassin formations as a Special Project under section 75 of the *Oil and Gas Activities Act*, for the operation and use of a storage reservoir for the disposal of produced water and non-hazardous fluid. Additional general information regarding disposal wells is available on the Commission's website at <http://www.bcogc.ca/industry-zone/documentation/Subsurface-Disposal>.

The Ministry of Environment identifies the type of effluent approved for injection in the separate Waste Discharge Permit, granted under the Environmental Management Act.

In certain circumstances, disposal well operation may induce seismicity. The Commission advises that disposal well permit holders monitor seismic events in proximity to the well and be prepared to modify operations to mitigate induced seismicity. Permit holders may monitor seismic events through the Natural Resources Canada seismic monitoring network at <http://www.earthquakescanada.nrcan.gc.ca/recent/index-eng.php>.

Should you have any questions, please contact Michelle Harding at (250) 419-4493 or the undersigned at (250) 419-4430.

Sincerely,



Ron Stefik, Eng.L.
Supervisor, Reservoir Engineering
Oil and Gas Commission

Attachment



ORDER 10-02-001 Amendment #2

- 1 Under Section 75(1)(d) of the *Oil and Gas Activities Act*, the Commission designates the operation and use of a storage reservoir for the disposal of non-hazardous waste as well as produced water, including flowback from fracturing operations, into the Cadomin and Nikanassin formations – Fort Saint John field as a special project in the following area:

DLS Twp 84 Rge 19 W6M Section 24 - Lsds 3, 4, 5, and 6

- 2 Under section 75(2) of the *Oil and Gas Activities Act*, the special project designation in this Order is subject to the following conditions. The Permit Holder shall:
- a) Inject non-hazardous waste and produced water only into the well AQTWM Ft St John 06-24-84-19; WA# 3060 Cadomin (1066.0 – 1102.0 mKB) and Nikanassin (1108.0 – 1120.0 mKB) formations.
 - b) Hold a valid Permit under the Environmental Management Act for the disposal of non-hazardous waste.
 - c) Not exceed an injection pressure, measured at the wellhead on the subject well, of 10,850 kPag or the pressure required to fracture the formation, whichever is lesser.
 - d) Inject only through tubing with a packer set as near as is practical above the injection interval.
 - e) Continually measure and record the wellhead casing and tubing pressures electronically.
 - f) Cease injection and notify the Commission immediately if hydraulic isolation is lost in the wellbore or formation.
 - g) Submit the annual packer isolation test report to the Commission within 30 days of the completion of the test.
 - h) Include the disposal operating hours and the maximum injection pressure values on the monthly disposal statement.
 - i) Report the disposal volumes on the monthly disposal statement 40% to the Cadomin formation and 60% to the Nikanassin formation.
 - j) Cease injection upon reaching a maximum formation pressure of 11,670 kPaa.
 - k) Maintain and manage the well head to prevent surface liquids from entering the well bore through the annulus outside or between casing and conductor strings.
 - l) Conduct an annual reservoir pressure test on the formation in the subject well, with a shut-in period of sufficient length to provide data for calculation of the reservoir pressure, and submit a report of the test within 60 days of the end of the test.
 - m) i) Perform a casing inspection log on the subject well and submit results to the Commission within 30 days of the completion of logging, at an interval of not more than every 10 years, commencing from the date of initial disposal operation into the Cadomin and Nikanassin zones.
ii) Perform an annual hydraulic isolation log on the subject well and submit results to the Commission within 30 days of the completion of logging.
 - n) Not conduct a hydraulic fracture stimulation on any formation in the subject well without prior Commission approval.
 - o) Implement a groundwater monitoring program as detailed in Appendix A.



Ron Stefik, Eng. L.
Supervisor, Reservoir Engineering
Oil and Gas Commission

DATED AT the City of Victoria, in the Province of British Columbia, this 10th day of June 2016.

Advisory Guidance for Order 10-02-001 Amendment #2

- I. A production packer must be set above the injection interval and the space between the tubing and casing filled with corrosion and frost inhibiting fluids, as per section 16(2) of the Drilling and Production Regulation.
- II. Annual packer isolation tests are required to be submitted, as per section 16(3) of the Drilling and Production Regulation.
- III. Injected fluids must be metered and the injection pressure measured at the wellhead, as per section 74 of the Drilling and Production Regulation.
- IV. A monthly disposal statement must be submitted to the Commission not later than the 25th day of the month following the reported month, as per section 75 of the Drilling and Production Regulation.
- V. Seismic events must be reported and disposal operations suspended as per section 21.1 of the Drilling and Production Regulation.

Appendix A – Groundwater Monitoring Requirements**AQTWM Ft St John 6-24-84-19 (WA# 3060) Non-Hazardous Waste and Produced Water Disposal**

Groundwater Monitoring Wells were constructed and tested as per the requirements laid out in Order 10-02-001 Amendment #1 Appendix A. Ongoing monitoring requirements are as follows

Groundwater sampling frequency and procedures

Water quality sampling shall be conducted using standard environmental sampling protocols in accordance with the *British Columbia Field Sampling Manual for Continuous Monitoring and the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples (2003)*, and as follows:

- The groundwater sampling program shall be completed under the supervision of a qualified groundwater professional registered with APEGBC.
- Groundwater sampling shall be conducted from each monitoring well on a quarterly basis under this Order, unless approval is obtained from the Commission to vary this sampling schedule.
- The groundwater analytical program, including sampling schedule, may be revised over time, with approval of the Commission, based on the analytical results.
- Groundwater sampling shall continue on a quarterly basis for a period of one year after disposal well abandonment, unless approval is obtained by the Commission to vary this sampling schedule.
- Groundwater sampling events shall include an appropriate quality assurance/quality control (QA/QC) program including field duplicates and field blanks.
- Groundwater samples shall be collected using standard environmental sampling procedures that ensure that the sample is representative of the aquifer at the zone of sampling and the sample is not cross-contaminated during sampling.
- Samples shall be transferred to appropriate sampling containers and preserved in the field as necessary for each analytical parameter.
- Samples shall be submitted, using appropriate storage and transportation procedures, with appropriate chain of custody documentation, within 48 hours of collection, for analysis at a certified laboratory.

Groundwater analytical parameters

- Groundwater samples shall be analyzed for: routine water quality parameters (pH, hardness, total dissolved solids, electrical conductivity, salinity, and major cations and anions); total and dissolved metals; and dissolved hydrocarbons including dissolved gases C1-C3, benzene, ethylbenzene, toluene, and xylenes (BETX), volatile petroleum hydrocarbons (VPH) and volatile hydrocarbons (VH), and light and heavy extractable hydrocarbons (LEPH/HEPH).
- If dissolved methane is detected at concentrations greater than 2 mg/L, isotopic analyses shall be conducted, if possible, to differentiate between biogenic and thermogenic sources. Methane isotopic sampling shall be conducted using protocols described in: *The Free Gas*

Sampling Standard Operating Procedure for Baseline Water Well Testing (2009), prepared for Alberta Environment and Sustainable Resource Development.

- The groundwater analytical program may be revised over time, with approval of the Commission, based on the analytical results.

Groundwater level monitoring

- Groundwater level monitoring shall be completed under the supervision of a qualified groundwater professional registered with APEGBC.
- Once disposal operations under this order have commenced, groundwater levels in the monitoring wells shall be measured daily using an electronic data logger or by hand measurement.
- The date and time of initiation of disposal operations under this order shall be recorded.

Reporting

- Once disposal operations have commenced under this order, monitoring data shall be submitted annually to the Commission by January 31st of the following year. The dates and times of groundwater sampling, analytical results, daily water level measurements, and daily injection volumes shall be reported. Analytical results shall be presented in table format, and original laboratory analytical reports shall be retained on file by the permit holder.
- In addition to annual reporting requirements, the results shall be reviewed by the permit holder at the time of receipt from the laboratory and immediately reported to the Commission if results indicate significant changes in groundwater chemistry compared to previous sampling.
- The Commission may request copies of the sampling information on file prior to the annual due date.
- Additional documentation and/or further sampling or investigation to that required under this Order amendment may be required by the Commission based on review of submitted documentation.

Requirements for Groundwater Monitoring Well Decommissioning

Monitoring wells shall be decommissioned in accordance with the BC Groundwater Protection Regulation.