

April 19, 2016

3600-2800-32640-02

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 11-12-084-19 W6M; WA# 3010
FORT ST JOHN FIELD – CADOMIN FORMATION**

Approval for produced water and non-hazardous waste disposal into the Cadomin formation of the subject well was issued March 11, 2016 under Order 16-02-002 Amendment #1. A number of disposal risk factors were identified for the well, including corrosion at 348mKB and proximity to residential groundwater wells. As such, an ongoing groundwater monitoring program is required.

Appendix A of the attached disposal Order details the groundwater monitoring program requirements. The requirements consider both current well site information and information documented in two reports provided by Aqua Terra regarding previous groundwater investigation conducted at the site:

- "Numac Energy Inc. 11-12-84-19 W6M Charlie Lake Disposal Well, Final Remediation 1998" prepared by Rudiger Enterprises Ltd.
- "2014 Groundwater Monitoring Program, AQTWM Ft. St. John 11-12-084-19 W6M", January 2015, prepared by Navus Environmental.

Attached please find **Order 16-02-002 Amendment #2**, designating an area in the Fort St John field – Cadomin formation 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.bccgc.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 16-02-002 Amendment #2

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

DLS Twp 84 Rge 19 W6M Section 12 - Lsds 11, 12, 13 and 14.

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 produced water and non-hazardous waste only into the well AQTWM Ft St John 11-12-84-19 W6M; WA# 3010 Cadomin formation (perforations from 1030.5 to 1067.0 mKB).
 - 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 9,480 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 value on the monthly disposal statement.
 - i) Cease injection upon reaching a maximum formation pressure of 11,485 kPaa measured at MPP.
 - j) 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.
 - k) 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.
 - l)
 - 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.
 - ii) Perform a hydraulic isolation temperature 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 5 years, commencing from the date of initial disposal.
 - m) Not conduct a hydraulic fracture stimulation on any formation in the subject well without prior Commission approval
 - n) 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 19th day of April 2016.

Advisory Guidance for Order 16-02-002 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 11-12-84-19 (WA 3010) Non-Hazardous Waste and Produced Water Disposal**

A "Reference Groundwater Assessment" shall be developed and implemented under the direction of a qualified professional registered with the Association of Professional Engineers and Geoscientists of BC (APEGBC). The assessment program shall include the following components:

1. Installation of three new monitoring wells – 1) on the northwest side of the tank farm, 2) on the north side of the tank farm, and 3) one at the southwest corner of the site proximal to existing monitoring well identified as P14-02 in the report entitled "2014 Groundwater Monitoring Program", prepared by Navus Environmental. These monitoring wells shall be installed in accordance with the BC [Groundwater Protection Regulation](#) and current standard environmental investigation protocols, such as those specified in [British Columbia Field Sampling Manual](#). The screened section of the monitoring wells shall be placed at appropriate depths to intersect the water table and shall not be more than 10 feet (3m) in length.
2. Collection groundwater samples from the newly drilled monitoring wells, and analysis for the same suite of parameters from the 2014 groundwater monitoring program. Groundwater samples shall be collected using standard environmental sampling and handling protocols such as those outlined in British Columbia Field Sampling Manual referenced above.
3. Completion of an elevation survey of the tops of all new and previously existing monitoring wells relative to geodetic datum (metres above sea level).
4. Measurement of water levels in all new and previously existing monitoring wells on two occasions for determination of groundwater elevation at each well (geodetic datum), groundwater flow direction, and horizontal gradient across the site.
5. A visual site inspection to identify and document indications of potential locations for releases of contaminants to the surface or subsurface (e.g., staining of surface materials, evidence of leaks/spills), and document any mitigation measures where implemented (e.g., secondary containment, sumps, etc.).
6. Compilation of a "Reference Groundwater Assessment Report" by the qualified professional that includes:
 - a. An introduction that states the purpose of the groundwater monitoring program with reference to OGAA and EMA permits and permit requirements, where applicable.
 - b. A site description that includes a description of infrastructure, local topography, site drainage, general site conditions, etc.
 - c. Documentation of the site inspection as per 5) above.
 - d. A site plan showing labelled locations of the disposal well and all site facilities.
 - e. A summary of previous environmental assessment, remediation, and monitoring work conducted at the site (as outlined in "Numac Energy Inc. 11-12-84-19 W6M Charlie Lake Disposal Well, Final Remediation 1998", prepared by Rudiger Enterprises Ltd., and "2014 Groundwater Monitoring Program, AQTWM Ft. St. John 11-12-084-19 W6M", prepared by Navus Environmental, and in any other available site investigation reports).

- f. A description of the groundwater assessment work and methodologies employed, consistent with requirements for the program stipulated in this order.
- g. Monitoring well logs for each of the newly installed monitoring wells indicating construction details and geological conditions encountered during drilling.
- h. A compilation of groundwater analytical results from the 1998 report and the 2014 report (referenced above), and all additional sampling, presented in tabular form with appropriate BC comparison criteria. Tables shall be presented to allow for comparison of groundwater sampling results collected on different dates from the same well.
- i. Tabulated information for current monitoring well ID, previous monitoring well ID (if applicable), monitoring well elevations relative to geodetic datum, monitoring well depth, screen interval depth, measured depth to groundwater (measured on at least two different monitoring dates), and calculated geodetic elevations of water levels.
- j. A site plan showing potentiometric elevations and estimated potentiometric contours based on the water level monitoring data.
- k. A proposed long term monitoring/sampling program that includes quarterly sampling from the monitoring wells (analytical parameters to be consistent with the 2014 sampling results), and quarterly measurement of potentiometric elevations. The qualified professional shall determine, based on the results presented in the report, the need for more frequent monitoring/sampling.
- l. Recommendations made by the qualified professional respecting mitigation measures or further investigation where warranted.
- m. Appended laboratory analytical reports for any results not detailed in previous reports.

Submission of Documentation

- The Reference Groundwater Assessment Report required under 5, above, shall be submitted to the Commission, by Email to Laurie.Welch@bcogc.ca and Michelle.Harding@bcogc.ca, within 60 days of the date of this Order amendment.
- Groundwater Monitoring Reports for the long term groundwater monitoring/sampling program (5.k., above) shall be submitted to the Commission annually. For each annual report, sampling procedures and dates shall be documented and any relevant site observations should be noted. Monitoring and sampling results shall be presented in tabular form with appropriate BC comparison criteria. Tables shall be presented to allow for comparison of groundwater sampling results collected on different dates from the same well. Laboratory analytical reports for the quarterly sampling shall be appended to the report. Laboratory analytical reports may be requested by the Commission at any time prior to the submission of the annual report.
- 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.