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The Chairman
Legislative Council Standing Committee
on Environment and Public Affairs
Parliament of Western Australia
Harvest Terrace
Perth WA 6000

2 April 2014

Dear Chairman,

Inquiry Into Hydraulic Fracturing for Unconventional Gas

I write further to the Committee's inquiry into the implications for Western Australia of hydraulic fracturing (HF) for unconventional gas.

As you would recall, Halliburton recently had the opportunity to appear before the Committee to provide evidence further to its submission of 4 October 2013. There were some issues raised by Committee members during this hearing where we consider further information may assist your deliberations.

This letter aims to provide further information to the Committee on potential regulatory models for disclosure of chemicals used in the unconventional gas industry as well as drawing together further internationally-sourced information in support of the proposition that there are no confirmed instances of drinking water contamination due to HF and that there is minimal risk of such contamination.

1 Public Disclosure of Chemicals Used in the Unconventional Gas Industry

In Halliburton's written submission to the inquiry, we raised the existing systems-based approach of the Department of Minerals and Petroleum (DMP) to disclosure of chemicals used by the state's unconventional gas industry. We stated that this approach is workable for the majority of products required by the industry, but that for innovative HF fluids, drilling muds and other products developed by companies like Halliburton to be made available, supplementary regulatory arrangements will be necessary to protect genuinely proprietary product information. As is the case in a range of other industries, the protection of confidential business information (CBI) from commercial competitors provides a critical incentive for investment in innovation.

In our earlier submission, we outlined two alternative approaches that could be considered: one modelled on the arrangements put in place by the Colorado Oil & Gas Conservation Commission; and a second that would involve comprehensive chemical disclosure (including full technical details of all proprietary ingredients) to a regulator, analogous to the arrangements in the US State of Wyoming through the Wyoming Oil and Gas Conservation Commission's (WOGCC) rules and regulations.

Based on questioning at the recent hearings, Halliburton believes it might be of interest to the Committee to expand on how this second model would operate.

This model, where the regulator is provided with full technical details on all chemical ingredients – non-proprietary and proprietary – could operate in an Australian context, with the relevant regulator either a Commonwealth or WA government agency. Under this type of model, disclosure must be made of chemicals proposed to be intentionally added to a hydraulic fracturing fluid through provision of the following details:

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- Each hydraulic fracturing additive used in the hydraulic fracturing fluid and the trade name, vendor and a brief descriptor or function of each hydraulic fracturing additive in the hydraulic fracturing fluid.
- Chemical abstracts service (CAS) number for each chemical.
- The maximum proposed concentration by mass of each chemical in the overall fluid mixture.

The information can be submitted by either the operator or the service company.

When submitting this information (similar to the process for claiming exempt information in relation to the notification of new chemicals under the *Industrial Chemicals (Notification and Assessment) Act 1989* (Cth) (**Industrial Chemicals Act**):

- Each piece of information which is CBI must be identified and a justification for the claim must be provided, unless it has been accepted as exempt information under the Industrial Chemicals Act, in which case it will be deemed CBI.
- An alternative description of each piece of information which is claimed to be CBI must be provided. For example, a chemical trade or family name may be used in lieu of a CAS number.
- If the regulator does not accept the information is CBI it may be withdrawn, or it will not be released until the time for any legal review has expired.

The information (with any CBI replaced with the alternative description of this information) is posted by the regulator on a public website which allows a search of individual well sites to be carried out to obtain a list of the chemicals that were used in the hydraulic fracturing process. In this regard, Halliburton has previously provided information to the Committee on the successful FracFocus website (<http://fracfocus.org/>) which operates in the U.S. and Canada.

Under this model, the regulator must maintain the confidentiality of the CBI. In the event of emergency, the relevant CBI may be disclosed by the regulator to an emergency manager or medical personnel. The information is still be deemed to be confidential and recipients of this information must enter into confidentiality agreements either before, or if time does not permit it in an emergency situation, after the CBI has been provided.

Halliburton submits that the benefits of this approach are as follows:

- The public will have routine access to meaningful information regarding the chemicals used in HF individual wells.
- Companies will be able to continue to compete for business and introduce new and innovative products that have environmental and production benefits.
- The regulator will have the benefit of the maximum information on the chemical composition of HF fluids to inform its assessment of risk.

2 HF Impact on Drinking Water Aquifers

Reference was made by Halliburton in its earlier written submission to the fact that there are no confirmed instances of hydraulic fracturing causing contamination of drinking water aquifers and that the risk of such contamination is minimal. This issue was raised and discussed further by the Committee with Halliburton and other parties who appeared during public hearings.

We have consolidated below for the Committee's information a range of international studies (some of which were raised in our earlier submission), statements by U.S. Federal officials,

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statements and studies by U.S. State government agencies, as well as U.S. non-government organisations to corroborate this important proposition.

A. U.S. Federal and International Studies

- A U.S. Environmental Protection Agency study of allegations of contamination from hydraulic fracturing of coalbed methane (“CBM”) wells “did not find confirmed evidence that drinking water wells have been contaminated by hydraulic fracturing fluid injection into CBM wells.” U.S. EPA, *Evaluation of Impacts to Underground Sources of Drinking Water by Hydraulic Fracturing of Coalbed Methane Reservoirs*, ES-1 (2004), available at http://water.epa.gov/type/groundwater/uic/class2/hydraulicfracturing/wells_coalbedmethanestudy.cfm.
- The U.S. Geological Survey released a study in January 2013 that examined groundwater samples representing approximately one-third of the Fayetteville Shale gas production area and found no regional effects on groundwater from activities related to gas production. Kresse, T.M. et al., *Shallow groundwater quality and geochemistry in the Fayetteville Shale gas-production area, north-central Arkansas, 2011*, U.S. Geological Survey Scientific Investigations Report 2012-5273 (Jan. 2013), available at <http://pubs.usgs.gov/sir/2012/5273/sir2012-5273.pdf>.
- A peer-reviewed paper by researchers at the Lawrence Berkeley National Laboratory reports on some of the results of modeling being conducted for EPA’s study of the impacts of HF on drinking water and concluded that the possibility of hydraulically induced fractures at great depths causing activation of faults and creation of a new flow path that can reach shallow groundwater resources is “remote.” Rutqvist, J., et al., “Modeling of fault reactivation and induced seismicity during hydraulic fracturing of shale-gas reservoirs,” *Journal of Petroleum Science and Engineering* (2013), available at <http://dx.doi.org/10.1016/j.petrol.2013.04.023>.
- The New Zealand Parliamentary Commissioner for the Environment issued a report in 2012 finding that “there is no evidence that fracking has caused groundwater contamination in New Zealand.” Government of New Zealand, Parliamentary Commissioner for the Environment, *Evaluating the environmental impacts of fracking in New Zealand: An interim report*, 43 (Nov. 2012), available at <http://www.pce.parliament.nz/publications/all-publications/evaluating-the-environmental-impacts-of-fracking-in-new-zealand-an-interim-report/>.
- In a May 2012 report, the Council for the Taranaki Region in New Zealand found that there was no evidence of environmental problems related to the hydraulic fracturing operations that had been undertaken in the region over a period of almost 20 years and that there is little risk to freshwater aquifers from properly conducted hydraulic fracturing operations. Government of New Zealand Taranaki Regional Council, *Hydrogeologic Risk Assessment of Hydraulic Fracturing for Gas Recovery in the Taranaki Region*, 3-4 (May 2012), available at <http://www.trc.govt.nz/assets/Publications/guidelines-procedures-and-publications/hydraulic-fracturing/hf-may2012-graph-p19.pdf>.
- The South African Department of Mineral Resources has stated that there are “no documented cases of properly placed hydraulic fracturing fluids migrating through the overlying strata to contaminate groundwater.” Republic of South Africa, Department of Mineral Resources, *Investigation of Hydraulic Fracturing in the Karoo Basin of South Africa*, 31 (July 2012), available at <http://www.dmr.gov.za/publications/summary/182-report-on-hydraulic-fracturing/852-executive-summary-investigation-of-hydraulic-fracturing-in-the-karoo-basin-of-south-africa.html>.

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- The United Kingdom Department of Energy and Climate Change concluded in a December 2013 report that groundwater contamination from HF “has not been observed in practice and would be unlikely” and that “it is considered reasonable to suggest that any risk of contamination from fracturing activities is exceptionally low.” AMEC Environment & Infrastructure UK Limited, Department of Energy and Climate Change, *Strategic Environmental Assessment for Further Onshore Oil and Gas Licensing*, 96 (Dec. 2013), available at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/273997/DECC_SEA_Environmental_Report.pdf.
- The Energy and Climate Change Committee appointed by the British House of Commons concluded in May 2011 that “hydraulic fracturing itself does not pose a direct risk to water aquifers, provided that the well-casing is intact before this commences.” United Kingdom Parliament, House of Commons, Energy and Climate Change Committee, *Fifth Report: Shale Gas* (May 10, 2011), available at <http://www.publications.parliament.uk/pa/cm201012/cmselect/cmenergy/795/79502.htm>.

B. Statements by U.S. Federal Officials

- Former EPA Administrator Lisa Jackson stated in testimony before the House Committee on Oversight and Government Reform that she was “not aware of any water contamination associated with the recent drilling” in the Marcellus Shale. *Pain at the Pump: Policies that Suppress Production of Oil and Gas*, Hearing Before the H. Comm. on Oversight & Gov’t Reform, Rep. No. 112-54, 87 (May 24, 2011), available at <http://www.gpo.gov/fdsys/pkg/CHRG-112hhrg70675/pdf/CHRG-112hhrg70675.pdf>. She again made statements to the press on April 30, 2012 that “in no case have we [EPA] made a definitive determination that [hydraulic fracturing] has caused chemicals to enter groundwater.” See https://www.youtube.com/watch?v=tBUTHB_7Cs.
- Former U.S. Bureau of Land Management (“BLM”) Director Bob Abbey stated that he had “never seen any evidence of impacts to groundwater from the use of fracing technology on wells that have been approved by” BLM. *Challenges Facing Domestic Oil and Gas Development: Review of Bureau of Land Management/U.S. Forest Service Ban on Horizontal Drilling on Federal Lands*, Hearing before the Subcomm. on Energy and Mineral Resources of the H. Comm. on Natural Resources and the Subcomm. on Conservation, Energy and Forestry of the H. Comm. on Agriculture, 112th Cong. (July 8, 2011), available at <http://www.gpo.gov/fdsys/pkg/CHRG-112hhrg72151/pdf/CHRG-112hhrg72151.pdf>.
- U.S. Department of Energy Secretary Ernest Moniz made remarks to the press on August 1, 2013 that, “to my knowledge, I still have not seen any evidence of fracking per se contaminating groundwater.” See <http://thehill.com/blogs/e2-wire/e2-wire/315009-energy-secretary-natural-gas-helps-battle-climate-change-for-now>.
- Dr. Mark Zoback, Professor of Geophysics, Stanford University and member of the Shale Gas Production Subcommittee of the Secretary of Energy Advisory Board stated that “[f]racturing fluids have not contaminated any water supply and with that much distance to an aquifer, it is very unlikely they could.” See <http://news.stanford.edu/news/2011/august/zoback-fracking-ganda-083011.html>.

C. Studies and Statements from U.S. State Governments and Agencies

- In 1998 the U.S. Ground Water Protection Council surveyed 25 state agencies responsible for oil and gas development and found that there was not a single substantiated claim of contamination of drinking water supplies attributable to hydraulic fracturing. Ground Water Protection Council, *Survey Results on Inventory and Extent of*

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Hydraulic Fracturing in Coalbed Methane Wells in the Producing States (1998), available at <https://cogcc.state.co.us/RuleMaking/PartyStatus/FinalPrehearingStmnts/HESIExhibits.PDF>.

- The Interstate Oil and Gas Compact Commission (“IOGCC”) surveyed its state regulatory agency members in 2002 and found that nearly one million wells had been hydraulically fractured over the course of several decades but again found no evidence of substantiated claims of contamination of drinking water supplies due to hydraulic fracturing. IOGCC, *States Experience with Hydraulic Fracturing: A Survey of the Interstate Oil and Gas Compact Commission* (2002), available at http://www.mde.state.md.us/programs/Land/mining/marcellus/Documents/Interstae_Oil_Gas_Compact_Commission_States_Experience_w_Hydraulic_Fracturing_2002.pdf. IOGCC continues to confirm on its website that “IOGCC member states have all stated that there have been no cases where hydraulic fracturing has been verified to have contaminated drinking water.” See <http://www.ioGCC.state.ok.us/hydraulic-fracturing>.
- In 2011, several states reported no evidence of groundwater contamination from hydraulic fracturing:
 - The New York State Department of Environmental Conservation reported that there are “no known instances of groundwater contamination have occurred from previous horizontal drilling or hydraulic fracturing projects in New York State.” New York State Department of Environmental Conservation, *Revised Draft Supplemental Generic Environmental Impact Statement on the Oil, Gas and Solution Mining Regulatory Program*, 6-47 (2011), available at <http://www.dec.ny.gov/energy/75370.html>. In reaching this conclusion, NYSDEC relied in part on the statements of regulatory officials from 15 states – including Colorado, New Mexico, Pennsylvania, Ohio, Texas and Wyoming – that hydraulic fracturing operations have not led to groundwater contamination. *Id.* at 6-41.
 - The Alaska Oil and Gas Conservation Commission affirmed that “[i]n over fifty years of oil and gas production, Alaska has yet to suffer a single documented instance of subsurface damage to an underground source of drinking water.” Alaska Oil and Gas Conservation Commission, *Hydraulic Fracturing in Alaska* (Apr. 6, 2011), available at <http://doa.alaska.gov/ogc/reports-studies/HydraulicFracWhitePaper.pdf>.
 - The Colorado Oil and Gas Conservation Commission (“COGCC”) director stated in responding to questions from the Senate Committee on Environment and Public Works: “we have found other instances where activities associated with oil and gas operations have impacted water supplies. These events have typically been tied to incidents such as a leaking storage pit, a poorly cemented oil and gas well, or leaking production equipment. These cases, however, have not been linked to the specific act of hydraulic fracturing hydrocarbon layers thousands of feet below the surface, and typically, thousands of feet below groundwater supplies.” David Neslin, *Written Answers to Follow-up Questions from the Senate Committee on the Environment and Public Works* (May 17, 2011), available at http://cogcc.state.co.us/Announcements/Hot_Topics/Hydraulic_Fracturing/EnviroPublicWorksQA.pdf.
- In 2012, regulators from a number of states – including Arkansas, Colorado, Louisiana, North Dakota, Ohio, Oklahoma, Pennsylvania and Texas – confirmed to the U.S. Government Accountability Office that, based on state investigations, the hydraulic fracturing process had not been identified as a cause of groundwater contamination in their states. U.S. GAO, *Information on Shale Resources, Development and*

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Environmental and Public Health Risks, 49 (Sept. 2012), available at <http://www.gao.gov/assets/650/647791.pdf>.

- California regulators have been quoted in recent years saying that the state has never experienced groundwater contamination from hydraulic fracturing. In 2012, a Division of Oil, Gas and Geothermal Resources official stated “there is no evidence of harm from fracking in groundwater in California at this point in time. And it has been going on for many years.” See http://www.mercurynews.com/ci_22219233/california-releases-first-ever-fracking-regulations. In 2013, the Director of the California Department of Conservation stated “[i]n California it has been used for 60 years, and actively used for 40 years, and in California there has been not one record of reported damage directly to the use of hydraulic fracturing.” See <http://www.nationaljournal.com/new-energy-paradigm/california-s-top-oil-regulator-on-fracking-climate-change-and-fossil-fuels-20131016>.
- In 2013, a Michigan Department of Environmental Quality official stated that “As far as migration of gas or fracture fluids, we have never seen an instance where a fracture communicates directly with the fresh water zone.” See <https://www.youtube.com/watch?v=A979CqCeH00>.

IV. U.S. Non-Government Organisation Studies

- MIT performed a study in 2011 on the potential risks of hydraulic fracturing to groundwater aquifers and found that “no incidents of direct invasion of shallow water zones by fracture fluids during the fracturing process have been recorded.” MIT Energy Initiative, *The Future of Natural Gas: An Interdisciplinary MIT Study*, Appx. 2E (2011), available at <https://mitei.mit.edu/publications/reports-studies/future-natural-gas>.
- An October 2012 report regarding hydraulic fracturing operations in the Inglewood Oil Field in the Baldwin Hills area of Los Angeles County showed that, based on actual groundwater monitoring results, the groundwater quality in the area was not affected by hydraulic fracturing activities. Cardno Entrix, *Hydraulic Fracturing Study: PXP Inglewood Oil Field* (Oct. 2012), available at <http://www.inglewoodoilfield.com/fracturing-study/>.
- Gradient’s 2013 National Human Health Risk Evaluation evaluates whether it is possible for fluids pumped into a tight formation during the HF process to migrate upward to reach drinking water aquifers and determined that once the fracturing fluids are pumped into a tight formation, it is “simply not plausible” that the fluids would migrate upwards from the target formation through several thousand feet of rock to contaminate drinking water aquifers. Gradient, *National Human Health Risk Evaluation for Hydraulic Fracturing Fluid Additives* (May 1, 2013), available at <http://www.energy.senate.gov/mwg-internal/de5fs23hu73ds/progress?id=SHYTKAd7p5&dl>.
- A peer-reviewed paper by Gradient discusses the physical constraints on upward fluid migration from black shales to shallow aquifers and concludes that upward migration of frac fluid and brine as a result of hydraulic fracturing activity does not appear to be physically possible. Flewelling & Sharma, “Constraints on Upward Migration of Hydraulic Fracturing Fluid and Brine,” *Groundwater* (Jul. 29, 2013), available at <http://onlinelibrary.wiley.com/doi/10.1111/gwat.12095/abstract>.
- Another peer-reviewed paper by Gradient and a Halliburton expert concludes that it is not physically plausible for induced fractures to create a hydraulic connection between tight formations at depth and overlying drinking water aquifers. Flewelling et al., “Hydraulic fracturing height limits and fault interactions in tight oil and gas formations,” *Geophysical Research Letters* (Jul. 26, 2013), available at <http://onlinelibrary.wiley.com/doi/10.1002/grl.50707/abstract>.

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Please do not hesitate to contact me should you have any queries in relation to the above or any other questions you may have.

Yours sincerely,

David Guglielmo
Country Manager