



Energy in
action[®]



Camden Gas Project.

Further understanding of produced water.

Did you know?

The volumes of water removed from the coal seams (known as produced water) within the Camden Gas Project are very low compared to other coal seam gas projects in Australia.

Recently, the entire Camden Gas Project has removed less than two Olympic sized swimming pools of water from the coal seams each year.

The quality of the produced water from the coal is generally slightly salty, but far less salty than sea water.

AGL continues to monitor the groundwater from the coal seams in the Camden Gas Project area to make sure our activities are not impacting on the shallow aquifers and surface waters.

Many gas wells that have been operating for several years within the Camden Gas Project now produce very little or no water.

Background.

The Camden Gas Project (CGP) extracts gas from the Balgownie and Bulli Coal seams which are about 700 metres below the ground. To allow gas to flow, AGL must first remove some of the naturally occurring water in the coal seam. This water that travels up the gas well is natural groundwater, called produced water.

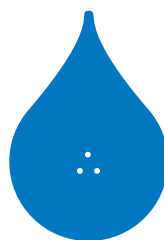
AGL conducts an ongoing water quality monitoring program for coal seam gas (CSG) wells, which monitors water quality and water volumes. The quality of the produced water from the coal is generally slightly salty, but far less salty than seawater, and the salt is mostly sodium bicarbonate. This is exactly the same as baking soda found in your kitchen but different from the salt in the sea or table salt (sodium chloride).

The amount of water produced at the CGP is very low compared to other CSG projects in Australia. The volume of produced water that a well makes reduces over time. Many wells that have been in operation for years within the CGP now produce very little or no water. In the year ending June 2013, less than 4.7 mega litres (ML) of water was produced from the entire Project (97 operating gas wells) – this is less than two Olympic swimming pools.

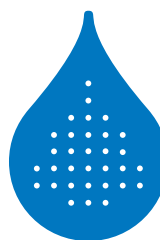
Results from AGL's water quality monitoring program.

As part of AGL's water quality monitoring program in 2011 and 2012, it was found that the produced water from some gas wells had significantly lower levels of salt than expected (at a level similar to rainwater or river water) and also a different ratio of the type of salts than is typical for CSG wells at the CGP. AGL wanted to understand why.

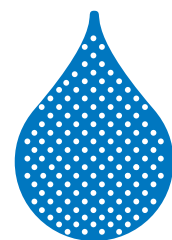
UNITS mg/L



Low salinity water
~ 100 - 350



Typical CGP
produced water
~ 8,000



Sea water
~ 35,000

Investigation.

After conducting internal investigations, AGL engaged Parsons Brinckerhoff to investigate the lower salinity of produced water coming from some gas wells and to provide reasons why this was happening. This investigation was completed July 2013 and was based on an extensive literature review of local and regional geology, groundwater chemistry, and local and international CSG and shale gas operations. The investigations examined possible reasons for the low salinity water including:

- > Coal seam water that physically and chemically changed during its journey from the coal seam to the surface (up the well) due to pressure and temperature changes
- > A groundwater connection between the deep coal seams and shallow groundwater and/or surface water
- > Leftover fracture stimulation (fracking) water or water from well maintenance

Explanation of the lower salinity water.

After expert chemical and isotope analysis, Parsons Brinckerhoff found that the low salinity water does come from the coal seam but it has been physically and chemically changed due to changes in pressure and temperature. This only happens in wells that bring small volumes of water to the surface. The change that happens to the water is called “flash” evaporation and condensation. Wells that bring large volumes of water to the surface flow too fast for this physical change to occur.

What is flash evaporation and condensation?

As the produced water moves up the coal and into the gas well, the low pressure and warm temperature means some liquid water can evaporate (turn into vapour) – this is called flash evaporation. The salts dissolved in the water cannot evaporate so either remain with some leftover water inside the rock or get left behind as a solid salt.

The temperature is cooler at or near the top of the CSG well, so the vapour turns back into liquid water which is very low in salts.

This is similar to what happens when salty sea water evaporates to make rain clouds – the salt stays in the sea and just the fresh, non salty water evaporates into water vapour. As the vapour rises higher and the temperature becomes lower the vapour turns into clouds (condensation).

Why is this low salinity produced water unique to the Camden Gas Project?

Across Australia, other operating CSG areas produce much more water from the coal seams than the Camden Gas Project. This is because of differences in the rocks (geology). The little changes in pressure and temperature don't have an effect on these wells that have high volumes of fast flowing water. The water brought to the surface of these wells hasn't changed and is the same as the water that is naturally occurring in the coal seams. Also, the Camden Gas Project has been operating for more than 10 years and many of the wells now produce much lower volumes of water than when they were first installed, so that is why we are seeing this trend to lower salinity waters now.

Summary.

The results from this investigation are very important in continuing to build on our comprehensive understanding of groundwater, produced water and CSG operations for the Camden Gas Project. These results have been shared with the NSW Office of Water, the Office of Coal Seam Gas, the NSW Environment Protection Authority, and the NSW Department of Planning and Infrastructure. AGL continues to monitor the groundwater from the coal seams and other groundwater resources within the Camden Gas Project area.

For more information you can download the report from:
agl.com.au/camden
or contact camdengasproject@agl.com.au

Report findings.

Global consulting firm, Parsons Brinckerhoff, did specialist chemical analysis (including isotopes) on different samples of water including produced water from gas wells, groundwater farm bores, the Nepean River and tap water to understand the properties of each.

The results of the investigations indicate:

- > The chemical composition and isotope data **support the conclusion** that the water is coal seam water that has been physically and chemically changed during its journey from the coal seam to the surface due to pressure and temperature changes.
- > The chemical composition and isotope results **rule out** the possibility of groundwater connection between deep coal seams and shallow groundwater and/or surface water
- > The chemical composition and isotope results **rule out** the possibility of leftover fracture stimulation (fracking) water or water from well maintenance programs.

For more information on the science behind the investigation and conclusions you can download the Parsons Brinckerhoff report from the AGL website: **agl.com.au/camden**



AGL Energy Limited

ABN 74 155 061 375