Potential groundwater impacts from tight oil and gas development in the Taroom Trough (Queensland)

Background

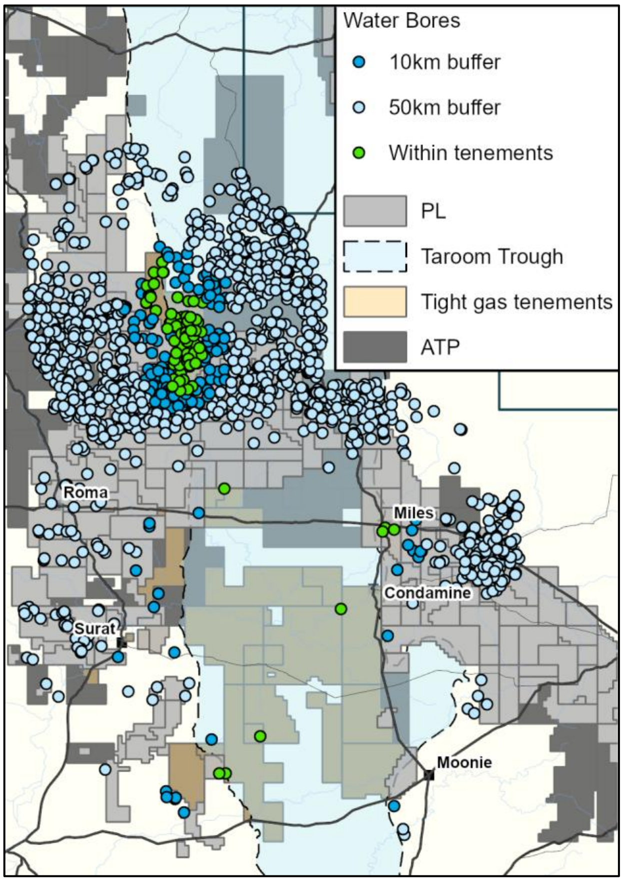
Tight oil and gas refer to natural petroleum fluids held in low-permeability rock formations typically found at greater depth than conventional oil and gas. Extracting those fluids requires a combination of horizontal drilling and hydraulic fracture stimulation (also referred to as fracking) to make them flow to wells in commercial quantities. This is different to conventional development that accesses oil and gas directly from high-permeability reservoirs generally without requiring hydraulic fracturing.

As of mid-2026, tight oil and gas exploration in the Taroom Trough is focussed on an area south of Roma and Miles and between Moonie and Surat (see map opposite). In this area, reservoirs are found in tight sandstone units – primarily in the Tinowon, Kianga and Muggleton formations. These reservoirs are typically deeper than 2,500 metres below the surface. Development of this resource will require drilling a well to a depth of approximately 2,500 to 4,000 m.

The well typically consists of a vertical section followed by a horizontal (or lateral) section extending approximately 500 to 2,000 m along the target formation. The horizontal section is then hydraulically fractured to allow oil and gas to flow to the well.

Aquifers and groundwater assets in the Taroom Trough

The Taroom Trough is part of the Bowen Basin, which underlies the Surat Basin (top figure, page 2). The Surat Basin hosts the aquifers of the Great Artesian Basin (GAB) including the Gubberamunda, Hutton and Precipice sandstones which are heavily accessed for agricultural and town water supply. In the exploration area for tight oil and gas in the Taroom Trough, these GAB aquifers are relatively deeper and accessed less frequently, mainly due to higher drilling costs and poorer water quality. There are only about 165



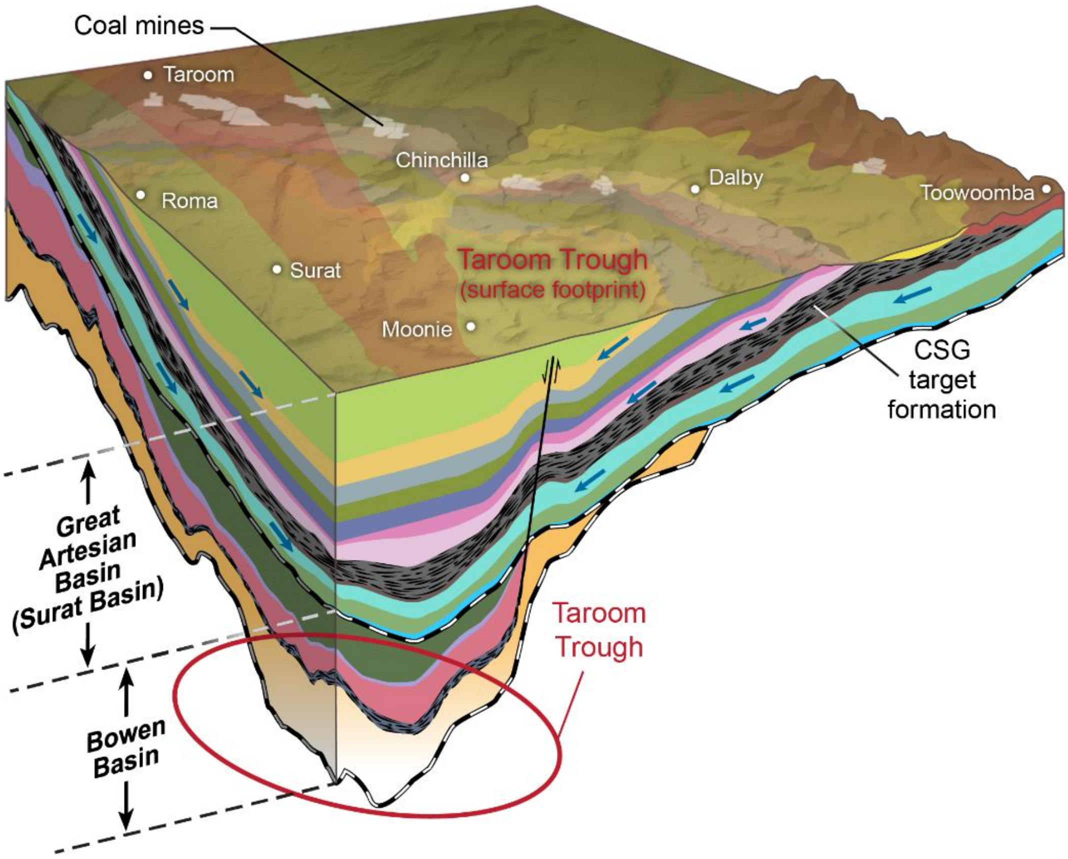
Bores in deep formations (Wallon Coal Measures or deeper) showing distance from the ATP with reported tight gas activity.

water bores accessing the deeper Hutton and Precipice sandstones within a 10 km buffer from current exploration tenures in the area, most of these are found in the northern areas where those formations are shallower (see map above).

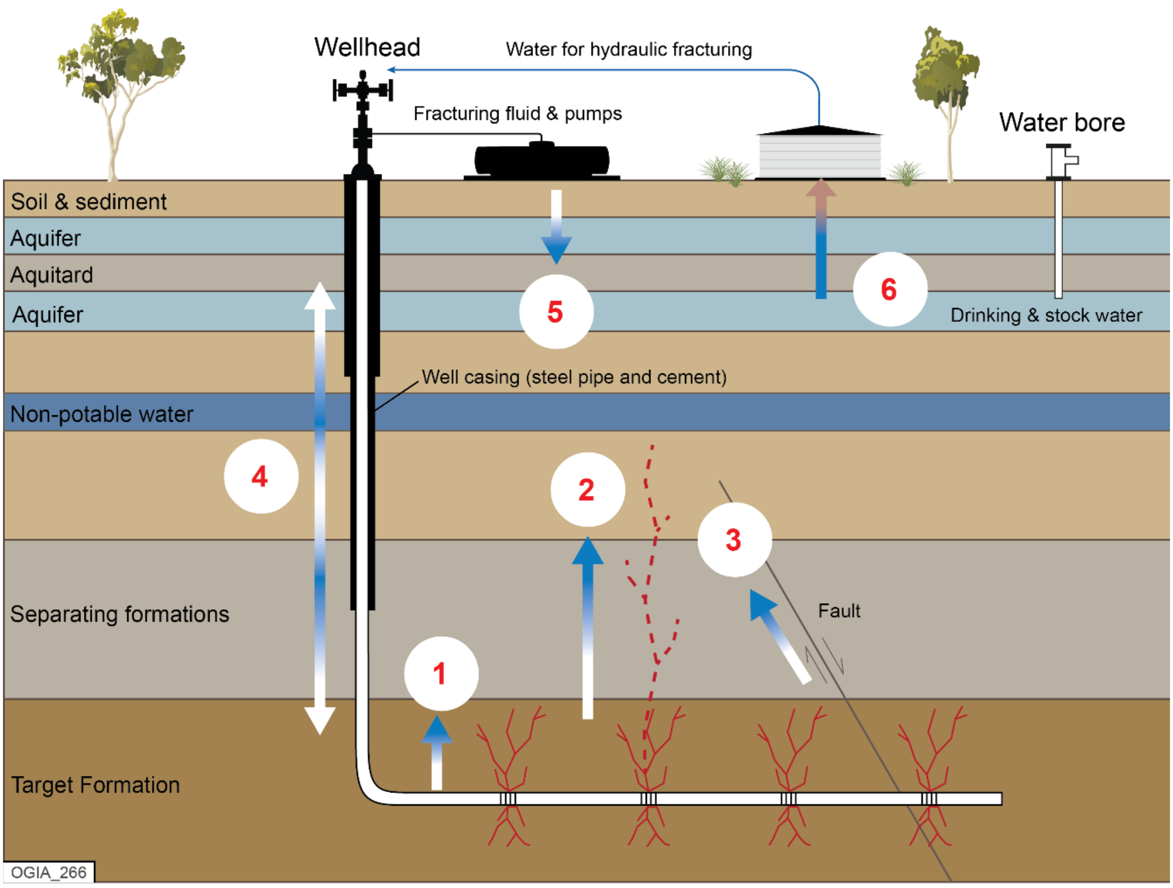
Groundwater extraction in the process of tight oil and gas development and production

In the context of groundwater, there are some fundamental differences between conventional, tight oil and gas, and coal seam gas (CSG) development.

In the case of CSG production, a large amount of *associated groundwater* is extracted for years to depressurise coal seams and release the gas. In conventional oil and gas production, the volume of *associated groundwater* extracted is much less. In comparison to those two methods, little to no *associated groundwater* is extracted in the process of tight oil and gas development and production. Instead, water is required for the hydraulic fracturing stage. This process typically lasts less than a month, and the water may be sourced from surface or groundwater.



3D diagram of geological basins and aquifers in the Taroom Trough



Potential risks to groundwater from tight oil and gas activities (numbered 1 to 6)

Potential risks to groundwater assets

The main risks to groundwater during tight oil and gas drilling activities (bottom figure, page 2) are related to competition for groundwater use, contamination of aquifers during drilling or hydraulic fracturing, or well integrity issues during drilling or later production stages. However, these risks are likely to be low in the Taroom Trough.

Competing water use

Drilling and fracturing of deep oil and gas wells requires an initial water usage of about 10 to 30 megalitres per well. Given the temporary nature of this requirement at changing locations, water sources near the well construction sites are preferred. This makes groundwater a priority option for tenure holders. If this water is sourced from GAB aquifers, then it has a potential to cause indirect impacts on these aquifers (risk 6 on the figure).

Well drilling and completion

Oil and gas wells cross multiple formations during the drilling process. To prevent cross-contamination and unintended fluid migration between aquifers and other formations, the well casing is installed and cemented in place. The integrity of the casing and the cement is pressure-tested to ensure the geological formations are hydraulically isolated (risk 4 on the figure). Over time, some deterioration of this zonal isolation may occur, but this can be mitigated through modern well construction and integrity management practices[i] so the risk of cross-contamination between formations, including groundwater aquifers, remains low.

Hydraulic fracturing

Hydraulic fracturing requires pumping a fluid typically consisting of water, sand and chemical additives (e.g. friction reducers, gelling agents, biocides), under high pressure into the target formation to open fractures and make oil and gas flow to the well.

Handling, mixing and pumping of these fluids at the surface, together with the storage of flowback returned after the operation, carries a risk of surface spills or leaks from tanks, lines and pumping equipment (risk 5 on the figure). This risk is managed through standard containment and handling practices and remains largely at the surface.

Once the hydraulic fracturing operation is complete, some of the fluid flows back to the surface, while a substantial proportion may remain in the target formation creating a contamination risk (risk 1 on the figure) – noting that BTEX – an acronym for a group of volatile aromatic hydrocarbons comprising **benzene, toluene, ethylbenzene and xylenes** – as an additive is not permitted for hydraulic fracturing in Queensland. Additionally, as the target formations are deep and not used to access water, this risk is inconsequential.

Another potential risk is the unintentional propagation of hydraulic fractures into overlying aquifers (risk 2 on the figure) or the inadvertent intersection and disturbance of existing geological faults (risk 3 on the figure), potentially creating hydraulic connections which in turn may cause water loss from aquifers or leakage of fracturing fluid into nearby aquifers. However, in practice, this risk is low for several reasons. Firstly, extensive international experience [ii] demonstrates that a range of geological, geomechanical and operational factors including lithological barriers, rock properties and pumping rates generally confines hydraulic fracture growth to the target reservoir and adjacent strata. Secondly, major faults are identified and avoided during planning, while inadvertent intersection can be potentially identified during hydraulic fracturing operations through changes in pressure, injection rates and fluid response. Thirdly, the gas target units are separated from the lowermost GAB aquifers by thick Triassic aquitards, providing substantial vertical separation and a tight barrier for hydraulic connectivity and cross contamination.

Monitoring and management of groundwater impacts

Whilst the risk to groundwater resources is low, ongoing monitoring and assessment of data is vital to ensure that potential risks are identified and mitigated proactively. This involves a network of strategically located monitoring bores at different depths, collecting baseline data of water bores in the area, groundwater sampling during the hydraulic fracturing process where necessary, pressure testing during the well construction process, selected micro-seismic data acquisition to determine the propagation of fractures and iterative assessment and reporting. Baseline assessments are important because they establish what the conditions were like before tight gas operations and provide landholders with a basis for identifying any future changes.

Groundwater obligations are managed through Environmental Authority conditions and the *Water Act 2000*. The Office of Groundwater Impact Assessment (OGIA) also prepares cumulative groundwater impact assessments for the Surat Cumulative Management Area, which covers coal seam gas (CSG) and coal mining in the Surat and southern Bowen basins and the Taroom Trough area.

References

(i) Resources Safety & Health Queensland 2022, Code of Practice for the construction and abandonment of petroleum wells and associated bores in Queensland, accessed January 31, 2024, from https://www.rshq.qld.gov.au/resources/documents/petroleum-and-gas/safety-and-health/code-of-practice-leak-management.pdf

(ii) Davies, RJ, Mathias, SA, Moss, J, Hustoft, S & Newport, L 2012, 'Hydraulic fractures: How far can they go?', Marine and petroleum geology, vol. 37, no. 1, pp. 1–6.

More information

https://www.ogia.water.qld.gov.au/publications-reports