United States Department of the Interior

BUREAU OF LAND MANAGEMENT
High Desert District
Pinedale Field Office
1625 West Pine, P.O. Box 768
Pinedale, Wyoming 82941
www.blm.gov/wy

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Dear Reader:

The Bureau of Land Management is pleased to provide you with the technical report entitled: Evaluation of Potential Sources of Low-Level Petroleum Hydrocarbon Compounds Detected in Groundwater (LLPHC), prepared by AMEC Environmental and NewFields Mining and Energy Services (AMEC/NewFields). The LLPHC report is the third and final technical report to be published under the Pinedale Anticline Project Area (PAPA) Supplemental Environmental Impact Statement (SEIS) Record of Decision (ROD) (September 2008), Interim Groundwater-Aquifer Pollution Prevention, Monitoring and Mitigation Plan (Interim Plan). The LLPHC report was prepared by AMEC/NewFields under contract to Ultra Resources, SWEPI, and QEP (USQ) to fulfill requirements of the 2008 PAPA ROD and Interim Plan.

This report evaluates whether naturally occurring hydrocarbons, oil and gas development activities or water supply well materials are contributing to low levels of petroleum hydrocarbon compound (PHCs) detections and builds upon previously completed aquifer characterization and numerical modeling studies. Gas collecting in the headspace of water supply wells and dissolved in the water was also subjected to chemical and isotopic analysis to determine where the mobile gas is originating.

Potential sources of organic constituents which were specifically evaluated in the LLPHC report include: flowback fluid, oil based drilling mud, condensate, produced water, light nonaqueous-phase liquid, water supply well pump materials, and carbonaceous shale. While this investigation identified no evidence of widespread impacts to groundwater in the PAPA as a result of natural gas exploration and production, BLM, in cooperation with regulatory agencies, will now proceed in the preparation of the final groundwater pollution prevention, monitoring and mitigation plan for this area.

Background

The PAPA covers approximately 309 square miles in Sublette County in southwestern Wyoming. Natural gas development in the PAPA began as early as 1939, but experienced rapid expansion after 1994. To meet the 2000 PAPA EIS ROD requirements, Sublette County Conservation District (SCCD), under contract with the PAPA operators began periodic sampling of water supply wells within one mile of existing or proposed natural gas wells in 2004. Detections of PHCs were first documented in 2006 and have continued to date; these detections are largely sporadic and remain below federal and/or state water quality standards, with few exceptions.

Because of the lack of information regarding groundwater resources and multiple detections of low-level hydrocarbons within the PAPA by SCCD, protection of groundwater resources was a major concern

during the preparation of the 2008 PAPA SEIS. As a result, the 2008 PAPA ROD prescribed a series of actions that BLM would take in accordance with BLM's Regional Framework for Water Resources Monitoring Related to Energy Exploration and Development (Regional Framework), 2007 to complete three steps. The three steps necessary under the Regional Framework are: 1) compile all existing information, 2) characterize the groundwater system, and, 3) update the interim monitoring plan (2008 PAPA SEIS ROD, Sec. 4.2, p. 29). Step 1 was completed prior to the 2008 PAPA SEIS under the purview of the Pinedale Anticline Working Group-Water Resources Task Group and was incorporated into the PAPA SEIS analysis.

Under the Interim Plan, previously prepared technical reports that were considered in the LLPHC technical report include:

- Hydrological Data Gaps Investigation, AMEC, May 2012. AMEC conducted extensive field investigations between 2009 and 2011 resulting in the installation of 30 study wells, ranging in depths from 15 to 795 feet, and 13 shallow piezometers throughout the PAPA to characterize the groundwater system.

- Numerical Groundwater Modeling Report, AMEC, October 2013. Although, not specifically required in the PAPA SEIS ROD, AMEC and USQ proposed the development and use of a numerical groundwater flow and transport model to: 1) provide an interpretive tool that would allow stakeholders to evaluate the flow and transport of potential contaminants across and throughout the project area rather than at single well location, 2) help identify locations where changes in groundwater quality due to legacy contamination would most likely develop, and 3) minimize uncertainty and further our understanding of the hydrogeologic system .

As required by the Interim Plan, AMEC/NewFields prepared a Plan of Study and Sampling and Analysis Plan (SAP) to guide the identification of sources potentially contributing to the low-level PHCs. The study design and SAP were accepted by BLM in consultation with EPA and WDEQ in 2009.

Thirty-four water supply wells were sampled under the LLPHC SAP and included multiple quality control samples and confirmation samples. Several of the water supply wells used in this study were specifically installed for this project and a number of the study wells were strategically placed outside of the productive gas field to assist in identifying the source of the PHCs.

Assessment of inorganics (calcium, carbonates, salts, phosphorus, etc.); Volatile (gasoline range organic constituents) organic carbons, Semi-volatile (diesel range organic constituents), Tentatively Identified Compounds (hydrocarbon chain groups), and metals (lead, iron, nickel, etc.) assisted in fingerprinting the hydrocarbons entrained within the water supply wells.

Findings

As a result of the investigation, AMEC/Newfields have made the following conclusions:
The investigation identified no evidence of widespread impacts to groundwater in the PAPA as a result of natural gas exploration and production. AMEC/NewFields has identified the following known or potential sources of low levels of organic constituents in water wells:

- Upward seepage by natural processes of natural gas from deep, underlying gas reservoirs over time into overlying geologic layers where groundwater occurs,
- Organic constituents introduced into water wells during drilling, installation, and operation of the natural gas well; and,
- Naturally occurring organic matter in groundwater or associated with particles suspended in water well during sample collection.

Using the results of the three above reports, a Final Groundwater/Aquifer Pollution Prevention, Mitigation and Monitoring Plan (FGMP) will be prepared and will contain recommendations for a comprehensive monitoring plan with associated network design, mitigation and/or pollution prevention actions, sampling and analysis plan, and a quality assurance plan. The BLM, in cooperation with regulatory agencies, is required to finalize the draft FGMP within six months of completion of the draft FGMP. The BLM, in coordination with their state and federal partners, is currently drafting the FGMP goals and objectives, and an administration plan. An estimated date for completion has not been identified.

All Interim Plan study documents can be found here:
http://www.blm.gov/wy/st/en/field_offices/Pinedale/anticline/resources/water.html.

If you have any questions on this report or the Interim Plan, please contact Merry Gamper, Project Lead, at 307-775-6272 or mgamper@blm.gov.

We invite your comments and input concerning this important study.

Sincerely,

Shane DeForest
Field Manager