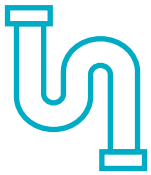
02 INFRASTRUCTURE AND ACTIVITIES

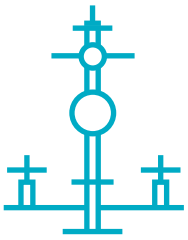
173M
hectares (ha) is the **total land area** of Queensland

3.5M ha
of Queensland is currently **under granted petroleum lease (PL)**

5,036
Conduct and Compensation Agreements (CCA) were in place at the end of FY21, with more than **$807 million paid in total cumulative compensation**



12,437 km
of **petroleum pipeline licences (PPLs)** that have been constructed and in operation



16,499
As of June 2021, total of **16,499 CSG and petroleum wells had been drilled** in Queensland

10,986
CSG wells that are currently in production

702 water bores
in the CMA are predicted to be impaired over the life of the CSG industry

108 IAA water bores
likely to be impacted between 2021 and 2024

Make Good Agreements have been successfully negotiated for

135 of the IAA bores

PETROLEUM AND GAS INDUSTRY TENURE AND FOOTPRINT

Industry Tenure Area: The total land area of Queensland is approximately 173 million hectares (1.73 million km^2).

As of 30 June 2021, approximately **3.5 million hectares (ha)** of Queensland was currently **under petroleum lease (PL) production tenure**, and **11.5 million ha** was under an **authority to prospect (ATP)** exploration tenure. The combined area covered by these tenures represents **approximately 8.6% of Queensland**, but the actual surface footprint of petroleum and gas development activities covers a much smaller area.

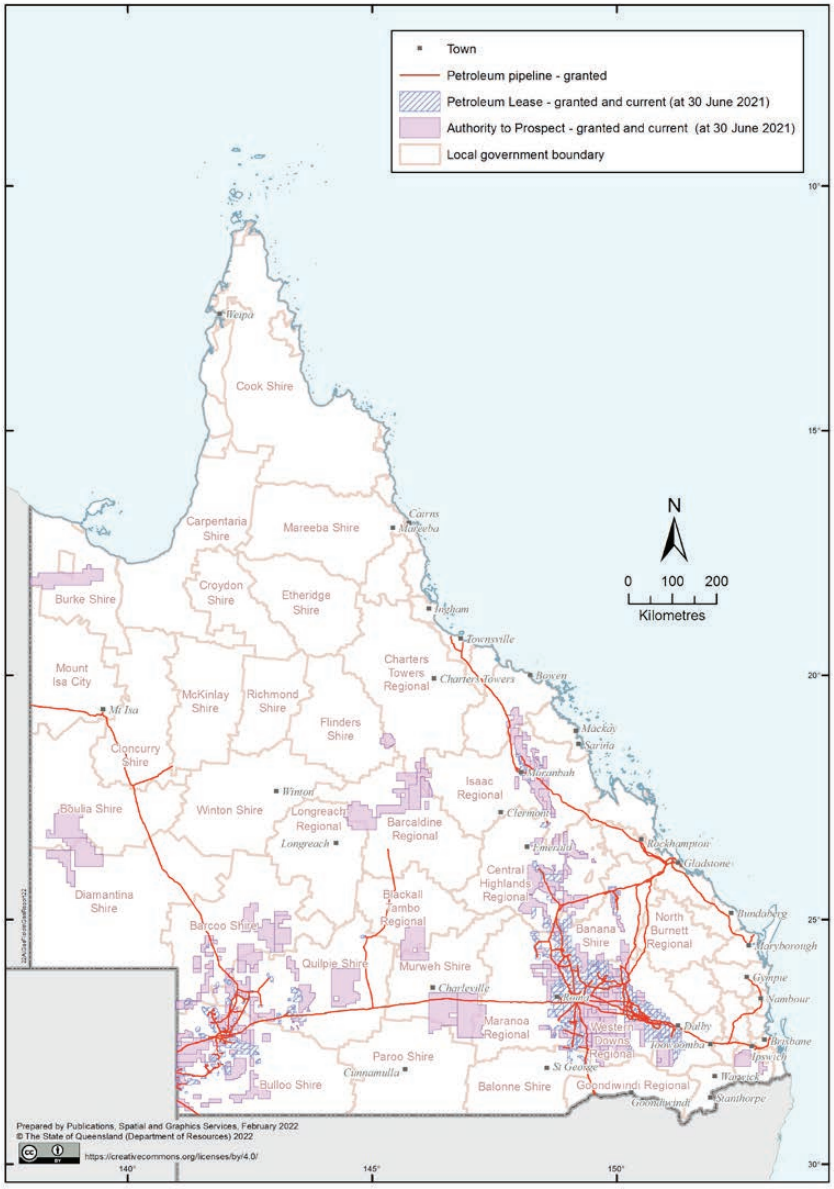
Industry Footprint

The area under tenure does not typically reflect the actual surface footprint of petroleum and gas activity. The actual footprint of gas industry activity and infrastructure is much smaller than the area under PL or ATP tenure due to resource companies concentrating their production in certain areas.

Infrastructure is built to expand into new regions before production activity progresses into that region; it includes high-pressure pipelines and low-pressure gathering pipelines, field compression stations, water treatment and gas processing facilities, storage facilities and well pads.

In the Surat Basin and Cooper Basin, the majority of significant infrastructure has already been constructed and commissioned. It can be expected that the scale of construction activity experienced in the Surat Basin between 2010 and 2015 will not be repeated as development expands into new areas.

Figure 1. Coverage of land area in Queensland as defined by granted exploration tenures (ATPs), petroleum leases (PLs) and petroleum pipeline licences (PPLs) as of 30 June 2021



Source: Department of Resources.

Approximately **920,500 ha** of petroleum and gas tenures granted have a condition attached whereby the gas produced must be supplied to the **Australian domestic gas market**. This condition was introduced in 2016 to secure gas supply to the east coast gas market and for the manufacturing industry.

Queensland has approximately **12,437 km of petroleum pipeline licences (PPLs)** that have been constructed and are in operation, with another 57.9 km in the application stage.

For more information see:
Pipeline and facility licences.

Table 1: Land area under petroleum and gas tenures (as of 30 June 2021)

Tenure type and status	Area (ha)	Area (km²)	% of Queensland Area
ATP granted	**11,454,510**	**114,545**	**6.6%**
ATP application	4,529,758	45,298	2.6%
PL granted	**3,476,265**	**34,763**	**2.0%**
PL application	843,396	8,434	0.5%
Total granted ATP and PL*	**14,930,775**	**149,308**	**8.6%**

* Total granted tenure area less than sum due to overlapping [application] tenures

Source: Department of Resources (This dataset captures all permit applications lodged with the department and permit grant decisions by the department to 30 June 2021)

Generally, exploration is far more widespread than production. There has been an increasing trend in exploration over the last 12 years, particularly in Banana, Central Highlands, Maranoa, Western Downs and Isaac LGA, with a sharp rise in Toowoomba since FY19. The sharp increase in Toowoomba can be attributed to the increase in activity associated with commencement of the Surat Gas Project. Baloone, Barcoo, Gondiwindi and Quilpie showed no increase.

Table 2. The area of an LGA in percent covered by GRANTED petroleum lease (PL) tenures in Queensland for the period 1 July 2010 to 30 June 2021

LGA	LGA area (ha)	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21
Balonne Shire	3,107,494	1.5%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.5%	1.5%
Banana Shire	2,854,864	5.7%	5.7%	5.7%	5.7%	6.2%	7.2%	7.5%	7.5%	7.5%	7.5%	8.2%	8.8%
Barcoo Shire	6,225,640	0.3%	0.3%	0.3%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
Bulloo Shire	7,323,489	6.6%	6.6%	6.6%	6.6%	6.6%	6.7%	6.7%	6.7%	6.7%	6.8%	6.8%	6.8%
Central Highlands Regional	5,983,558	2.1%	2.1%	2.1%	2.1%	2.1%	2.5%	2.5%	2.5%	3.0%	3.0%	3.8%	3.8%
Goondiwindi Regional	1,928,080	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Isaac Regional	8,260,621	0.6%	0.6%	0.6%	0.6%	0.6%	0.7%	0.7%	0.7%	0.7%	0.9%	0.9%	0.9%
Maranoa Regional	5,871,000	12.7%	13.0%	13.1%	13.4%	13.3%	13.3%	13.7%	13.7%	15.9%	15.9%	17.2%	17.2%
Quilpie Shire	6,745,556	2.8%	2.8%	2.8%	2.8%	3.0%	3.0%	3.0%	3.0%	2.8%	2.8%	2.8%	2.8%
Toowoomba Regional	1,297,541	1.6%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	8.5%	8.5%	8.5%
Western Downs Regional	3,794,438	6.9%	8.1%	13.3%	15.4%	17.0%	19.8%	20.8%	20.9%	21.0%	26.3%	27.7%	27.7%

Area of LGA covered by PLs is calculated from the grants and relinquishments processed as of 30 June each year. Only Petroleum Leases with approval dates have been included. Where a PL had an approval date, but not a date at which it became non-current, it was treated as current if a renewal application had been lodged, but otherwise the expiry date was taken as the non-current date. Some LGAs have not had PLs granted within them and so do not show in the results tables.

The Maranoa and Western Downs LGAs, situated in the Surat Basin, host the majority of Queensland's CSG activities. The Barcoo, Bulloo and Quilpie LGAs host the majority of the Cooper Basin's petroleum development activities which have traditionally been focused on conventional oil and gas targets. As new and emerging areas develop further, increased activity can be expected in the Banana, Central Highlands and Isaac LGAs.

These and other emerging areas in the McKinlay and Bourke LGAs may host gas exploration activities that are associated with what is commonly referred to as 'unconventional' targets.

The terms 'conventional' and 'unconventional' refer to the techniques and technologies required to extract the gas from host rocks. Conventional resources are extracted using traditional methods, drilling wells directly into a subsurface reservoir where oil and gas is trapped in a geological structure. Unconventional resources are those that require greater than industry-standard levels of technology or investment to extract.

Find out more on the CSIRO website: What is unconventional gas?

Pipelines

For safety reasons all pipelines (large-diameter, high-pressure transmission pipelines and gathering lines that transport gas over long distances) are positioned underground. Only under certain circumstances will sections of pipeline be positioned above ground (such as for ongoing maintenance purposes).

Well pads

Well pads are typically comprised of well heads, separator, and compressors (this varies amongst resource companies). Well pads are easily visible due to their positioning on a well cleared area, typically measuring 100 m x 100 m in size[1] during drilling operations. For the purpose of this report, the well footprint refers to the area directly under a well pad.

[1] See page 61 of 'Gas Guide 2.0 – Full edition' (https://www.gfcq.org.au/gasguide) – Types of gas wells and well pads

Table 3. Cumulative petroleum well footprint area (ha) and percentage by LGA to 30 June 2021*

Local Government Area (LGA)	LGA area (ha)	Year	Total number of wells*	Area of well pads (ha)**	% Well footprint over LGA
Balonne Shire	3,107,494	2011	98	98	0.003
		2016	98	98	0.003
		2021	98	98	0.003
Banana Shire	2,854,864	2011	345	345	0.012
		2016	576	576	0.020
		2021	827	827	0.029
Bulloo Shire	7,323,489	2011	587	587	0.008
		2016	683	683	0.009
		2021	805	805	0.011
Central Highlands Regional	6,040,099	2011	107	107	0.002
		2016	184	184	0.003
		2021	368	368	0.006
Isaac Regional	8,260,621	2011	636	636	0.008
		2016	759	759	0.009
		2021	844	844	0.010
Maranoa Regional	5,871,000	2011	1,039	1,039	0.018
		2016	1,762	1,762	0.030
		2021	3,203	3,203	0.055
Quilpie Shire	6,745,556	2011	309	309	0.005
		2016	344	344	0.005
		2021	360	360	0.005
Toowoomba Regional	1,297,541	2011	135	135	0.010
		2016	135	135	0.010
		2021	181	181	0.014
Western Downs Regional	3,794,438	2011	1,186	1,186	0.031
		2016	4,829	4,829	0.127
		2021	6,427	6,427	0.169

Source: Department of Resources.

* The total number of wells include CSG and petroleum wells only (including exploration, appraisal and development wells), that have not been decommissioned.

** Area of well pads is typically 1 to 1.5 ha in area and provide the working area for drilling operations (GISERA, 2018), with most being closer to 1 ha.

1 ha is used here for simplicity. A well pad footprint is generally smaller once a well is constructed and in production.

Well footprint is taken to mean the area covered by well pads in Queensland and does not include any geomechanical impacts. Aggregate well footprint is estimated as the cumulative sum of the number of wells drilled each year, minus the number of wells abandoned each year, for the period July 1901 to June 2021.

Financial year totals from 2011 to 2021 are provided in separate columns. This data extract captures data submitted to the Department for the period to 30 June 2021.

Estimates of well footprint areas are approximate only. It is assumed that each well pad, on average, covers a footprint of 1 hectare (ha). It is also assumed that abandoned well sites are rehabilitated, hence plugged and abandoned wells are subtracted from the estimate. Note, however, that there was no requirement to notify the Department of abandoned wells prior to 2011.

Marked increase in trend over the last 12 years particularly Banana, Maranoa, and Western Downs LGA's has been experienced. This is due to the development of the CSG industry and subsequent incremental growth to maintain supply to the LNG trains at Gladstone. Increasing trends also seen in Bulloo, Central Highlands, Isaac Quilpie and Toowoomba.

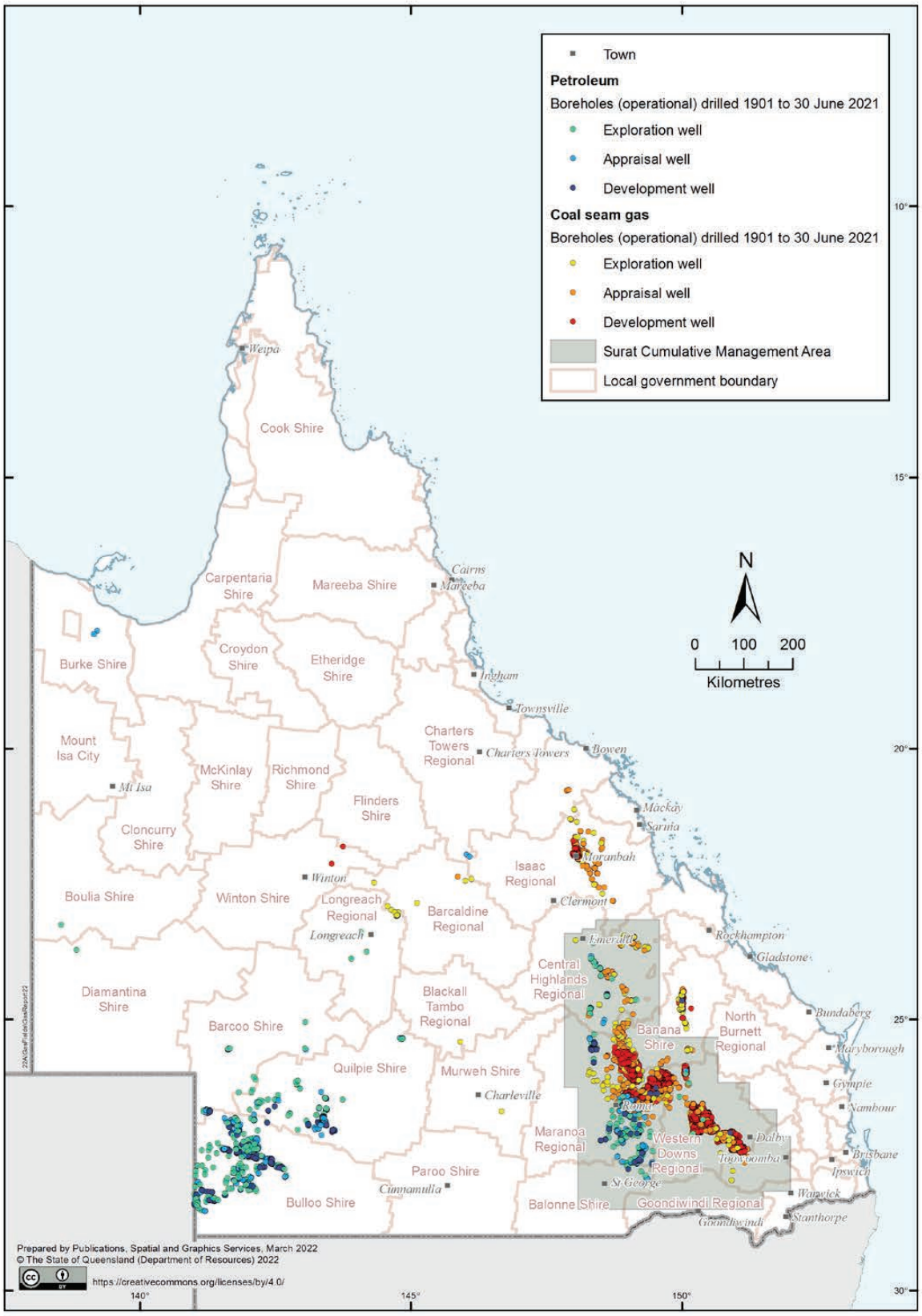
At its highest peak (as of June 2021), CSG and petroleum well footprint covers approximately 0.17% of land surface in the Western Downs area (where there is an average of 17 wells per 10,000 ha). The density is even lower in the Maranoa LGA, where there is an average of around five wells per 10,000 ha. The density of development activities differs when comparing conventional and CSG field developments (see Figure 2).

Typically, CSG production requires the depressurisation of the coal seams across a broad area to extract the gas from the reservoir. This requires wells to be drilled at an approximate spacing of 750 metres apart. As the development footprint expands, more wells need to be drilled to continue to extract the gas. Therefore, more wells are required to be drilled to extract the gas compared to the traditional conventional petroleum and gas targets.

Conversely, the techniques used to extract petroleum and gas from conventional reservoirs in Queensland requires the drilling of fewer wells.

The maturing of conventional petroleum and gas activity in the Cooper Basin means that the number of wells being drilled are declining, compared to CSG and other unconventional resources that are still developing, particularly in the Surat and Bowen Basins as seen in Figure 3.

Figure 2. The predominance of conventional activity in the west of Queensland compared to CSG activity in the east



Source: Department of Resources.

The Surat Cumulative Management Area (Surat CMA) was established by the Queensland Government in 2011 in response to coal seam gas development in the area. It covers the Surat, Southern Bowen and Western Clarence-Moreton geological basins.

Industry Production Area

Development and production areas are not static, they continuously change based on a range of factors that influence resource companies' development scenarios (e.g. reservoir dynamics, market demand, production performance, resource quality, capital investment, investment confidence). Typically, about 50 to 70%[2] of the total tenure area is used for production purposes with some parts of a tenure never being developed. Production areas are expressed in terms of existing areas (those areas already in production) and planned areas (those areas that are not yet in production).

Based on the 2021 Underground Water Impact Report (UWIR), the Office of Groundwater Impact Assessment (OGIA) reported the **total existing and planned production area** has increased by 8% to approximately 15,000 km^2 when compared to the 2018 development scenarios reported in May 2019.

The existing area of production has increased by 14% compared to 2018 which can be seen in the vicinity between Dalby and Miles, and

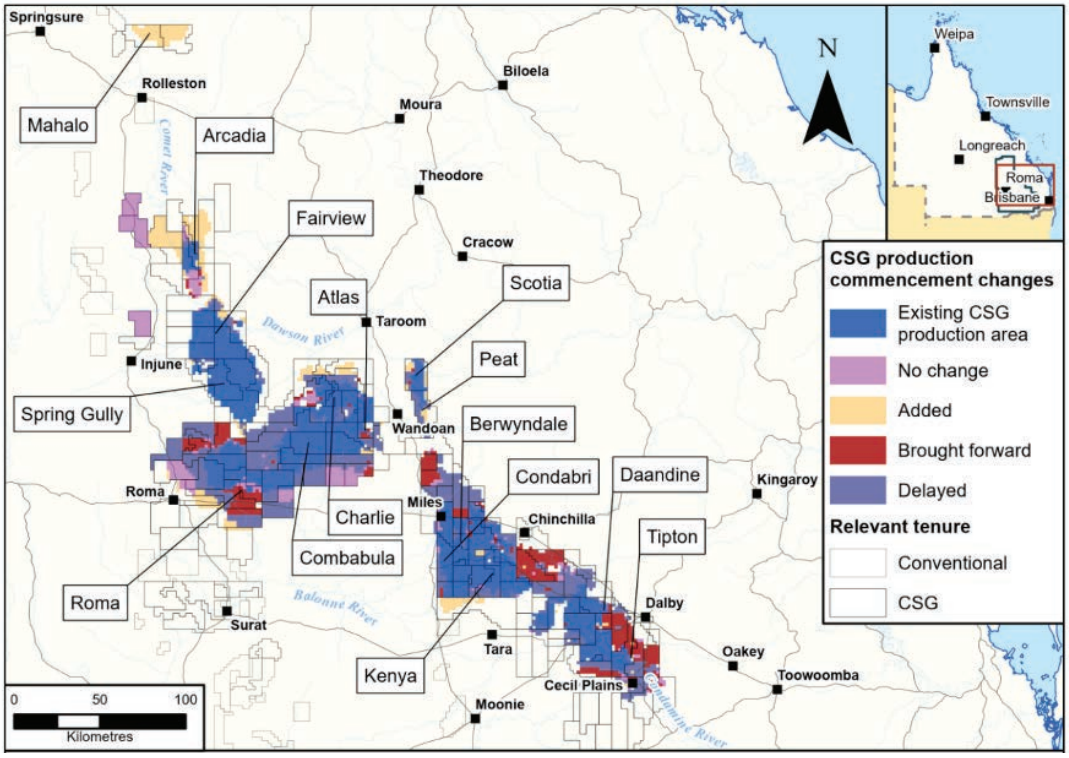
The expansion of the planned CSG production area includes the new Mahalo gas field, the re-establishment of Origin's Ironbark gas field, Santos' expansion of the Arcadia and Arcadia West gas fields, and the introduction of new area for the Arcadia field east of Rolleston.

Senex's planned production schedule has undergone major change as the Rhea, Dione, Phoebe and Pandora gas fields have all been rescheduled to commence at a later date.

Development between Dalby and Cecil Plains has generally been brought forward, as has the planned development south of Chinchilla while development area located north of Miles has generally been scheduled later, except for the northernmost part of this gas field which has been brought forward by up to 10 years.

According the 2021 UWIR, despite an increase in the planned production areas over the longer term, there has been an overall slowing in the rate of development in the short term. The slowdown in development was likely a response to the market conditions related to the COVID-19 pandemic.

Figure 3. Development profile and planned production scenarios as of 2020



[2] Underground Water Impact Report 2021 for the Surat Cumulative Management Area

INSIGHTS

For the purpose of groundwater impact assessment, OGIA compiles the changes to the development profile within the Surat CMA on an annual basis and then uses this information to predict impacts and provide relevant commentary on changes.

The development profile is used by OGIA as the input scenario for the regional groundwater flow model for impact predictions, the development of various impact-management strategies and to provide relevant commentary on changes.[3]

The most recent statutory report from OGIA is the Underground Water Impact Report 2021 for the Surat Cumulative Management Area (UWIR 2021).

PETROLEUM AND GAS WELLS

Infrastructure associated with gas wells and well pads typically deliver the greatest surface disturbance.

As of **30 June 2021, a total of 16,499 CSG and petroleum wells** had been drilled in Queensland (across all tenure types) since records began in 1901. Of these wells:

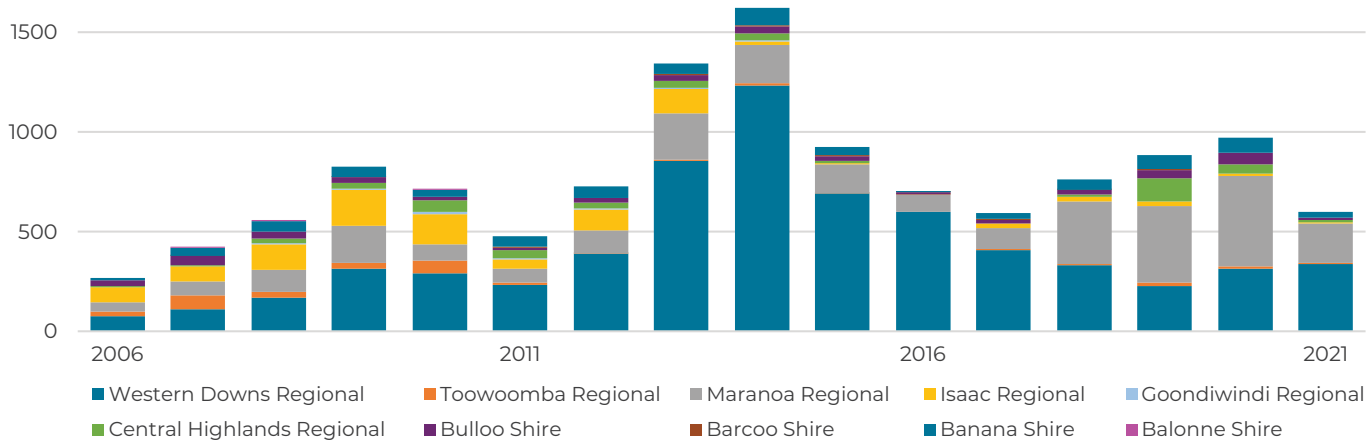
- 12,941 targeted CSG with 96% located within the Bowen and Surat basins, and the remainder (529 wells) located in other basins
- 3,558 targeted conventional and other unconventional resources (non-CSG), 48% of these are located in the Cooper-Eromanga basins; 44% in Bowen-Surat basins, and 8% located in other basins.

During FY21, a total of 585 CSG wells and 18 non-CSG wells were drilled throughout Queensland.

It is important to note that at any point in time, not all petroleum and or CSG wells that have been drilled are in production. Some wells have been decommissioned (plugged and abandoned), some have been repurposed (converted into water bores, reinjection wells, or monitoring bores) while others are capped/shut-in/suspended.[4]

Therefore, the total number of producing wells is far fewer than the total number of wells drilled.

Figure 4. Total petroleum and coal seam gas wells drilled in each local government area (LGA) for financial years 2006-2021



[3] Underground Water Impact Report 2021 for the Surat Cumulative Management Area

[4] The status 'capped/shut-in/suspended' refers to wells that are on standby to come into production. It can also refer to producing wells that have been turned off. This can happen for a number of reasons, e.g. waiting for a workover, uneconomic to produce, waiting for abandonment etc.

CSG AND PETROLEUM WELL STATUS BY LGA

The data presented below reflects the status of each well at the time it was entered into the Geological Survey of Queensland's (GSQ) database.

A resource company can bring capped/shut-in/suspended wells back into production, or cap, shut-in or suspend producing wells at any time without notifying the Department of Resources (Resources). Therefore, the term "operational" in Table 4 encompasses those wells that are in production and those that are classified as capped/shut-in/suspended.

Table 4. Number of wells drilled and their status in FY21 as grouped by LGAs (also see Figure 8 and Figure 9)

Local Government Area (LGA)	Plugged and abandoned		Operational (producing and capped/ shut-in/suspended)	
	CSG	Petroleum	CSG	Petroleum
Banana Shire	0	0	24	0
Bulloo Shire	0	1	0	12
Central Highlands Regional	0	0	12	1
Isaac Regional	0	0	3	0
Longreach	0	0	5	0
Maranoa Regional	2	0	195	3
Toowoomba Regional	0	0	4	0
Western Downs Regional	2	0	338	1
Total	**4**	**1**	**581**	**17**

Source: Department of Resources.

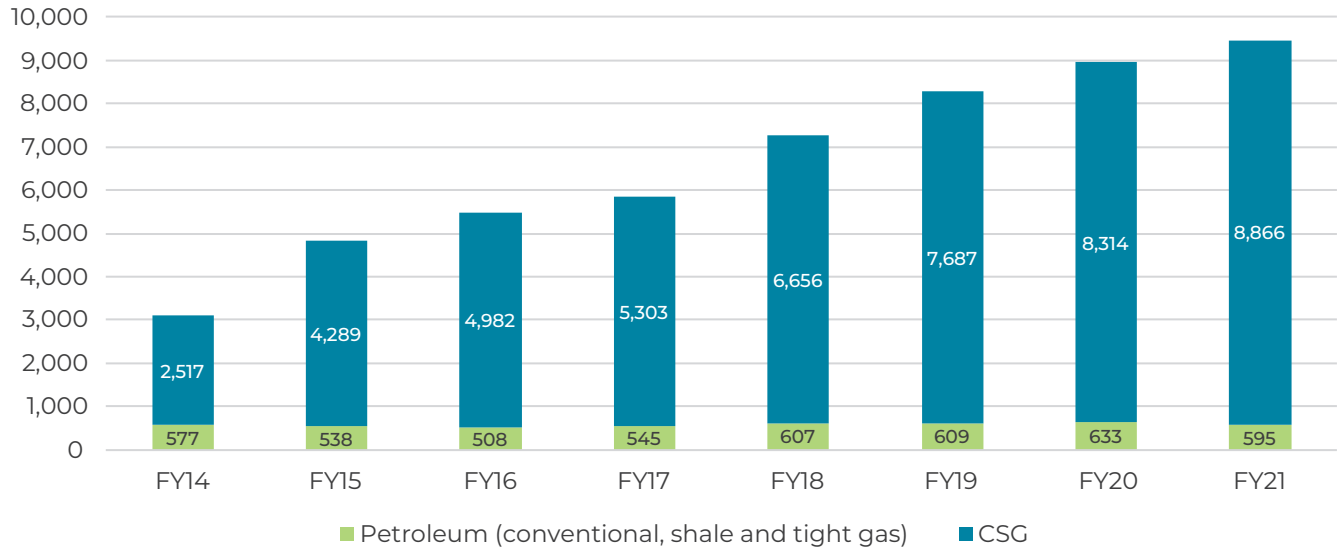
Producing Wells

As of 30 June 2021, there was a total of 9,461 producing petroleum and CSG wells in Queensland.[5] The number of CSG wells in Queensland has grown rapidly since 2010 to support Queensland's growing LNG export industry.

The actual number of producing petroleum and gas wells is obtained from Resources Safety & Health Queensland (RSHQ), who collect and maintain a register of producing wells based on the safety and health fee paid by resource companies.

[5] This is the number of petroleum and gas wells within petroleum leases that have produced petroleum and/or gas in each financial year and for which a safety and health fee was paid.

Figure 5. The growth in the number of producing CSG wells since FY14



Source: Resources Safety & Health Queensland.

INSIGHTS

As technology has improved over the years, many changes have occurred, particularly in the time it takes to drill wells[6] and with resource companies adapting and introducing new practices to minimise the impacts and surface disturbance for landholders.[7] These include the use of multi-well pads that allow multiple wells to be drilled on a pad,[8] colocation and grouping of infrastructure, negotiating with landholders to locate infrastructure in areas that will least affect their existing farming practices, and increasing use of constraints mapping.

[6] Page 63 of 'Gas Guide 2.0' (https://www.gfcq.org.au/resource-hub/the-gas-guide/) – Days development drilling
[7] Page 65 of 'Gas Guide 2.0' (https://www.gfcq.org.au/resource-hub/the-gas-guide/) – Noise, light & dust
[8] Page 61 of 'Gas Guide 2.0' (https://www.gfcq.org.au/resource-hub/the-gas-guide/) – Types of gas wells and well pads

FUTURE WELL PROJECTIONS WITHIN THE SURAT CMA

By the end of 2021, approximately 8,900 CSG wells were already drilled within the Surat CMA, 84% of which are located in the Surat Basin, with the remainder found in the southern Bowen Basin. Approximately 500 wells (used for exploration or testing purposes) are located outside CSG production areas.[9]

With the increase in the net production area footprint in the Surat CMA, the total number of projected wells has also increased slightly, from approximately 21,000 wells reported in May 2019, to approximately 22,000 wells by 2050 (Figure 6). Since 2012, when the gas fields increased production to supply the LNG facilities at Curtis Island, between 1,000 to 1,500 wells have been drilled and completed annually. This trend is forecast to continue until approximately 2023.

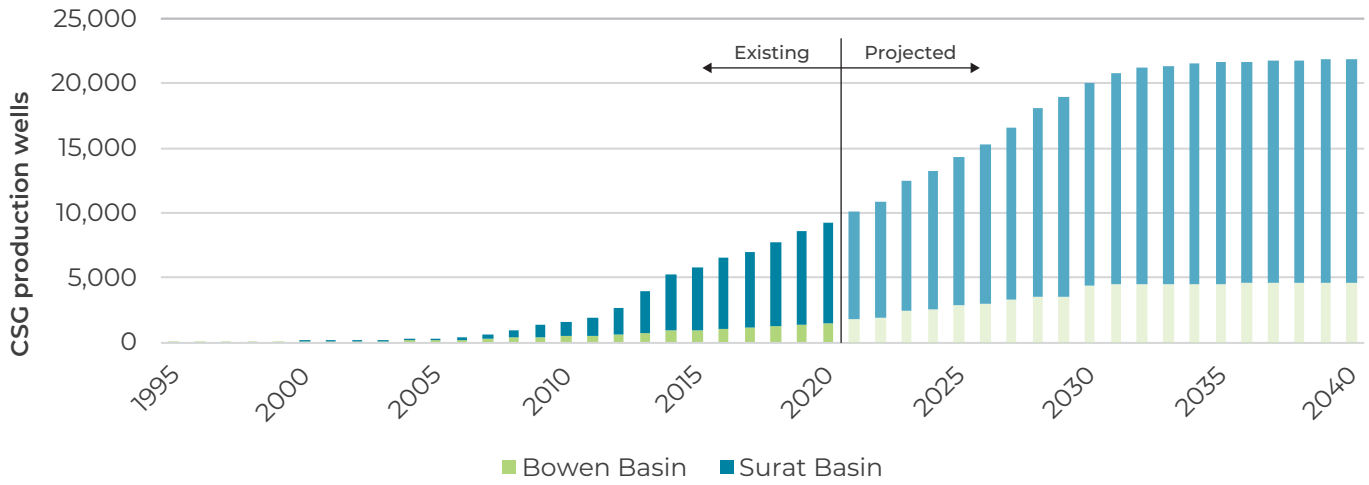
With technological advances, industry has deployed alternative drilling techniques to access petroleum and gas resources, including the use of directional and horizontal drilling.

There are approximately 730 directional or horizontal wells in 352 clusters, 314 in the Bowen Basin and 38 in the Surat Basin. Directional wells involve drilling a well at non-vertical and non-horizontal angles. Directional drilling allows a resource company to intersect target formations where vertical wells are not possible or practical. Directional wells are also used where multiple wells are drilled from the same well pad location, referred to as a multi-well pad.

Multi-well pads allow multiple wells to be drilled on a single pad. The benefits include a smaller over-all footprint per well, fewer well pads on a property, a greater distance between pads (up to 2.4km), less gathering pipelines and access required by the resource company, and the ability to locate pads in paddock corners/less productive areas for a better fit with existing farming practices.

Horizontal wells can be drilled along a target formation. This type of well typically involves drilling a vertical well to the desired depth and then steering the drill bit to travel horizontally along a target formation. The benefit of horizontal wells is that intersection with target formations is maximised, which reduces the overall number of wells required to be drilled.

Figure 6. Existing and projected CSG wells to 2050



Source: Office of Groundwater Impact Assessment

The number of petroleum and gas wells recorded in the GSQ Open Data Portal may be significantly higher than reported above because the portal includes non-operational, converted, and abandoned wells. OGIA infers the type of wells and their status based on contextual information such as their location, depth, tenure types and reported water production.

[9] Underground Water Impact Report 2021 for the Surat Cumulative Management Area

HYDRAULIC FRACTURING

The process of hydraulic fracturing[10] ('fracking' or 'fraccing') is used to stimulate gas production from geological formations with a low permeability.

About hydraulic fracturing

Hydraulic fracturing is a post-drilling stimulation technique used in the oil and gas sector to enhance permeability (connected pore spaces) of an oil or gas reservoir (sandstone, shale or coal).

Permeability of petroleum reservoirs is the key parameter that determines the flow rate and recoverable volume of petroleum (oil or gas) that can be produced economically from a well.

In areas of low permeability, it is possible to artificially increase oil and gas flow rates by the hydraulic fracturing process, which involves pumping water under high-pressure to fracture a limited zone around the injection point in the reservoir.

Hydraulic fracturing is a high-cost activity and only undertaken when economic factors (i.e., improved gas/oil flow rate and volume) warrant its use.

In Australian CSG fields, a key determinant of permeability will be depth of the reservoir. In general terms, the deeper the target coal (or sandstone or shale in the case of petroleum) the lower the permeability.

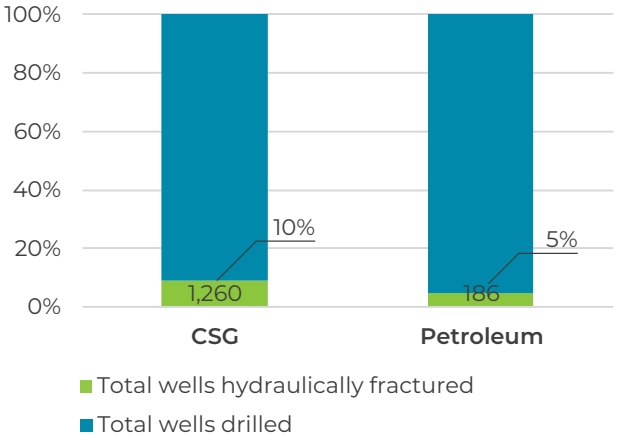
As a consequence of the depth-to-permeability relationship, wells requiring hydraulic fracturing will be located in deeper parts of petroleum basins, which is generally towards the centre. The Bandanna Formation in the Northern Bowen Basin is an example of a region where hydraulic fracturing is used for these reasons. Conversely, for tenures near the margins of a basin where coals are shallower (such as the Walloon Coal Measures of the Surat Basin), stimulation is both unlikely to be required, and is technically and commercially unviable.

Hydraulic fracturing is a regulated activity in Queensland and before the practice can be deployed, a petroleum and gas company is required to obtain the appropriate approvals. Currently, only a small fraction of wells drilled in Queensland are hydraulically fractured, as this process adds significant expense to the cost of gas production.

As the gas exploration and production activity expands into geological plays that are technologically more difficult to extract, it could be expected that hydraulic fracturing of wells will become more prevalent especially in the emerging areas across Queensland where tight gas and shale gas are being targeted.

[10] See FAQ 'What is hydraulic fracturing ('fraccing'/'fracking'), what chemicals are used and how are they regulated?' via: https://www.gfcq.org.au/resource-hub/faqs/

Figure 7. Total CSG and Petroleum Wells drilled and % hydraulically fractured



Overall, as of 30 June 2021, 10% of CSG wells drilled in Queensland were hydraulically fractured, while 5% of petroleum wells drilled were hydraulically fractured.*

*Data presented in this section begins in FY2011

This data is based on PGGD-04 forms (Notice of completion of hydraulic fracturing activities), which were introduced in 2010; therefore, the data presented here begins in FY11. Some LGAs do not have hydraulically fractured wells within them, so may not be shown in these data tables. This data extract captures data submitted to Resources for the period to 30 June 2021 (as of 9 September 2021). The figure of number of wells hydraulically fractured represents the first instance a well was hydraulically fractured in its lifetime. A well can be hydraulically fractured a number of times at any point during its lifetime thereafter.

As of 30 June 2021, the following number of CSG and petroleum wells were hydraulically fractured compared to those that were not. This graph only includes LGAs where wells were hydraulically fractured.

Figure 8. CSG Wells

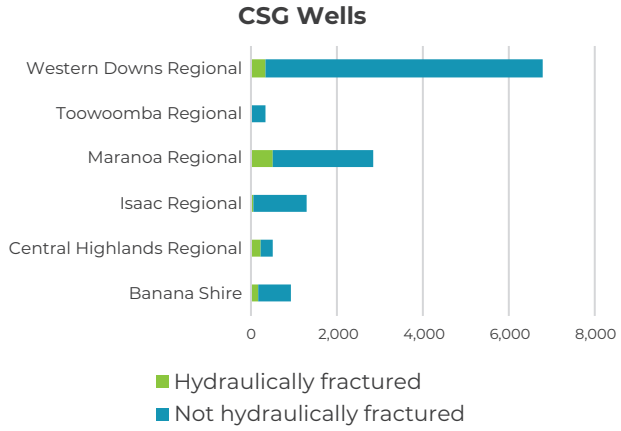


Figure 9. Petroleum Wells

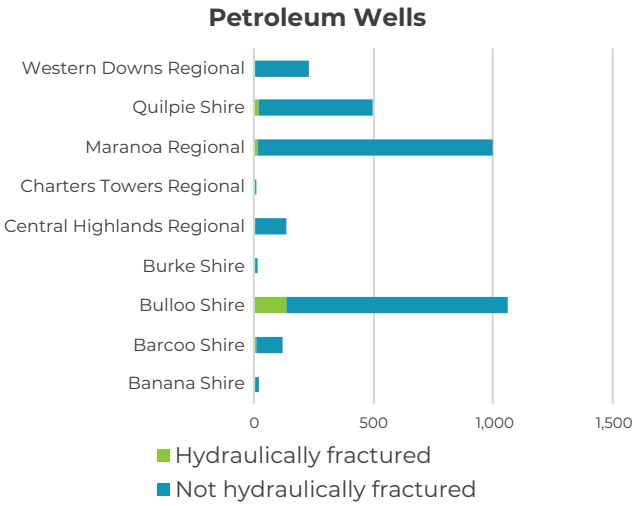


Figure 10. Percentage of CSG wells drilled in FY21 that were hydraulically fractured

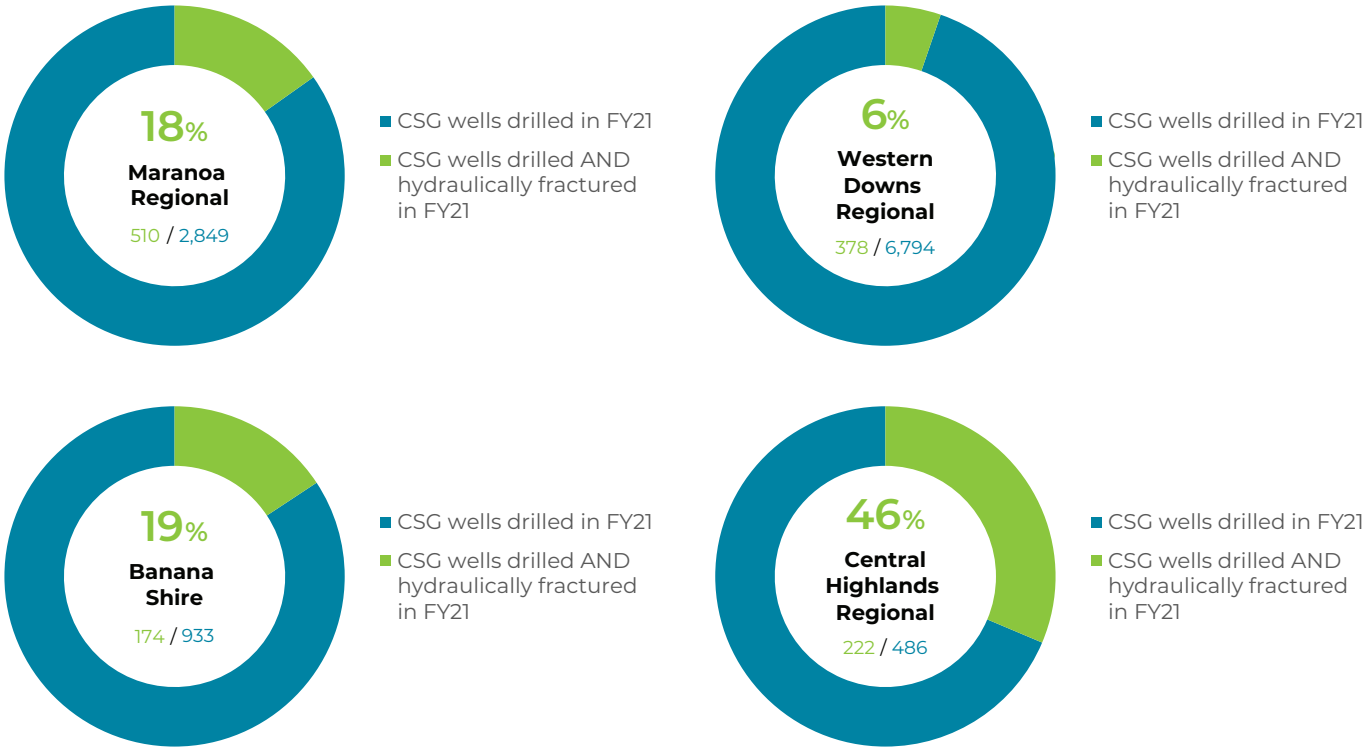
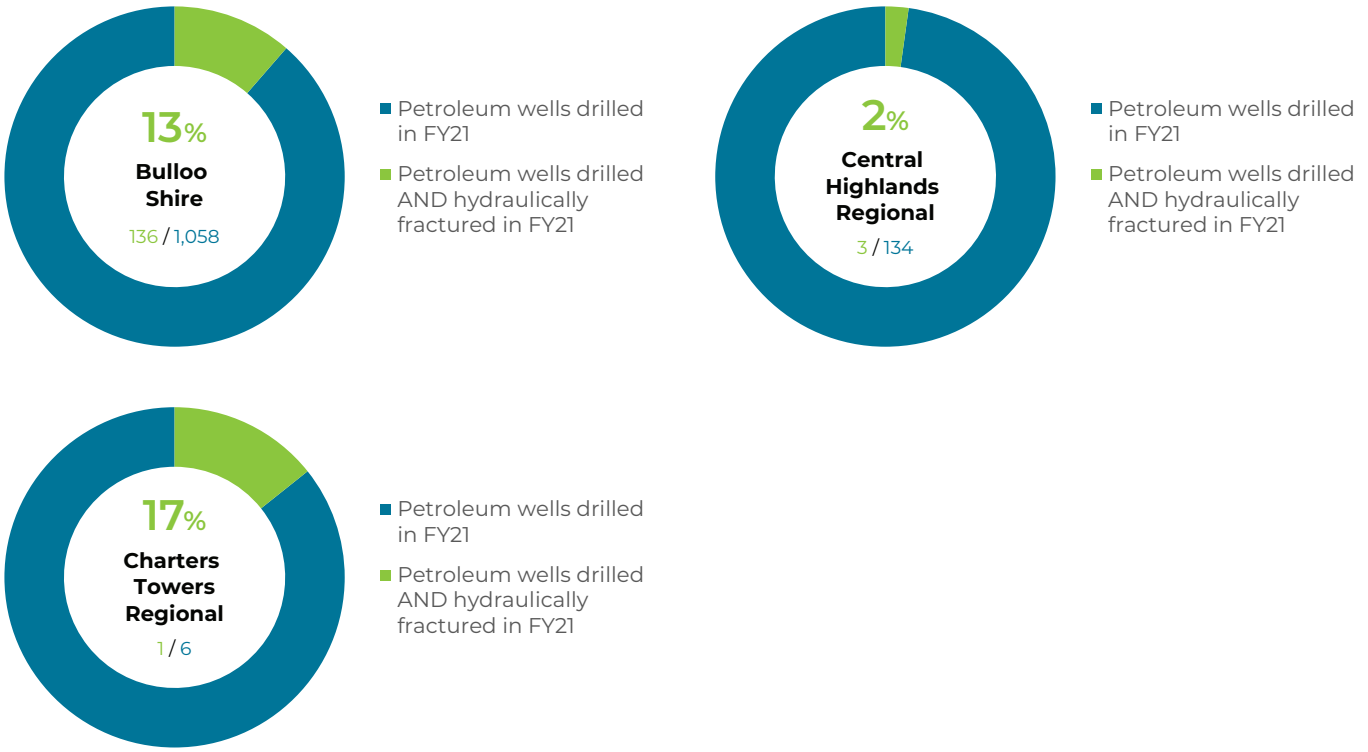


Figure 11. Percentage of petroleum wells drilled in FY21 that were hydraulically fractured



It is important to note that a well can be hydraulically fractured several times during its lifetime; however, for the purpose of this report, it is only counted once. The numbers represented here are the total number of wells that have been hydraulically fractured (at least once), not the number of times each well have been hydraulically fractured.

Hydraulic fracturing may have occurred at some point during the life of the well, and may or may not be in the year it was drilled.

AGRICULTURE AND INDUSTRY OVERLAP – LAND USE

Queensland has the largest area of agricultural land (83%) of any Australian state or territory and the highest proportion of land area in Australia dedicated to agriculture.[11] As the majority of land in Queensland is used for agricultural purposes, it can be expected that resource tenure overlaps with land used for agricultural purposes. While landholders have ownership rights to the surface of the land, the resources that lay in the subsurface are owned by the State on behalf of the entire community.

Petroleum and gas resources in Queensland are owned by the State and managed by the Queensland Government on behalf of the people of Queensland. The Queensland Government grants tenures that gives resource companies the right to explore for, produce and transport petroleum and gas.

Petroleum tenures are often on properties not owned by the tenure holder, and agricultural businesses are typically either leasehold or freehold property. As such, petroleum and gas tenures often overlap with other land uses. Before a resource company can access freehold or leasehold land, it must obtain the necessary approvals from government and comply with land access requirements.

Concerns about overlapping land uses are best resolved through land use government policies or civil means rather than applying bans or objections to resources activity on agricultural land. Leading-practice policies seek to balance the trade-offs between resources development and other land uses to maximise economic benefits for the community.

Table 5 shows the primary land use coverage by petroleum production tenures (granted and under application) for each land use category listed. The land use categories contain relevant sub-categories which were summed and merged to produce the Primary Land Use areas.

[11] Queensland AgTrends 2019–2020

Table 5. Primary land use coverage by petroleum production tenures as of 30 June 2021

Primary land use	Examples of related land use	Queensland land use areas (% of Queensland area)*	% of primary land use area overlapped by PL (granted and under application)**
Intensive uses	Residential and industrial areas, as well as intensive agricultural production such as feedlots and greenhouses. These also include manufacturing and industrial, residential and farm infrastructure, services, utilities, transport and communication, mining, waste treatment and disposal	1,200,000 ha (0.7%)	49,200 ha (4.1%)
Production from dryland agriculture and plantations	Cropping, non-irrigated pastures and plantation forests	3,500,000 ha (2.0%)	329,000 ha (9.4%)
Production from irrigated agriculture and plantations	Irrigated cropping, irrigated fruits and vegetables, including irrigated plantation forests	1,100,000 ha (0.6%)	86,900 ha (7.9%)
Production from relatively natural environments	Grazing native vegetation (e.g. in a state forest and on State owned land) including production from native forests	140,800,000 ha (81.4%)	3,660,800 ha (2.6%)
Water	Lakes/dams, rivers, estuaries and wetlands	7,200,000 ha (4.2%)	172,800 ha (2.4%)
Conservation and natural environments	National parks, stock routes and natural areas of defence land	19,200,000 ha (11.1%)	172,800 ha (0.9%)
Total		173,000,000 ha (100.0%)	4,471,500 ha (2.6%)

*Qld land use areas in ha are rounded.

**PL Granted and under application. This doesn't reflect the actual surface footprint of petroleum and gas infrastructure over these land use types (refer to Industry Footprint section).

Source: Department of Resources (2021) Areas of Regional Interest

Areas of Regional Interest

Areas of regional interest are identified under the Regional Planning Interests Act 2014. Each area of regional interest is identified based on its contribution, or likely contribution, to Queensland's economic, social and environmental prosperity. For the purposes of resources activities, areas of regional interest are considered to be 'constrained land'.

There are four categories of areas of regional interest:

- Priority Agricultural Area (PAA)
- Priority Living Area (PLA)
- Strategic Cropping Land (SCL)
- Strategic Environmental Area (SEA)

Before a resource activity can occur in areas of regional interest, a resource company must apply for and be granted a Regional Interest Development Approval (RIDA) as described under the *Regional Planning Interest Act 2014*. Alternatively, the resource company must demonstrate that it is exempt from the requirement to obtain a RIDA.

Table 6. Constrained land use under petroleum tenure as of 30 June 2021

LGA	Constrained Land type	Amount of LGA that is constrained land		Amount of constrained land covered by petroleum lease		Number of operational P&G wells within the constrained land
		Area (ha)	Percentage of LGA	Area (ha)	Percentage of constrained land type	
Balonne Shire	PAA	439,608	14.1%	0	0.0	0
	PLA	8,411	0.3%	0	0.0%	0
	SCL	693,171	22.3%	10,877	1.6%	11
Banana Shire	PAA	165,702	5.8%	21,529	13.0%	66
	PLA	19,586	0.7%	3,273	16.7%	7
	SCL	908,833	31.8%	76,781	8.4%	215
Barcoo Shire	SEA	1,463,309	23.5%	15,934	1.1%	2
Bulloo Shire	SEA	964,152	13.2%	162,013	16.8%	202
Central Highlands Regional	PAA	886,387	14.8%	83,064	9.4%	48
	PLA	27,871	0.5%	0	0.0%	0
	SCL	1,326,011	22.2%	111,024	8.4%	212
Goondiwindi	PAA	254,382	13.2%	0	0.0%	0
	PLA	13,055	0.7%	0	0.0%	0
	SCL	1,160,100	60.2%	710	0.1%	0
Isaac	PAA	14	0.0%	0	0.0%	0
	SCL	484,900	5.9%	611	0.1%	1
Maranoa	PLA	19,469	0.3%	11,689	60.0%	0
	SCL	990,483	16.9%	373,908	37.8%	1310
Quilpie	SEA	433,234	6.4%	27,680	6.4%	9
Toowoomba	PAA	1,025,514	79.0%	109,933	10.7%	173
	PLA	101,159	7.8%	2,361	2.3%	1
	SCL	639,090	49.3%	76,148	11.9%	21
Western Downs	PAA	743,571	19.6%	250,793	33.7%	1289
	PLA	33,944	0.9%	8,993	26.5%	33
	SCL	1,933,711	51%	467,257	24.2%	2458

Where a constrained land type is not present in an LGA, that row has been removed.

Areas with different constraints can not be summed. They are not additive because multiple constrained land types can overlap the same area.

The land use data was processed in ArcGIS to produce areas and calculate the number of wells within each LGA for each constrained land category. Processing involved spatial clipping, polygon intersections and reprojection to enable area calculations. This spatial manipulation and inherent polygon overlap errors may have introduced minor inaccuracies in area calculations. Only the final results are provided here.

Maranoa and Western Downs have the highest number of operation P&G wells within constrained land.

LAND ACCESS AND COMPENSATION

Under Queensland's land access laws, resource companies have the right to access and undertake petroleum and gas activities on a landholder's property provided that all legal requirements under the land access laws are complied with. The legal requirements depend on the type of activities that are to be carried out on the landholder's property.

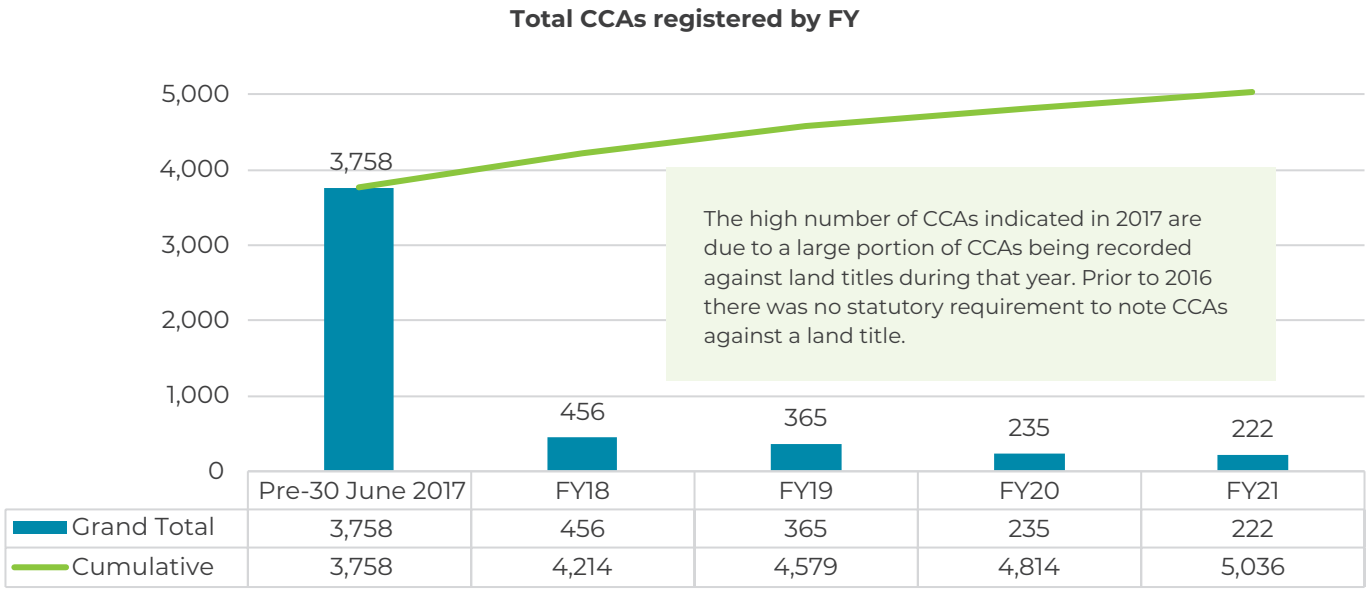
As of June 2021, there were 5,036 Conduct and Compensation Agreements (CCAs) recorded on Queensland land titles. The majority of these are associated with production lease and pipeline licence activities.

Preliminary activities	Advanced activities	Decommisioning activities
such as walking the area, taking soil samples or survey pegging (minimal impact on landholders)	such as infrastructure construction (longer term and/or extensive impacts on landholders)	such as rehabilitation for wells or pipelines

A Conduct and Compensation Agreement (CCA) is required for any advanced activites. This is a legally binding document that specifies the company's activities and behaviours, respective obligations and protections. A CCA also ensures the landholder is compensated for the effects and impacts of the advanced activities.

All CCAs are registered on the property's land title. If a property is sold, any registered CCAs are transferred with it.

Figure 12. Total CCAs registered by FY



	Pre-30 June 2017	FY18	FY19	FY20	FY21
Grand Total	3,758	456	365	235	222
Cumulative	3,758	4,214	4,579	4,814	5,036

Figure 13. Total CCAs registered by LGA

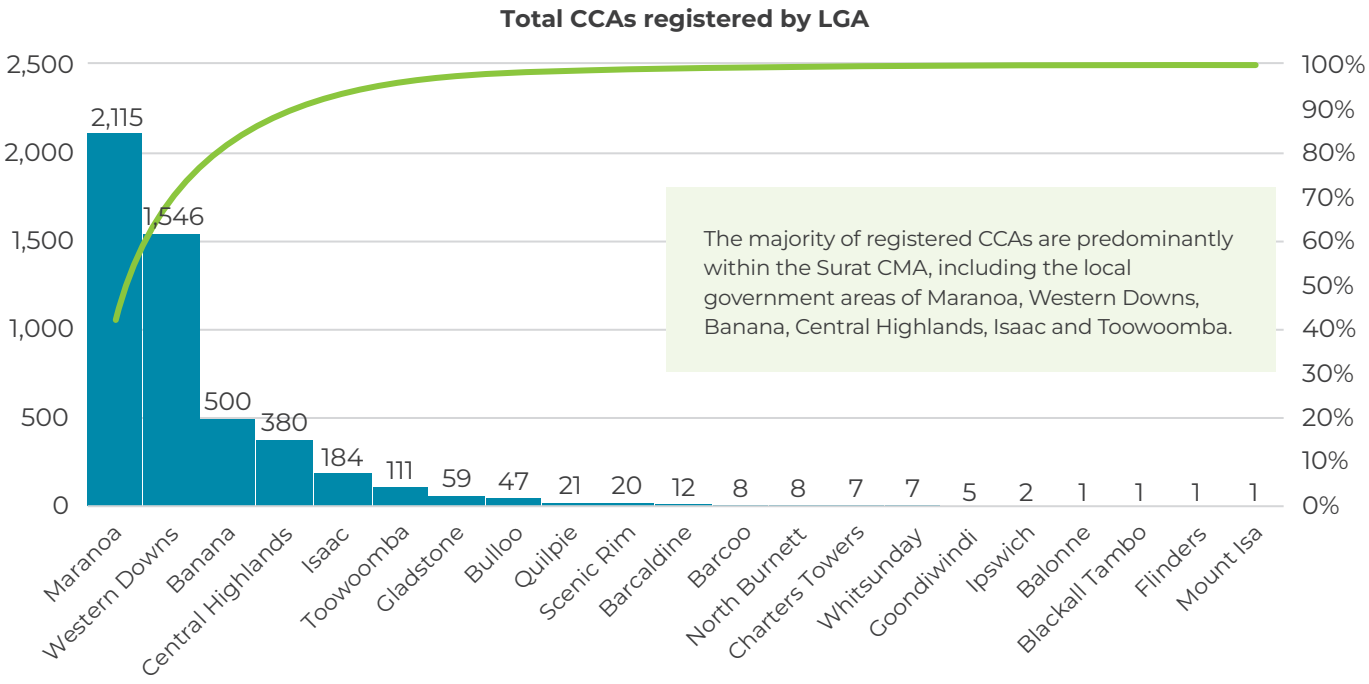
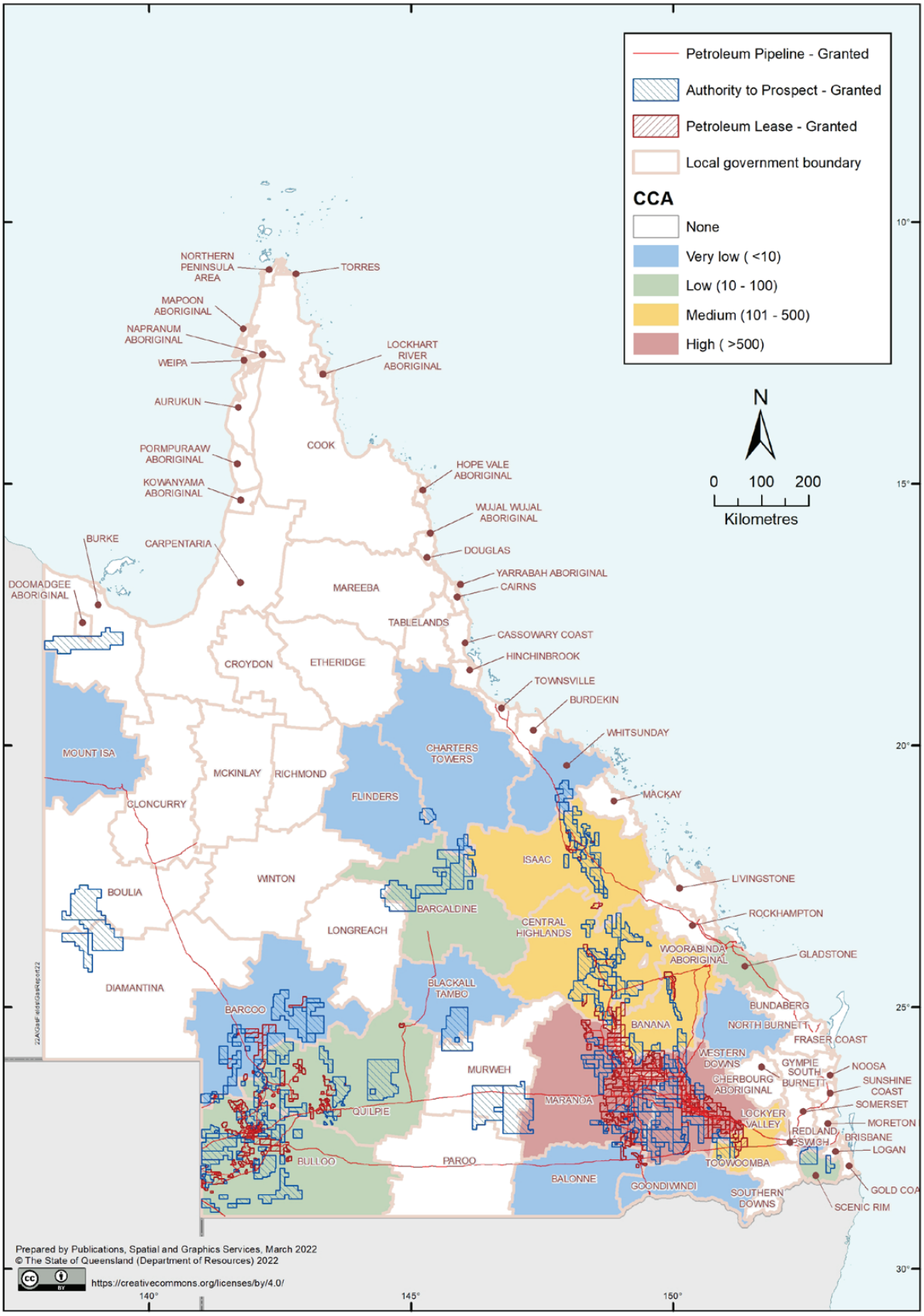


Figure 14. Landholders living in the Maranoa and Western Downs LGAs accounted for 72% of all CCAs



Based on the Commission's research, the 5,036 CCAs recorded on title are registered across 2,491 different lot on plans. This indicates that some landholders hold more than one CCA.

INSIGHTS

A CCA that is registered on title is also referred to as a "dealing". A lot on plan may have more than one dealing (CCA) and a dealing may have more than one owner registered on title. The registered owners (or landholders) on title are not limited to individuals, but may include other entities such as corporations, gas companies, regional councils, and the State of Queensland.

Because of this situation, it can be difficult to determine/calculate the number of unique landholders that have signed CCAs with the gas industry.

For example, when there are four people named on title for one lot on plan, there will be four owners party to the same CCA. Therefore, the title records will only register the one CCA, however, there will be four landholders who have a CCA with the resource company.

As a result, the Commission has determined that it will report on the total number of CCAs and the number of individual lot and plans only.

Table 7. Number of lot on plans with the corresponding number of registered CCAs

Number of CCAs registered against a lot on plan	Number of lot on plans with CCAs	Description
>10	48	48 lot on plans have more than 10 CCAs registered against it
4-10	198	198 lot on plans have between 4 and 10 CCAs registered against it
3	181	181 lot on plans have 3 CCAs registered against it
2	488	488 lot on plans have 2 CCAs registered against it
1	1,576	1576 lot on plans have 1 CCAs registered against it
Total	**2,491**	

Table 8. Number of CCAs on freehold and leasehold properties per LGA

90% percent of the CCAs are associated with freehold land.

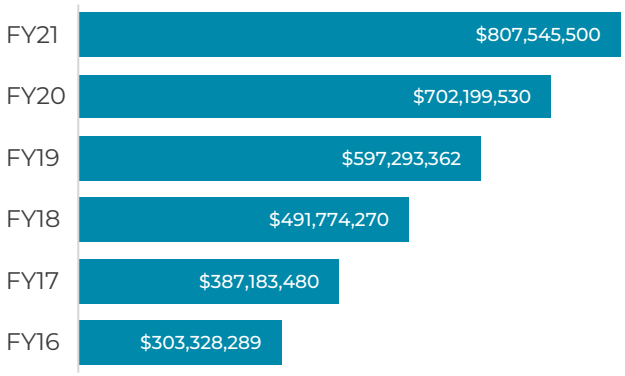
Count of Dealing No	FREEHOLD	LEASEHOLD	Grand Total
Balonne	1		1
Banana	373	127	500
Barcaldine	4	8	12
Barcoo		8	8
Blackall Tambo	1		1
Bulloo		47	47
Central Highlands	344	36	380
Charters Towers		7	7
Flinders	1		1
Gladstone	58	1	59
Goondiwindi	3	2	5
Ipswich	2		2
Isaac	149	35	184
Maranoa	1,986	129	2,115
Mount Isa	1		1
North Burnett	6	2	8
Quilpie	1	20	21
Scenic Rim	20		20
Toowoomba	108	3	111
Western Downs	1,470	76	1,546
Whitsunday	2	5	7
Grand Total	**4,530**	**506**	**5,036**

COMPENSATION PAID

In FY21, $105 million in compensation was paid to landholders for the impacts resulting from petroleum and gas development activities on their properties.

The figure below shows the cumulative compensation that has been paid to date is more than $807 million.

Figure 15. Cumulative compensation paid to landholders



Important considerations:

It is not possible to calculate an individual CCA value as each CCA is uniquely negotiated based on factors such as:

- every property, land value, business operation and profitability is different;
- the type and extent of company activity on each property and impact to a landholder's operations is different.

Other considerations include:

- the total number of CCAs include agreements that are signed before the commencement of company activities, and payments are not yet due; and
- apportionment of payments vary significantly between agreements, from a large proportion of total compensation paid up front to annual compensation payments over the life of the agreement.

Other Notes

- There are agreements in place within and between resource companies. These agreements are regarded in the same ways as if they were another landholder. CCAs are required from a joint venture perspective to recover costs as part of the commercial arrangement.
- There will be a number of agreements for Queensland State Forests and other State Government owned land.
- There are also some CCAs in place with local government where infrastructure is placed on road easements or on land owned by the council – although in this case they are the public authority for the land under the legislation and do not require a CCA. Historically it has been done this way by some companies and the local government haven't brought themselves up to speed with the process for accessing their land.
- There are other instances where the lessees and/or occupants of the land owned by and a separate CCA for the owner of the land (the State or Local Authority).

GROUNDWATER TAKE AND IMPACT MANAGEMENT

Queensland Groundwater take

The estimated total groundwater take from all aquifers across the petroleum and gas producing areas of Queensland for all purposes is approximately 390,000 ML/year.

Most of this is used for agricultural (includes stock intensive and irrigation use) and stock and domestic purposes.

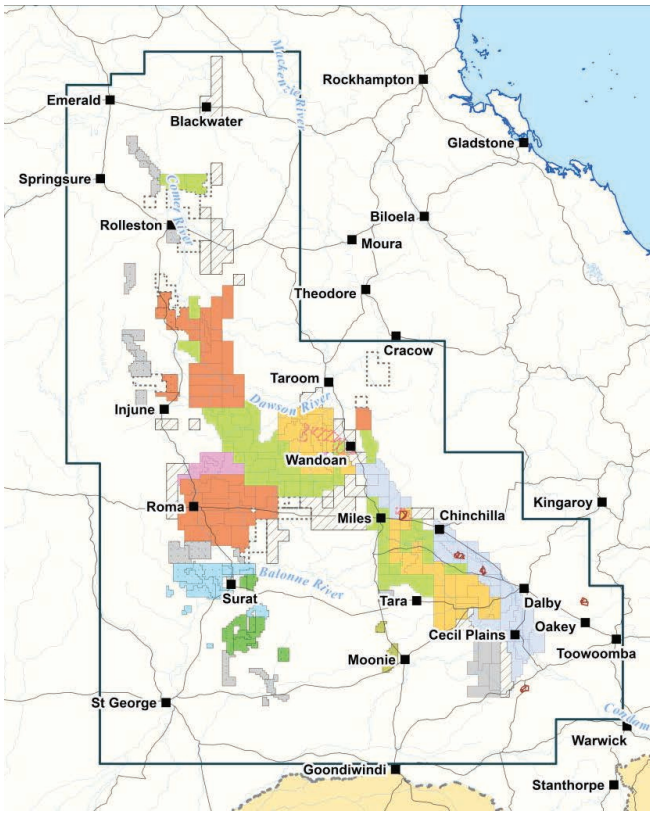
Of the total water take, approximately 134,000 ML/year (34%) is drawn from the upper alluvial and volcanic aquifers that overlie the Bowen and Surat basins for non-petroleum and gas activities.

Approximately 66,000 ML/year or 17% of the total water take is for petroleum and gas purposes.

Extracted groundwater is generally known by several different names, including 'CSG produced water', 'co-produced water', 'associated water' and 'CSG water'.

Associated water can be treated and re-used for a variety of applications including farm irrigation, town water supply, reinjection into aquifers and various industrial applications. Associated water extraction from CSG depressurisation and conventional oil and gas production is metered.

Figure 16. Surat Cumulative Management Area



Source: Office of Groundwater Impact Assessment – A summary of Underground Water Impact Report 2021 for the Surat Cumulative Management Area

Under Queensland's current regulatory framework, resource companies have the right to extract groundwater as part of the process of extracting petroleum and gas (underground water right).

The underground water right is provided to enable safe operating conditions in mines and to achieve the production of petroleum and gas. The right does not apply to other extraction of groundwater by resource tenure holders specifically for purposes such as camp water supply or road construction. Groundwater extracted for such purposes is referred to as non-associated water, the taking of which requires a water licence or water entitlement under Chapter 2 of the *Water Act 2000* (Water Act). Extracted associated water, however, can be used for other purposes, in accordance with the Queensland Government's CSG Water Management Policy which encourages the beneficial use of associated water.[12]

INSIGHTS

Resource companies operating outside the Surat CMA are required to submit a UWIR every three years, which includes an assessment of the water level decline in aquifers and any impacts to springs in both the long and short term. Within the Surat CMA, this responsibility rests with OGIA.[13] The UWIR does not detail the bores that have been impacted, but rather identifies bores accessing water from an aquifer that is predicted to experience an impact or drawdown of more than the trigger threshold.[14]

[12] Underground Water Impact Report 2021 for the Surat Cumulative Management Area
[13] Guideline - *Water Act 2000* - Underground water impact reports and final reports
[14] GasFields Commission Queensland – Gas Guide 2.0

GROUNDWATER TAKE FOR PETROLEUM AND GAS ACTIVITIES

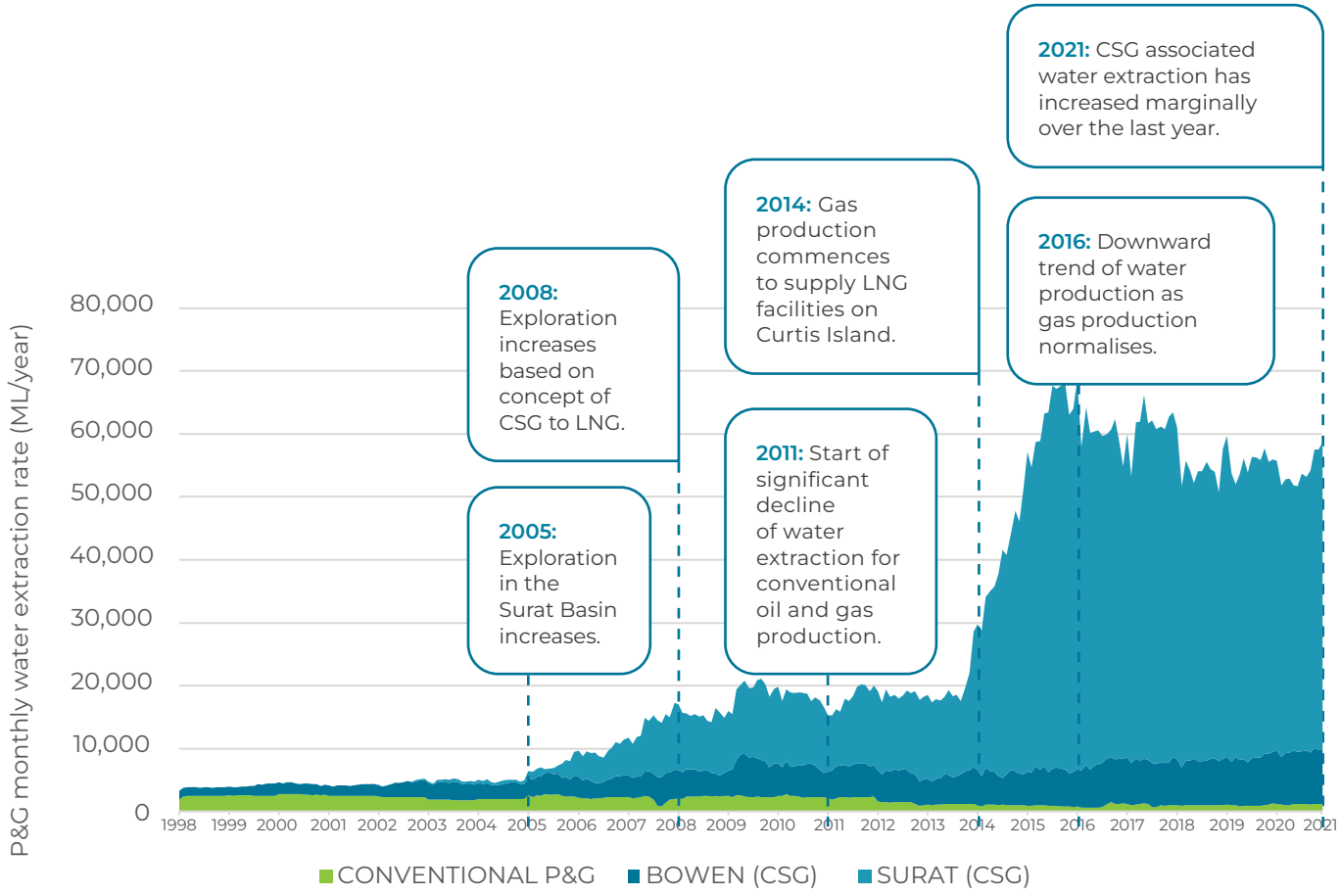
The recent UWIR reported that average predicted CSG associated water extraction has increased marginally to 54,000 ML/year due to changes in the development profile since the UWIR 2019. The total existing and planned production footprint has also increased by about 8% compared to the previous UWIR, but remains within the previously approved (2019) development footprint.

Conventional oil and gas production in the Surat CMA is in a mature phase. Water extraction has declined significantly since 2011 to the current level of around 1,000 ML/year, corresponding with declining oil production.

There has been a significant increase in associated water extraction since 2014 coinciding with the commencement of gas production to supply LNG facilities on Curtis Island peaking at 67,000 ML/year in 2015.

Overall, since 2016, the extraction rate has been progressively declining from a peak of around 67,000 ML/year – partially due to reduction in extracted water over time from existing wells and infilling of new wells in areas where partial depressurisation has already occurred.

Figure 17. **Historical associated water extraction by the P&G tenure holders in the Surat CMA**



About 95% of conventional associated water extraction is from the Precipice Sandstone and Evergreen Formation in the Moonie oil field. There is also some minor extraction from the Clematis Sandstone.

Summary of Surat CMA Groundwater Take for P&G purposes

The majority (45,000 ML/year) of extracted water is in the Surat Basin.

CSG water extraction in the Surat CMA has remained relatively stable in recent years, at around 9,000 ML/year (largest associated water extraction occurs from the Fairview, Talinga, Daandine, Kenya and Berwyndale gas fields).

Conventional oil and gas production in the Surat CMA is in a mature phase, with water extraction declining significantly since 2011 to the current level of around 1,000 ML/year, corresponding with declining oil production.

About 95% of conventional associated water extraction is from the Precipice Sandstone and Evergreen Formation in the Moonie oil field. There is also some minor extraction from the Clematis Sandstone

GROUNDWATER IMPACT

Under the regulatory framework, resource companies are required to manage the impacts of groundwater removal resulting from the gas extraction process. For example, resource companies are required to take a number of steps to ensure that water bore owners are not disadvantaged by their operations. This includes monitoring and identifying any potential impacts on water bores, to then negotiate the appropriate make good measure in a Make Good Agreement[15] (MGA) for the affected water bore.

Predicted impacts account for all existing and proposed development over the life of the industry.

As a result of the associated groundwater take within the Surat CMA:

- **702 water bores** are predicted to be impaired over the life of the CSG industry of which 516 physically exist and are usable water bores, while 186 have now been decommissioned or proactively entered into MGAs. This is an addition of 109 bores compared to previously reported (593 bores), as a result of:
  - changes in the development profile;
  - integration of coal mining impacts;
  - changes in water bore information; and
  - additional water bores being identified that were not previously recorded in the groundwater database.
- **108 newly identified immediately affected area (IAA)** bores are likely to be impacted between 2021 and 2024, with 233 IAA bores previously identified in the previous UWIR. The total number of IAA bores to date is now 341.
  - The 108 IAA bores will require follow-up bore assessments by the resource tenure holders (assigned by OGIA for each of these bores based on rules established in the UWIR) to assess impairment of capacity. If a water bore's water supply is likely to be impaired, then the tenure holder will negotiate and implement an appropriate make good measure with the water bore owner.
- A further **361 water bores are predicted to be impaired over the life of CSG industry**. These are referred to as long-term affected area (LAA) bores.
- About **92% of water bored predicted to be impacted are for stock and domestic purposes**. The majority are in the Walloon Coal Measure targeted by tenure holders, or the Springbok Sandstone. Fewer than 1% are in recognised aquifers of the Great Artesian Basin and none are in the Condamine Alluvium.

[15] Page 46 of 'Gas Guide 2.0' (https://www.gfcq.org.au/resource-hub/the-gas-guide/) – Make Good

Figure 18. Predicted impacts to water bores in the Surat CMA

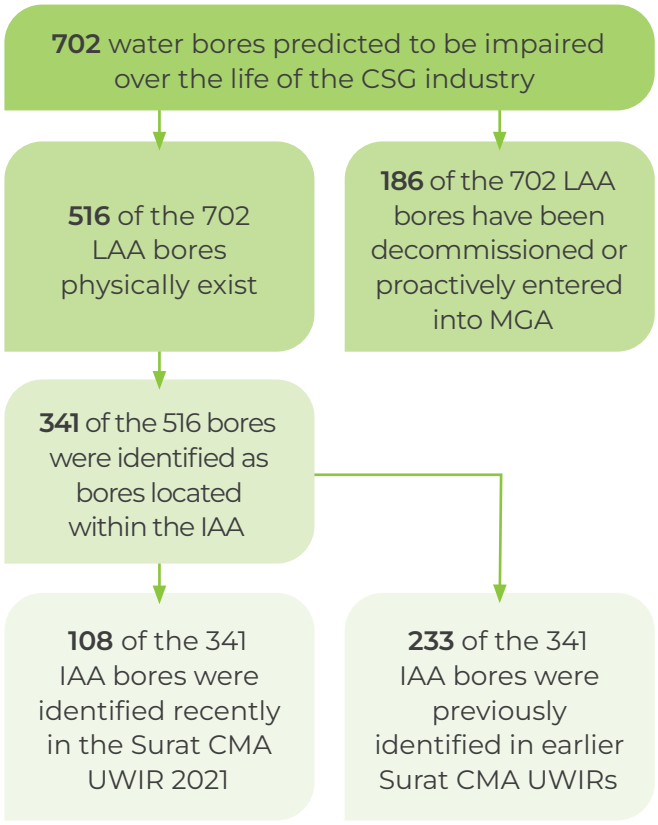


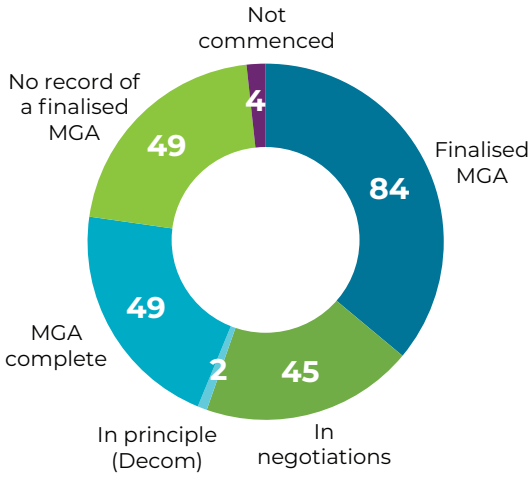
Table 9. Tracking of changes to IAA bores

Period	Added	Removed	Net IAA bores (running total)
UWIR 2012	85	-	85
Post-UWIR	10	25	70
UWIR 2016	57	-	127
Post-UWIR	1	6	122
UWIR 2019	100	-	222
Post-UWIR	13	2	**233**
UWIR 2021	108	-	341

Of the **233 net IAA bores:**

- Bore assessments have so far been completed for 170 water bores as the first step towards MGAs, while 45 bore assessments are outstanding.

Figure 19. Make Good status of the 233 net IAA bores



- MGAs have been successfully negotiated for 135 of the IAA bores. In some instances, MGAs were reached without bore assessments.
  - Make good measures may include one or more elements based on specific circumstances relating to the affected water bore. Types of make good measures include ongoing monitoring, additional local-scale assessment, rework/modification of existing water bore infrastructure, drilling of a replacement water bore in a non-affected formation, provision of an alternate water supply and financial compensation.
- Make good is currently under negotiation for 45 bores, while 53 are outstanding (not started/no record).
- 117 water bores have so far been decommissioned or agreed to be decommissioned primarily as a result of MGAs.
- A number of supplementary agreements have been signed through proactive initiatives by some resource companies for bores yet to be identified as IAA bores.

The type of MGA is based on individual circumstances. For example, for landholder bores that are distal to current operations, a monitoring agreement may be a suitable make good measure until (and if) impairment occurs. For landholder bores with no capacity, a no impairment (no make good measure) agreement is reasonable.

Details about prediction of impacts for a water bore located within the Surat CMA, including whether the water bore is an IAA or LAA bore, along with magnitude and timing of impacts, is provided by OGIA in a web based 'Bore Search Tool'.

Outside the Surat CMA, underground water impact reports (UWIRs) are prepared by individual resource tenure holders. At the time of writing, 22 have been approved by DES and are available on their website. In other areas where only exploration has occurred to date, UWIR is not required as the activity has not reached the stage of taking associated water during testing.

Groundwater monitoring data provides important information for impact modelling and predictions as part of UWIRs. Consistently obtained groundwater levels and quality measurements over time can provide valuable insights into how particular aquifers are functioning, and collectively assess the groundwater system. Details of the existing groundwater monitoring networks can be viewed on the Commission's website.

Beneficial Use

An estimated total of more than 365,000 ML of treated associated water has been beneficially used between July 2015 and June 2021.

Figure 20 shows the distribution of use of associated water over the last six financial years, with the dominant beneficial use being irrigation.

A small portion of associated water is used for purposes such as discharge into watercourses or used in petroleum and gas operational activities.

In FY21 the majority of associated water was treated and discharged into water courses for beneficial use.

Figure 20. Volume of associated water used beneficially for various purposes from FY16 to FY21