

# **Pavillion Groundwater Report Fact Sheet**

## **November 7, 2016**

### **Updated December 23, 2019**

#### **Background**

The Wyoming Department of Environmental Quality (WDEQ) November 2016 *Pavillion, Wyoming Area Domestic Water Wells Final Report and Palatability Study* (WDEQ 2016 Final Report) provides the results of the investigation into drinking water quality issues in the rural area east of the Town of Pavillion, Wyoming. The scientific investigation followed the process outlined in the June 20, 2013 Framework Document which included the collection of water quality and operational data for the water-supply wells (domestic, irrigation and stock), in order to assess water quality and identify parameters or conditions that might cause palatability or toxicity issues. An evaluation of the integrity of nearby oil and gas wells and the historic use of surface pits in the Pavillion Gas Field was also performed.

The WDEQ December 2019 *Final Pavillion, Wyoming Gas Field Domestic Water Wells Report on Recommendations for Further Investigation* (WDEQ 2019 Final Report) report provides findings of domestic water wells sampling conducted as part of the recommendations for further investigation identified in the WDEQ 2016 Final Report. The WDEQ 2016 Final Report identified ten recommendations for further investigation. This report focuses on two of the ten recommendations: **Recommendation 1**, bacteria sampling and analysis and confirmation analysis of major anions, major ions and TDS; and **Recommendation 8**, evaluation of organic chemical detection limits. Remaining recommendations are briefly discussed in the report and will be evaluated separately by the Wyoming Oil and Gas Conservation Commission (WOGCC) with input from the WDEQ and the US Environmental Protection Agency (US EPA).

#### **Key Findings**

- Based on the WDEQ's June and August 2014 sampling of the 13 water supply wells, other than an organochlorine (OC) pesticide (beta-hexachlorocyclohexane or beta-BHC) and a phthalate ester (bis (2-ethylhexyl phthalate) or BEHP), no organic compounds were identified at concentrations exceeding applicable drinking water standards. Phthalate is used as a plasticizer in flexible PVC plastics and is a common laboratory contaminant.
  - Inorganic compounds that were found over applicable drinking water standards are generally associated with naturally occurring salts, metals and radionuclides. Industrial applications may use some of these same compounds (e.g. oil and gas drilling mud contains chloride and potassium). Elevated salts, metals, and radionuclide concentrations in the water supply wells were confirmed in 2017 and 2018.
  - All organic constituents identified in groundwater samples at concentrations less than drinking water standards or comparison values may have originated from a multitude of possible sources, including spills, oil and gas activities, agricultural chemical applications, and other residential and industrial uses.

- In 2017, BEHP and beta-BHC were analyzed in groundwater samples to confirm concentrations found in 2014. Results from 2017 and 2018 show that beta-BHC and BEHP, respectively, were not detected indicating that concentrations from 2014 were artifacts of sampling and or analysis processes.
- Evidence does not indicate that hydraulic fracturing fluids have risen to shallow depths utilized by water-supply wells. Also, based on an evaluation of hydraulic fracturing history, and methods used in the Pavillion Gas Field, it is unlikely that hydraulic fracturing has caused any impacts to the water-supply wells.
- Gas in the upper Wind River Formation appears to have originated mainly from upward migration from deeper commercial gas-bearing zones and evidence suggests that upward gas seepage (or gas charging of shallow sands) was happening naturally before gas well development.
- Some gas wells are experiencing slow gas seepage. The relative contribution of potential gas seepage along gas wells versus natural upward migration of gas is undefined and would be very difficult to quantify.
  - Water quality in the intermediate zones is expected to be different than in the shallow water-bearing zones, such as higher dissolved solids concentrations, therefore communication between the two zones could introduce water of poorer quality into the shallow water-bearing zones.
  - Sustained bradenhead pressures in several gas wells provide an indication that gas and possibly liquid migration may be happening, however, there is no evidence this migration has caused water quality issues.
- Geochemical changes associated with the biodegradation of dissolved organic compounds likely have produced constituents associated with poor water palatability, and appear to be linked to declining well yields.
- Limited baseline water quality data, predating development of the Pavillion Gas Field hinders reaching firm conclusions on causes and effects of reported water quality changes.

### **Status of Recommendations for Additional Work**

- **2016 Recommendation No. 1:** Expanded evaluation of identified groundwater constituents was completed, including bacteria, which can cause palatability issues and confirmation of general water quality parameters (major cations, anions, and TDS).

**2017 – 2018 Status Update:** Data collected and evaluated confirm the conclusions drawn in the WDEQ 2016 Final Report. Geochemical changes associated with the biodegradation of dissolved organic compounds likely have produced constituents associated with poor water palatability, and appear to be linked to declining well yields. The bacteria were identified as primarily sulfate reducing bacteria and appear to be considered a secondary source to the palatability issues. Low levels of methanogens and gas identified in samples appear to be thermogenic in origin and thus does not suggest a shallow biogenic source.

Sampling and analysis of major cations, anions, and TDS confirmed 2014 concentrations.

- **2016 Recommendation No. 2:** Focused assessment of the potential for gas seepage along gas wells versus naturally occurring upward seepage of gas, as well as evaluating conditions that might allow the potential movement of gas and/or liquid from intermediate zones pressurized by gas into shallower water bearing zones.

**2017 – 2018 Status Update:** The WOGCC is reviewing a report of the work conducted by Encana in response to the WOGCC Well Integrity report. All field work related to this item is reportedly complete, pending WOGCC’s review of the report and concurrence that the work done meets the agency recommendations. No additional activities were conducted by the WDEQ as part of this report.

- **2016 Recommendation No. 3:** Review and evaluate existing data, including well logs for a) potential intermediate to shallow gas zones, b) potential shallow permeable groundwater zones, c) casing cementing conditions, and d) information on Bradenhead pressure.

**2017 – 2018 Status Update:** The WOGCC is reviewing a report of the work conducted by Encana in response to the WOGCC Well Integrity report. All field work related to this item is reportedly complete, pending WOGCC’s review of the report and concurrence that the work done meets the agency recommendations. No additional activities were conducted by the WDEQ as part of this report.

- **2016 Recommendation No. 4:** Further evaluation of the surface pits and their potential impact on water quality. In addition, hold collaborative discussions between WDEQ and WOGCC to evaluate consistent criteria for the closure of pits impacting groundwater.

**2017 – 2018 Status Update:** The WOGCC continues to meet with Encana to review recommendations related to the WOGCC pit review report. Encana has completed field investigation activities between 2017 and 2019 on an additional set of pits and will be submitting information regarding historical investigations done at other pits for WDEQ and WOGCC to review to help determine the adequacy of historical investigations.

In May 2018, the Water Quality Division-Groundwater Section assumed regulatory oversight of the four pits that are in the WDEQ Voluntary Remediation Program (VRP). The four pits will continue to follow WDEQ VRP policies and procedures.

- **2016 Recommendation No. 5:** The WDEQ concurred with the WOGCC Well Integrity Review (October 8, 2014) and Pavillion Field Pit Review (June 4, 2015) recommendations that were not completed as of the date of issuance of the WDEQ 2016 Report.

**2017 – 2018 Status Update:** The WDEQ continues to support completion of the recommendations identified in the WOGCC Well Integrity Review and Pit Review Reports.

- **2016 Recommendation No. 6:** Perform a detailed review and evaluation of existing and closed pits once the WDEQ VRP investigations and WOGCC recommended field work are completed. Depending on the outcome of this evaluation, it may then be beneficial to conduct an expanded investigation (e.g., additional monitoring wells at multiple depths and analysis of more constituents) at selected sites of different characteristics to demonstrate whether surface pits contribute to water-quality issues in water-supply wells.

**2017 – 2018 Status Update:** The WOGCC continues to meet with Encana to review recommendations related to the WOGCC pit review report. Encana has completed field investigation activities between 2017 and 2019 on an additional set of pits and will be submitting information regarding historical investigations done at other pits for WDEQ and WOGCC to review to help determine the adequacy of historical investigations.

- **2016 Recommendation No. 7:** Further evaluation of other potential sources of petroleum hydrocarbons such as drill cuttings disposal sites, petroleum storage tanks and gas production and gathering facilities.

**2017 – 2018 Status Update:** The WDEQ believes that based on current information, this recommendation has been satisfied with the data contained in WDEQ 2016 Final Report Table 9 and Figure 12. Additional investigation in regards to other potential sources of petroleum hydrocarbons will be more appropriately addressed through the pits investigation being conducted by WOGCC or the WDEQ VRP.

- **2016 Recommendation No. 8:** Analyze additional samples to achieve method detection limits (MDLs) below respective standards for: three VOCs; eighteen SVOCs; and two OC pesticides that are listed in Table 29 of the WDEQ 2016 Final Report.

**2017 – 2018 Status Update:** Constituents identified as having MDLs above standards were resampled and analyzed to achieve MDLs below standards. MDLs below standards were confirmed as non-detect and included one VOC, seven SVOCs, and two OC pesticides. Where lower MDLs could not be achieved (the technology is not available in the laboratory to achieve lower MDLs) evaluation of the constituents and their industrial uses indicate that they are not associated with oil and gas activities.

- **2016 Recommendation No. 9:** The WDEQ recommends that the WDEQ and the WOGCC work collaboratively to evaluate consistent criteria for the closure of pits.

**2017 – 2018 Status Update:** The WDEQ and WOGCC have discussed analytical analysis criteria for investigating pits and will continue to work together to develop consistent criteria for the closure of the pits under WDEQ VRP or WOGCC regulatory oversight authority.

- **2016 Recommendation No. 10:** Recommend that the US Environmental Protection Agency (US EPA) plug and abandon the two monitoring wells constructed in 2010 in accordance with Wyoming Water Quality Rules and Regulations Chapter 26, due to the potential hazard they pose in relation to groundwater supplies and physical safety.

**2017 – 2018 Status Update:** At the time of the issuance of this report, the US EPA has not plugged and abandoned the two wells but is currently working on a plan to plug and abandon the monitoring wells.

## **Next Steps**

- A public meeting was held in Riverton, Wyoming in early December 2016. This meeting was intended to provide an opportunity for the public and other interested parties to obtain clarification regarding information included in the final report.
- An electronic copy of the final report was made available on WDEQ's website on Thursday, November 10, 2015.
- The WDEQ developed and plans to issue a scope of work for additional sampling and analysis of water-supply wells within the Pavillion Gas Field to apply laboratory methods having sufficiently low method detection limits.
- Meet with landowners in the Area of Investigation to discuss the results for their water-supply well(s) and the WDEQ 2019 Final Report (December 18 and 20, 2019).
- An electronic copy of the final report will be made available on WDEQ's website on Monday, December 23, 2019.
- Continue to work with WOGCC to evaluate consistent criteria for the closure of pits, and to perform a detailed review and evaluation of existing and closed pits (on-going).
- Continue to work with the US EPA to plug and abandon the two monitoring wells (on-going).

### **Additional Information**

- Legislation has been enacted for the Pavillion East Water Supply Project (Level III) authorizing design and construction services of cistern systems be offered to landowners who expressed an interest in a cistern and met project operating criteria. The cistern project began in January 2014 and concluded in February 2015. To date, a total of 31 cisterns for 28 landowners have been installed. The total amount spent for this project to date is \$929,268. For those landowners not participating in the cistern program, a bottled water delivery program was available and has been extended until March 31, 2017. The delivery program is provided to 11 homeowners.
- Twenty-seven surface pits were originally entered into the WDEQ Voluntary Remediation Program (VRP). Nineteen of those pits were subsequently withdrawn from the VRP because they were determined to fall under WOGCC regulatory authority for investigation, eight pits remained in the VRP. Four of the eight pits have been granted a Certificate of Completion. Four pit sites remain in the VRP and are being actively investigated with oversight by the WQD. Pits are still being investigated and will be entered into the VRP as information becomes available and if groundwater is impacted.
- The WDEQ received comments on the draft report for the 2014 investigation from 38 entities including private citizens, industry and governmental organizations. Based on these comments, changes were incorporated into the final report which improved the overall quality of the work product.
- Subsequent to the release of the Draft Report (December 2015), existing Wyoming Drinking Water Equivalent Levels (DWELs) were reviewed and updated using the most current toxicology data published by US EPA as the Regional Screening Levels – Generic Tables (May 2016). Twenty-six WY DWELs were changed, 15 of the DWELs decreased,

and 11 of the DWELs increased. DWELs were removed from the tables because corresponding federal Maximum Contaminant Levels and Wyoming Class I Domestic values existed. One-hundred and six newly calculated WY DWELs were added to the tables. In most cases where the WY DWEL was updated, the corresponding chemical was not detected greater than the laboratory reporting limit, and no additional compounds were detected above screening criteria.

- Over 11,700 analytical results were reviewed, only eight of which were rejected due to quality assurance/quality control review guidelines for the WDEQ 2016 Final Report. Over 3,650 analytical results were evaluated for the WDEQ 2019 Final Report; none of the results were rejected.
- The WDEQ 2016 Final Report, including lab results, is over 80,000 pages. The WDEQ 2019 Final Report, including lab results, is 4,266 pages.
- The cumulative cost for the WDEQ Pavillion Palatability Investigation (results presented in the WDEQ 2016 Final Report and WDEQ 2019 Final Report) has exceeded \$1.2 Million Dollars.