
August 9, 2017

James Armstrong
Encana Corporation
P.O. Box 2850, 500 Centre St SE
Calgary, AB, T2P 2S5

Dear Mr Armstrong:

**RE: PRODUCED WATER DISPOSAL SPECIAL PROJECT APPROVAL, AMENDMENT #1
GROUNDWATER MONITORING REQUIREMENTS
ECA ECOG ETSHO d-C70-J/94-O-08; WA# 24469
HORN RIVER FIELD – DEBOLT FORMATION**

Thank you for submitting the report for groundwater monitoring well installation and sampling at Encana's disposal well site, ECA ECOG ETSHO d-C70-J/94-O-08 (WA 24469) dated July 21, 2017, prepared by Gemini Corporation.

The activities conducted and the submitted report satisfy requirements of the BC Oil and Gas Commission's (BC OGC) Special Project Approval Order 10-02-004 Amendment #1 to implement a groundwater monitoring program as per Appendix A the Order Amendment #1.

The following technical points are noted, however, and should be addressed in future monitoring activities and reporting, and/or by revisions to the submitted report as appropriate.

- Please confirm the adequacy of the surface seal for the monitoring well and compliance with the the [BC Groundwater Protection Regulation](#). It is noted in the report that a 5.1 cm (2") solid stem auger was used to drill the borehole and a 5.1 cm (2") diameter PVC monitoring well was installed in the borehole. As documented, this procedure would not permit an annulus of sufficient width to accommodate an effective (bentonite) surface seal. A 10 cm (4") diameter solid stem auger is a standard size. Please confirm, with the drilling contractor if necessary, the diameter of the solid stem auger used during drilling.
- It is noted in the report that the monitoring well was purged and a "known volume" was removed. Please document purge volumes prior to sampling in terms of "well volumes" to document standard monitoring well purging protocols, and/or document stabilized field measurements (e.g., pH, conductivity, temperature) during purging.
- The report indicates the sample was collected using a "Waterra pump". Please comment on the specific pump used and whether agitation of the sample could compromise (lower) the analytical results for volatile hydrocarbons and hydrocarbon gases.

- With respect to the points above, and as referenced in the Approval Order Appendix A, please refer to the BC Field Sampling Manual 2013 for acceptable environmental sampling protocols for groundwater (Chapter: Groundwater Pollution Monitoring). http://www2.gov.bc.ca/assets/gov/environment/research-monitoring-and-reporting/monitoring/emre/field_sample_man2013.pdf As the purpose of the sampling is to document reference groundwater chemistry and monitor for consistency, the importance of conducting sampling using consistent and well-documented protocols in accordance with standard environmental sampling practices is emphasized.
- The monitoring well water level indicates artesian conditions and over 20 m of hydraulic head from the screened interval which is noted be a dry to moist silty clay loam. Were there any drilling or purging observations (e.g., wet zone during drilling, recharge following drilling or purging) that might be consistent with the water level observation? The recovery level of the water in the 10 minutes following purging should be documented as an indicator of well recharge.
- The report indicates samples were collected in accordance with the BC MOE Technical Guidance on [Contaminated Sites 1: Site Characterization and Confirmation Testing \(2009\)](#), however, this document “contains guidance for investigating and characterizing fill and soil”.
- Under the “Regulatory Context” section of the report it is implied that the Oil and Gas Activities Act is Federal. It is Provincial legislation. Also implied is that the Oil and Gas Activities Act contains numerical standards for water although it does not. For future, in addition to CSR standards, the applicability of BC Approved Water Quality Guidelines should be considered. <http://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines>.
- While reference to specific potentially applicable groundwater standards is useful for comparison to analytical results, it could be noted in the report that this investigation was not conducted as a contaminated site investigation.
- In Table A of the report, please clarify the difference between “Static Water Level (from the top of the well)”, and “Water Level (measured from the top of the casing)”.

Sincerely,



Laurie Welch, P.Geo., Hydrogeologist
BC Oil and Gas Commission

cc: Ron Stefik, Eng.L. Supervisor, Reservoir Engineering, BC Oil and Gas Commission
Michelle Harding, EIT, Reservoir Engineer, Reservoir Engineering
Diana Dunn, Encana
Ramona Stoica, Encana