

This is the AER's emailed response to reporter Andrew Nikiforuk's questions about the Campbell investigation, dated Oct. 10. Though the letter promised answers to specific questions, they were not provided.

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Hello Mr. Nikiforuk.

Thank you for your inquiry of July 4, 2013.

The Alberta Energy Regulator (AER) is required to protect the privacy of individuals in these circumstances. As such, we cannot comment directly on the file in question. I can speak to you in general terms about our methods and processes for investigations similar to the one you've referenced. What answers we can provide are found at the end of this letter.

Firstly, Alberta Environment and Sustainable Resource Development (ESRD) holds the responsibility for regulating water wells and is the first point of contact for complaints in Alberta. For information about ESRD's processes, I encourage you to contact them directly.

The AER does work closely with ESRD and occasionally, the outcome of an ESRD investigation will indicate that nearby energy activity could cause the water-well problem. At this point, ESRD will request the AER's involvement in the investigation. Water-well complaints also reach AER through our field centres, from the Alberta Farmers' Advocate, and from

industry self-disclosure. While there is no central registry or tracking mechanism, the AER responds to every complaint.

As the energy regulator, there are a number of things we look for. Wells that have been impacted by energy activity may demonstrate an unusual taste, odour or sheen, visible or detectable liquid hydrocarbons in the well or well-water, and/or elevated levels of sodium and chloride associated with produced water from deep formations.

If the complaint is based on direct observation of those elements, it is usually quite straightforward to identify the source. Refined hydrocarbons would indicate a local source, which is usually an on-site storage tank or spill.

Unrefined liquid hydrocarbons could suggest a release from an energy well, facility, or pipeline. In this example, a review of AER records of historical energy activity and a site visit will quickly narrow down possible sources. The respective operator would then be engaged by AER to carry out more investigation and remediate the situation as required. If the existing operations are in compliance with all regulations and are not the cause, a more detailed historical review of local energy development and land use would be necessary.

If the complaint involves gases in groundwater, especially without significant change in other chemical parameters associated with hydrocarbon reservoirs, the situation is more complex.

Gas in groundwater in Alberta is a common natural occurrence. Naturally occurring petroleum gases like methane, ethane, and propane generated deep below ground (also called thermogenic gases) are known to migrate into shallow aquifers through geologic pathways as part of natural processes. Almost all bedrock aquifer systems in Alberta produce commercial quantities of natural gas and petroleum gas seeps from deep reservoirs are known across the entire province. In addition to petroleum gases, bacteria living in aquifers and/or growing in poorly-maintained water wells can produce methane gas (commonly called biogenic gas), carbon dioxide, nitrogen, and even hydrogen sulfide, all of which can contaminate groundwater or exit to surface via a water well. Biogenic gas in groundwater is also very common in Alberta.

Petroleum gases can also escape from reservoir levels or gas-bearing zones above to the atmosphere through pathways along poorly completed energy wells. Gases usually exit to surface around the surface casing, creating what are known as surface-casing vent flows. Surface-casing vent flows are localized and not likely to affect domestic water wells or aquifers. AER regulations require operators to mitigate surface-casing vent flows when they occur.

When a water-well complaint reaches AER with any significant proportion of thermogenic gas, the AER will begin an investigation. The AER takes all complaints very seriously. To launch such an investigation, AER staff review all data and records to ensure nearby wells are in compliance with all of our regulations with respect to completion, operation, and pollution

prevention. If necessary, we will direct energy operators to conduct field tests to ensure that they comply with all regulatory requirements. Any wells or pipelines found to be out of compliance with AER regulations during this review will be ordered remediated, regardless of whether said operations are impacting the complainant's water well.

We will also review the geology of the water well in question and the aquifer material around it. Drillers' records, hydrogeological reports, and geological maps from ESRD and the Alberta Geological Survey will be used to investigate the whether the water well itself is completed in a zone capable of producing petroleum (also called thermogenic) gas. For example, many water wells are drilled into Alberta bedrock that has coal seams within or nearby: coal seams will store and produce natural gas under depressurization. Similarly, many water wells in central Alberta are completed in the Paskapoo Formation, the Horseshoe Canyon Formation, the Belly River Formation, and the Milk River Formation (among others), all of which produce natural gas in commercial quantities.

The radius of investigation of energy wells etc. from a water-well of concern varies, but we look at every immediately offsetting well at a minimum. Directive 035 defines testing requirements of water wells in the vicinity of CBM wells completed above the Base of Groundwater Protection, and uses a 600-metre radius based on the physics of gas migration. Energy wells beyond this radius may also be examined if there are no wells within the 600-metre radius or if wells within that radius are determined not to be causing the issue.

We will also use the gas fingerprint from the complainant's well and geological data from local energy production to identify any additional energy wells for review, regardless of offset distance. If petroleum gas compositional data is unavailable, AER will order operators of possible sources to submit laboratory fingerprints of their hydrocarbons and produced fluids to assist us in evaluating or eliminating their energy wells as potential sources of the complaint. The AER retains all records of gas detection during drilling as well as gas analyses submitted to the AER as per Directives 040 and 059. This information will be reviewed as well.

If an energy well is found to be out of compliance and could be a source of the gases detected in the water well, the AER will order the immediate remediation of the well and may offer to monitor the affected water well for a period of time to ensure that the effects have been mitigated. If there are no candidate energy wells or other local energy sources after this step, the AER will close its file and return its results to ESRD, with the advice that all energy wells, facilities are in compliance with regulations and no industry source is apparent.

The AER's new Directive 083 on hydraulic fracturing takes a precautionary, risk-to-outcomes approach to protecting groundwater and we are providing support and assistance to university researchers interested in advancing this area.

The AER is aware of independent research such as the Duke University study linking water quality to proximity to energy

development. The AER takes peer-reviewed, published studies into account during investigations and during regulatory requirements development. Questions around subsurface forensics in matters of gas in water wells and future local or cumulative effects of pathways like microseeps along casing are of importance to the organization and therefore the AER provides support and assistance to researchers in these areas where we can, both directly and through support of such research provided through other Government of Alberta departments and agencies. Through the work of the Alberta Geological Survey, AER also generates its own peer-reviewed, scientific knowledge on Alberta's subsurface framework and fluids in support of regulating energy development and protecting the environment. I would invite you to visit www.ags.gov.ab.ca to obtain reports and maps on Alberta's bedrock aquifers and groundwater.

In addition, I would like to assure you that AER staff involved in water-well investigations have extensive skills and scientific backgrounds in hydrogeology and petroleum geology in energy development. For example, Mr. Maunder, who oversees our technical professional staff running these investigations, has nearly 30 years' experience in water resources evaluation, investigations, policy development, and compliance. My role is to oversee Mr. Maunder and his staff, and review the results of AER water-well investigations. I also have nearly 30 years of experience in hydrogeology and contaminant hydrogeology including a M.Sc. and Ph.D. in hydrogeology, specializing in petroleum migration and subsurface-pathway analysis. In addition, we use independent, professional consultants and

university researchers to conduct field work and prepare technical reports on matters where we need additional expertise. The AER strives to ensure that our technical professional staff are well trained and delivering our mandates to protect the environment while balancing the need for orderly development of Alberta's petroleum resources.

I hope that you find this information useful for your work. In addition, below are specific answers to questions in your email, to the extent that we are able to answer them. If you have any further questions about our investigations in general, please contact any of our Public Affairs staff.