Unconventional Gas Mining

Water quality and quantity

Potential effects on water quality and quantity are central to dairy industry discussions on unconventional gas mining. Effects on groundwater systems cause concern as gas extraction involves removing water from gas-bearing geological formations to the surface. This so-called “produced water” usually needs treatment prior to reuse.

Quality issues centre on the salinity levels and possible chemical concentrations in the produced water, including any traces of fracking fluid additives. As treated produced water may potentially be reused in agriculture, research and on-farm trials are underway.

What is produced water?

Produced water is the combination of water already present in the coal seam and fracking fluid, if fracking was undertaken (See Fact Sheet: Unconventional Gas Mining – FAQ). Water is pumped out of coal seams in order to release the gas. Over time, the volume of produced water normally declines and the volume of produced gas increases.

Once the produced water and the gas, which consists mostly of methane, reach the surface, they are separated. The methane is collected and piped to a central compressor station where it is processed and added to a pipeline network for delivery to users. The produced water is piped elsewhere for further treatment or reuse (see section on produced water management and treatment).

Locational characteristics determine the volume, chemical/mineral content and concentration of produced water. No two wells behave identically, depending on underground water pressures and geology.

Avoiding groundwater interference

Produced water is not groundwater from surrounding aquifers. It is chemically different to freshwater and other groundwater sources, reflecting the seam from which it directly comes (CSIRO, 2014a).

In the drilling process, the well is positioned and designed to avoid contact with aquifers. Extraction takes place hundreds of metres below ground, generally deeper than local groundwater supplies. Targeted fracking zones are typically located at around 300 to 1000 metres below the freshwater zones and are separated by rocks with low permeability.

A number of techniques are employed to reduce the contamination risks associated with fracking. Wells are lined with steel casing from top to bottom, which is pressure-cemented in place to isolate aquifers overlying the target seams.

Before fracking is conducted, the integrity of the cement bond between the casing and rock needs to be confirmed and verified under mandatory codes of practice in NSW and Queensland.

Victoria has a moratorium on fracking until at least mid-2016. Tasmania has a moratorium until 2020.

Avoiding spills to surface water

Preventative mitigation measures are a requirement of environmental conditions. These measures include locating wells based on accurate geological and hydrological investigations, engineering design and operational management.

In the unlikely event that all safeguards fail, untreated produced water may leak into aquifers and surface lands, and enter local surface waterways.
Produced water management and treatment

Evaporation ponds were once widely used in NSW and Queensland but are now banned. Today projects must pipe produced water to treatment facilities where it’s stored in large, lined ponds pending treatment (Fall, 2014). Opportunities to simply dilute the water and apply it on location are also being explored.

Produced water is generally high in dissolved salts (measured as Total Dissolved Solids (TDS)) and contains low concentrations of metals, dissolved or dispersed oil compounds (that may include naturally occurring BTEX compounds), dissolved gases and naturally occurring radioactive materials (NORM).

As water quality is highly variable from site to site, ‘typical produced water’ does not exist although it is unlikely to be fit for human or stock consumption without some type of treatment (Fall, 2014).

This means that the water needs to be treated prior to any reuse, whether through simple dilution to perhaps more complex treatment at a Waste Water Treatment Plant (WWTP) using microfiltration or reverse osmosis (RO) technology. The treatment process will most likely be determined by the quality of the untreated water, its intended use and prevailing environmental regulations.

If water is not treated and re-used on-site, it will be piped off the site.

Setting Water Quality Standards

The main references for establishing water quality parameters and criteria in Australia are:

- The Australian Drinking Water Guidelines (ADWG) (NHMRC/NRMMC, 2011); and,  

Which reference is used for produced water depends upon its final intended use. Government departments use these guidelines to set the water quality parameters in the compliance conditions of environmental approvals.

For example, criteria set out in the ADWG would be used where final use demands higher quality water standards because human consumption or prolonged exposure may need to be considered.

Some water quality trigger levels in the ANZECC Guidelines can be used to stipulate minimal standards for livestock and irrigation use. Other fact sheets are also available, such as NSW DPI Prime Fact 533 – Water for livestock: interpreting water quality tests, 2014.

CSG water quality varies across regions but is most often brackish (3000-7000 mg/L TDS), with values ranging from 200 to more than 10,000 mg/L, and alkaline due to high levels of bicarbonate. Sea water is between 36,000 and 38,000 mg/L.

By comparison, good quality drinking water has a TDS value of less than 500 mg/L according to the ADWG. Tolerance levels for dairy cattle without loss of production is considered to be less than 4000 mg/L (ANZECC Guidelines), or less than 3500 mg/L for lactating dairy cows (converted from EC levels in DPI NSW Prime Fact 533).

Potential opportunities for produced water use on dairy farms

Approved methods for produced water disposal include beneficial use (for example, dust suppression), reinjection to an aquifer, or treatment (for example by reverse osmosis) and reuse.

Several beneficial reuse and brine management research projects and trials are being undertaken in the agricultural sector in partnership with gas companies.

These include:

- Water for local farmers and communities.
- Irrigation of agricultural crops or plantation forestry.
- Discharge of interim or occasional surpluses of treated water into river or weir/dam systems.
- Reinjection into suitable underground aquifers or discharge as surface water.
Opportunities to reuse produced water may include livestock watering, crop and pasture irrigation and use in the dairy shed. The following options may ensure produced water is treated to meet ANZECC Guidelines for such uses:

**Irrigation**
- Blending with freshwater and settlement of suspended solids.
- “Precipitation of Metals” to remove the metal ions (for pasture and feed crops only).
- Dissolved solids removal using reverse osmosis (RO), if blending alone is inadequate.
- Filtration pre-RO to remove suspended solids (both organic and inorganic, including hydrocarbons).

**Livestock farming:**
- Alkalinity correction such as dosing with hydrochloric or sulphuric acid (species-dependent).
- “Precipitation of Metals” to remove the metal ions.
- Filtration and/or Adsorption to remove hydrocarbons.
- Disinfection (chlorine or irradiating with ultra violet light), most effective once suspended and dissolved solids are removed.

These technologies are all available to the CSG industry and most are also readily used in dairy processing plants. Each option requires different transfer and treatment. The cost of some options may be uneconomical for gas companies to consider in the longer term.

Also, the dairy industry’s intermittent water requirements for stock watering and pasture/fodder irrigation may make it a less attractive supply option to the gas sector than industries with steady water supply demands, such as commercial cropping and intensive livestock (feed lots).

**Monitoring groundwater quality and quantity**

**Cumulative monitoring**
Central to the discussion on groundwater resources is whether current and future demand is sustainable. This has brought about calls for mandatory baseline and monitoring water data to be collected and made publicly available.

NSW and Queensland will now have centralised web portals established, to more accurately inform cumulative studies. These portals are relevant to all groundwater users. Queensland and NSW have begun the process of centralising responsibility for ongoing compliance monitoring of environmental approval conditions to a single agency. Many of these environmental conditions relate to the management of water to meet statutory enforceable quality parameters.

**Location-specific monitoring**
Groundwater modelling and mapping can assist in indicating the extent to which coal seams are connected to aquifers, and to predict whether drawing water from one can affect levels and water quality in the other.

Technologies such as 3D geophysical surveying techniques, mathematical-based modelling and imaging of underground reservoirs can be used to observe subsurface aquifers and geological strata.

Water quality samples can be analysed to measure barriers to flow between deep and shallow groundwater zones. Seismic mapping can also be used to map fracture locations and channels for water movement underground.

Information gathered from analyses and geological characterisations can be used to build computer models of the site. These models can then be used to predict the impacts of gas production on groundwater systems, and therefore the suitability of the proposed well site.

Although absolute guarantees are not possible, existing knowledge from research on aquifers and groundwater models make it possible to estimate the risks and uncertainties of adverse impacts.

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**When exploring the potential use of treated produced water on your farm, you should consider the following (this list is not exhaustive):**

- First obtain and evaluate independently verified water quality data provided by the mining company or arrange independent water quality assessments yourself; the water must meet relevant quality guidelines before being used.
- Consider other potential opportunities for water use collectively with neighbours and peer groups;
- Consider long and short-term farm water management options (storage and use) together with the risk and management of unplanned spills or contamination in any access or compensation agreements;
- Identify any potential disruptions to the farm business in any unplanned incident, including having to move stock to “safe zones” or having to remove areas of the farm from the rotation to meet withholding periods for any chemicals that may be present in the produced water;
- Ensure the gas company provides a list of chemicals to be brought onto the farm and check that the produced water has been analysed against relevant food safety standards. Ask your milk company to seek clarification from the state food safety authority on any potential impacts and control measures that should be deployed;
- Consider the information that will be required to on-sell any fodder produced on the farm using treated produced waters. Specify in any land access agreement the timeframe in which the company must supply information related to potential quality assurance concerns; and,
- In negotiating land access with the company to undertake required baseline groundwater and surface water monitoring, obtain any analysis and reports from these investigations. Include baseline data in land access or compensation agreements as evidence of existing conditions.
The Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (the IESC) provides advice based on the best available science to decision makers (mainly federal and state government regulators) on the effects that coal seam gas and large coal mining development may have on Australia’s water resources.

The IESC was established as a statutory committee in 2012. It also provides advice to the Australian Government on Bioregional Assessments and research priorities and projects. Bioregional assessments and other research will improve our knowledge base on the potential water-related impacts of coal seam gas and large coal mining.

Bioregional Assessments

A Bioregional Assessment is a scientific analysis of a particular area including its ecology, hydrology, geology and hydrogeology, with explicit assessment of the potential direct, indirect and cumulative impacts of CSG and large coal mining development on water resources. This includes improving understanding of the connectivity between aquifers and their connection to surface water.

Bioregional assessments will initially be undertaken in up to 15 subregions within six bioregions. The four Bioregional Assessments of interest to the dairy industry are the Sydney Bioregion, Northern Sydney Bioregion (encompassing the Hunter and Gloucester sub-bioregions), Clarence-Moreton Bioregion (Subtropical dairy) and the Gippsland Bioregion.

The first three are due to be completed by early 2016. The Gippsland assessment being undertaken by the Victorian Government will be completed in late 2016.

See Fact Sheet Unconventional Gas Mining – Overview of regulatory safeguards and research.

Further Information

A full set of dairy fact sheets and a comprehensive contact list for each State is on www.dairyaustralia.com.au.

References


