

Supplementary Material

Technology review of the Northern Bowen and Galilee basins

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Literature Review

Well completion design

Miyazaki provided a summary on the history of CSG (Coal Seam Gas) and CMM (Coal Mine Methane) in Australia and projections on supply (Miyazaki, 2005). There was a section in this review that discussed technical challenges; however, this work mainly focused on production, reserve forecasts and supply contract figures without providing well designs or completion information. The Queensland state government published a book, *Geology of Queensland*, in 2013 (Jell, 2013), primarily covering geology and the history of petroleum activities in Queensland; again, it did not provide information on well designs or completions. In 2014, Johnson and Mazumder outlined key geological factors and technical factors for successful developments in both the Surat and Bowen Basins (Johnson Jr. & Mazumder, 2014). This work focused on key geological and reservoir variables underlying specific field completion techniques, production behaviours, and technical differences relative to North American coals. Finally, in 2016, the Centre for Natural Gas provided an overview of the CSG development in Queensland (Towler, et al., 2016). The paper discussed the history of natural gas in Queensland along with the geological settings and several challenges faced by the Queensland CSG industry including fines generation, two-phase flow, social license-to-operate, and commercial factors.

Mine pre-drainage activities

Coal mining pre-drainage activities have advanced the understanding of CSG productivity and technical advancements in the both the Bowen and Sydney Basins. Examples of this include:

- Vertical drain holes and early CSG studies in mine pre-drainage developed strategies that were implemented in early pilots in the Moranbah, Moura/Dawson River, Peat/Scotia, and Fairview/Durham Ranch areas (Gray, 1983, 1987a, 1987b).
- SIS wells have been used in mine pre-drainage in the Oaky Creek, Grasree, and Moranbah North areas since the early-2000s.
- In the Central Colliery area, hydraulic fracturing and mine back studies were performed, which aided the understanding of hydraulic fracturing in Bowen Basin coals (R. G. Jeffrey, et al., 1992).
- Recently, indirect hydraulic fracturing techniques inside pre-existing SIS patterns, have been trialled in the Goonyella Middle (GM) seam at Anglo's Moranbah North mine (R. L. Johnson, et al., 2021). This technology could enable indirect, hydraulic fracture wells to interconnect and reduce compartmentalization within patterns of existing SIS wells, potentially extending higher recovery to lower permeability areas.

Galilee Basin Area B Gilmore gas field

Further information on the Gilmore gas field can be found in the work by Benstead (1972), Brand (1993) and de Boer (1996).

There is a significant body of literature regarding the production assets in the Denison Trough. This includes the work by Brown (1977), Paten et al (1979), Brown et al (1983), Elkington (1988), Riley (1989), Edgar (1997) and Anthony (2004).

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Supplementary Table 1 – Galilee Basin Area A Summary

Permit number	Permit status	Permit sub-status	Lodge date	Grant date	Expiry date	Authorised holder name	Operator	Permit name	Comments
ATP 743	Granted	Renewal Lodged	18-Mar-03	2-Sep-09	3-Sep-21	COMET RIDGE GALILEE PTY LTD	Comet Ridge		Refer to PCA319.
ATP 744	Granted	Renewal Lodged	18-Mar-03	15-Oct-09	31-Oct-21	COMET RIDGE GALILEE PTY LTD	Comet Ridge		Refer to PCA320, PCA321 and PCA322.
ATP 813	Granted	Renewal Lodged	17-Nov-04	2-Feb-06	28-Feb-18	EUREKA PETROLEUM PTY LTD	Blue Energy		Refer to PCA202, PCA203, PCA205, PCA211, PCA210, PCA204, PCA212, PCA209 and PCA208.
ATP 1015	Granted	None	4-Aug-08	25-Nov-10	30-Nov-22	COMET RIDGE GALILEE PTY LTD	Comet Ridge		Refer to PCA323 and PCA324 plus two other areas with no activity to date.
ATP 2019	Granted	None	31-Oct-16	28-Nov-16	30-Nov-24	CAPRICORN ENERGY PTY LTD	Galilee Energy	Glenaras Gas Project	Refer to PCA314 and PCA315.
PCA 315	Granted	None	9-Sep-20	21-Dec-20	20-Dec-30	CAPRICORN ENERGY PTY LTD	Galilee Energy	Potential Commercial Area - PCA1	Two other wells drilled by Longreach Oil in 1969 (Rand 1 P&A) and Phillips Petroleum in 1966 (Glenaras 1 P&A). 35 CSG wells, 5 Rodney Creek and Crossmore wells drilled by Enron Exploration Australia in 1993 to 1995, 5 Rodney Creek wells drilled by Galilee Energy in 2000 to 2007, 12 drilled by AGL in 2008 to 2011 (8 Glenaras, Vera Park 1, Crossmore South 1, Laugharne Creek 1 and Acacia 1) and 13 Glenaras wells drilled by Galilee Energy in 2018 to 2020.
PCA 314	Granted	None	9-Sep-20	21-Dec-20	20-Dec-35	CAPRICORN ENERGY PTY LTD	Galilee Energy	Potential Commercial Area - PCA2	One other well drilled by Pelsart Oil in 1969 (Muttaborra 1 P&A) and 1 CSG well drilled by AGL in 2009 (Muttaborra 2 P&A).
PCA 208	Application	None	4-Jan-18			EUREKA PETROLEUM PTY LTD	Blue Energy	PCA 1	2 CSG wells drilled by Blue Energy in 2009 to 2010 (Kanaka 1 P&A and Stainbury Downs 1 suspended).
PCA 209	Application	None	4-Jan-18			EUREKA PETROLEUM PTY LTD	Blue Energy	PCA 2	No activity to date.
PCA 204	Application	None	5-Jan-18			EUREKA PETROLEUM PTY LTD	Blue Energy	PCA 4	No activity to date.
PCA 210	Application	None	4-Jan-18			EUREKA PETROLEUM PTY LTD	Blue Energy	PCA 5	No activity to date.
PCA 211	Application	None	5-Jan-18			EUREKA PETROLEUM PTY LTD	Blue Energy	PCA 6	1 CSG well drilled by Blue Energy in 2010 (Ballyneety 1 P&A).
PCA 202	Application	None	5-Jan-18			EUREKA PETROLEUM PTY LTD	Blue Energy	PCA 7	No activity to date.
PCA 205	Application	None	5-Jan-18			EUREKA PETROLEUM PTY LTD	Blue Energy	PCA8	1 CSG well drilled by Blue Energy in 2008 (Carolina 1 P&A).

PCA 203	Application	None	5-Jan-18			EUREKA PETROLEUM PTY LTD	Blue Energy	PCA 9	No activity to date.
PCA 212	Application	None	4-Jan-18			EUREKA PETROLEUM PTY LTD	Blue Energy	PCA 3	2 CSG wells drilled by Blue Energy in 2010 and 2013 (Myross 1 P&A and Stagmount 1 converted to a water bore).
PCA 319	Application	None	4-Aug-21			COMET RIDGE GALILEE PTY LTD	Comet Ridge	ATP 743 Koburra PCA	One other well drilled in 1970. P&A.
PCA 320	Application	None	10-Aug-21			COMET RIDGE GALILEE PTY LTD	Comet Ridge	ATP 744 - Albany PCA	Four other wells drilled by Maple Oil in 1995 (Carmichael 1 P&A) and Comet Ridge in 2018 to 2019 (Albany wells) plus 1 CSG well (Montani 1) drilled by Comet Ridge in 2010 (P&A).
PCA 322	Application	None	29-Sep-21			COMET RIDGE GALILEE PTY LTD	Comet Ridge	GUNN PCA	One other well (Lake Galilee 1) drilled by Exoil in 1964 (P&A) and 3 CSG wells drilled by Comet Ridge in 2010 to 2012 (Hergenrother 1 and Gunn 1 and 2).
PCA 321	Application	None	29-Sep-21			COMET RIDGE GALILEE PTY LTD	Comet Ridge	Schmitt East PCA	No activity to date.
PCA 323	Application	None	21-Oct-21			COMET RIDGE GALILEE PTY LTD	Comet Ridge	Schmitt PCA	2 CSG wells drilled by Comet Ridge in 2012 (Cernan 1 and Schmitt 1).
PCA 324	Application	None	21-Oct-21			COMET RIDGE GALILEE PTY LTD	Comet Ridge	Ophir	One other well drilled by Enron Exploration Australia in 1993 (P&A) and 3 CSG wells drilled by Queensland Energy Resources in 2012 to 2014 (Ophir wells, P&A).

Supplementary Table 2 – Galilee Basin Area B Summary

Permit number	Permit status	Permit sub-status	Lodge date	Grant date	Expiry date	Authorised holder name	Operator	Permit name	Comments
ATP 1069	Granted	None	27-Sep-10	24-Jan-13	31-Jan-25	TOMORROW ENERGY CORPORATION PTY LTD			1 CSG well Barwinock 2 drilled by Tri-Star in 2019. Target Bandanna Formation and Betts Creek Beds of the Galilee Basin. The well is cased and suspended with 7" casing to 1631mRT and 6-1/8" open hole below this to TD at 1720mRT. It was an offset to another well, Barwinock 1 drilled in 1988. Primary target was Triassic and Permian sequences of the Galilee Basin. The well was plugged back to 1306m and converted to a water bore.
ATP 1072	Granted	None	27-Sep-10	24-Jan-13	31-Jan-23	EASTERN GAS HOLDINGS PTY LTD	Northstar Energy		No activity to date in the bit overlapping the Galilee Basin.
ATP 2039	Granted	None	31-May-18	29-Nov-19	28-Nov-25	CHI OIL AND GAS PTY LTD	Chi Oil and Gas	ATP PLR201818-2-1	Two other wells, one in, one just outside the tenement drilled by Phillips Petroleum Company in 1961-1962. <ul style="list-style-type: none"> • Gumbardo 1 looking to test Palaeozoic formations of the Adavale Basin. Core was cut. 5 DSTs. • Buckabie 1 Core and 5 DSTs. One other well, Paradise 1 in the tenement drilled by Icon Oil Drilling Company in 1998 to test the Lissoy Sandstone (which was absent). All three wells were plugged and abandoned at the time of drilling.
PL 65	Granted	None	23-Dec-92	16-Dec-93	15-Dec-29	AUSTRALIAN GASFIELDS LIMITED	Australian Gasfields Limited		Gilmore field first drilled in the 60s. Also, Phfarlet wells drilled in 80s and 90s.

Supplementary Table 3 – Northern Bowen Basin Area A Summary

Permit number	Permit status	Permit sub-status	Lodge date	Grant date	Expiry date	Authorised holder name	Operator	Permit name	Comments
PCA 129	Granted	None	28-Feb-13	11-Aug-14	10-Aug-29	BOW CSG PTY LTD	Arrow Energy		9 CSG wells, 7 drilled by Arrow from 2012 to 2013 (All WL wells and P&A), 1 drilled by Bow in 2010 (DY 3 P&A) and 1 drilled by CH4 in 2004 (CX 4 suspended).
PCA 130	Granted	None	28-Feb-13	11-Aug-14	10-Aug-29	BOW CSG PTY LTD	Arrow Energy		No activity to date.
PCA 131	Granted	None	28-Feb-13	11-Aug-14	10-Aug-29	BOW CSG PTY LTD	Arrow Energy		12 CSG wells, 10 drilled by Arrow from 2012 to 2013 (PY, 9 of 10 P&A) and 2 drilled by Bow in 2010 (VM 2 and NW 12 P&A).
PCA 132	Granted	None	28-Feb-13	11-Aug-14	10-Aug-29	BOW CSG PTY LTD	Arrow Energy		14 CSG wells, 12 drilled by Arrow from 2012 to 2013 (VM, WL and DY, all P&A) and 2 drilled by Bow in 2009 to 2010 (VM 1 and 2 P&A).
PCA 133	Granted	None	28-Feb-13	11-Aug-14	10-Aug-29	BOW CSG PTY LTD	Arrow Energy		14 CSG wells, 13 drilled by Arrow from 2010 to 2013 (NW and PY, 12 of 13 P&A) and 1 drilled by Bow in 2010 (NW 2 P&A).
PCA 135	Granted	None	5-Aug-13	4-Dec-14	3-Dec-29	CH4 PTY LTD	Arrow Energy	GERMAN CREEK NORTH	1 CSG well drilled by Arrow in 2011. GC 003C P&A.
PCA 136	Granted	None	5-Aug-13	4-Dec-14	3-Dec-29	CH4 PTY LTD	Arrow Energy	GERMAN CREEK SOUTH	1 CSG well (GC 001C) drilled by Arrow in 2011. P&A.
PCA 138	Granted	None	8-Aug-13	19-Aug-14	18-Aug-29	CH4 PTY LTD	Arrow Energy	KEMMIS CREEK EAST	No activity to date.
PCA 139	Granted	None	23-Aug-13	4-Dec-14	3-Dec-29	CH4 PTY LTD	Arrow Energy	NORWICH PARK	8 CSG wells drilled by Arrow from 2011 to 2013. All NP wells and 7 of 8 P&A.
PCA 140	Granted	None	1-Oct-13	19-Aug-14	18-Aug-29	CH4 PTY LTD	Arrow Energy	KEMMIS CREEK	12 CSG wells, 10 drilled by Arrow from 2009 to 2022 and 2 drilled by MGC Resources in 1991 to 1993. Arrow wells are KC and Kemmis Creek, MGC Resources wells are Carborough 1 (P&A) and Kemmis Creek 1 (Suspended).
PCA 141	Granted	None	3-Oct-13	15-Sep-14	14-Sep-29	CH4 PTY LTD	Arrow Energy	COXENDEAN EAST	12 CSG wells drilled by CH4 and Arrow from 2004 to 2011. All CX wells with 9 of 12 P&A.
PCA 142	Granted	None	3-Oct-13	21-Aug-14	20-Aug-29	CH4 PTY LTD	Arrow Energy	MAVIS DOWNS NORTH	3 CSG wells drilled by North Queensland Energy in 1990 (Harrybrandt 1 P&A), CH4 in 2005 (SW10 P&A) and Arrow in 2022 (Mavis Downs 10).
PCA 143	Granted	None	11-Oct-13	8-May-20	7-May-27	CH4 PTY LTD	Arrow Energy	PEAK DOWNS NORTH	15 CSG wells, 11 drilled by CH4 and Arrow from 2004 to 2012, 3 drilled by North

									Queensland Energy in 1989 (all P&A) and 1 drilled by MGC Resources in 1993 (P&A). Arrow wells are PD wells (9 of 11 P&A).
PCA 144	Granted	None	11-Oct-13	17-Oct-14	16-Oct-29	CH4 PTY LTD	Arrow Energy	PEAK DOWNS SOUTH	29 CSG wells, 28 drilled by Arrow from 2009 to 2013 and 1 drilled by MGC Resources in 1993. Arrow wells are PD wells (12 of 28 P&A), MGC Resources well was Ripstone 1 (P&A).
PCA 145	Granted	None	16-Oct-13	19-Aug-14	18-Aug-29	CH4 PTY LTD	Arrow Energy	SOUTH WALKER	36 CSG wells, 35 drilled by CH4 and Arrow from 2004 to 2008 and 1 drilled by MGC Resources in 1991. Arrow wells are SW, MB, and HY wells, MGC Resources well was Strathfield 1 (P&A).
PCA 146	Granted	None	21-Oct-13	19-Aug-14	18-Aug-29	CH4 PTY LTD	Arrow Energy	LANCEWOOD	16 CSG wells drilled from 2008 to 2014 including Lancewood, LW and SC wells.
PCA 147	Granted	None	4-Nov-13	19-Aug-14	18-Aug-29	CH4 PTY LTD	Arrow Energy	WARDS WELL EAST	2 CSG wells, one drilled by MGC Resources in 1992 that is cased and suspended (Glenden 1) and one drilled by Arrow in 2010 (WB 5P) that is P&A.
PCA 148	Granted	None	4-Nov-13	19-Aug-14	18-Aug-29	CH4 PTY LTD	Arrow Energy	SUTTOR CREEK	17 CSG wells drilled from 1989 to 2010 including Suttor Creek and SC wells.
PCA 149	Granted	None	4-Nov-13	19-Aug-14	18-Aug-29	CH4 PTY LTD	Arrow Energy	ELLENSFIELD	12 CSG wells drilled by Arrow from 2012 to 2013. All EF wells.
PCA 150	Granted	None	4-Nov-13	21-Aug-14	20-Aug-29	CH4 PTY LTD	Arrow Energy	WEST BURTON	16 CSG wells drilled from 1991 to 2013 including WB, Ellensfield, EF and Burton.
PCA 151	Granted	None	20-Nov-13	21-Aug-14	20-Aug-29	CH4 PTY LTD	Arrow Energy	COXENDEAN WEST	23 CSG wells drilled by CH4 and Arrow from 2009 to 2013 including CX and OD wells. 10 of 23 are P&A.
PCA 152	Granted	None	20-Nov-13	21-Aug-14	20-Aug-29	CH4 PTY LTD	Arrow Energy	MAVIS DOWNS SOUTH	36 CSG wells drilled by CH4 and Arrow from 2009 to 2013 including CX, MD and OD wells. 17 of 36 are P&A, one well (CX 17LL2VR) has a status of unknown.
PCA 199	Granted	None	18-Dec-17	22-Jul-20	21-Jul-27	EUREKA PETROLEUM PTY LTD	Blue Energy	South	No activity to date.
PCA 201	Granted	None	18-Dec-17	22-Jul-20	21-Jul-27	EUREKA PETROLEUM PTY LTD	Blue Energy	Hillalong	No activity to date.
PCA 213	Granted	None	21-Feb-18	22-Jul-20	21-Jul-27	EUREKA PETROLEUM PTY LTD	Blue Energy	Monslatt	12 Monslatt CSG wells drilled by Blue Energy in 2009 to 2011.
PCA 260	Granted	None	30-Oct-18	8-May-20	7-May-27	CH4 PTY LTD	Arrow Energy	Cerito	6 CSG wells (Cerito and Newlands) drilled by Arrow in 2014 to 2015. All P&A.
PCA 266	Granted	None	30-Oct-18	8-May-20	7-May-27	CH4 PTY LTD	Arrow Energy	Newlands	1 CSG well (Byerwen 1) drilled by Arrow in 2014. P&A.
PCA 255	Granted	None	30-Oct-18	8-May-20	7-May-27	CH4 PTY LTD	Arrow Energy	Moranbah South	19 CSG wells, 17 drilled by CH4 and Arrow from 2003 to 2012 and 2 drilled by MGC

									Resources in 1993 to 1994. Arrow wells are PD wells (11 of 17 P&A). MGC Resources wells are River Paddock 1 (P&A) and River Paddock 2 (Suspended).
PCA 265	Granted	None	30-Oct-18	8-May-20	7-May-27	CH4 PTY LTD	Arrow Energy	Red Hill East	20 CSG wells drilled by CH4 and Arrow Energy from 2002 to 2022 including WW, WB, RH and Red Hill wells.
PCA 257	Granted	None	30-Oct-18	8-May-20	7-May-27	CH4 PTY LTD	Arrow Energy	Red Hill South	14 CSG wells drilled by CH4 and Arrow Energy from 2004 to 2022 including EF, RH and Red Hill wells.
PCA 262	Granted	None	30-Oct-18	8-May-20	7-May-27	CH4 PTY LTD	Arrow Energy	Saraji North	23 CSG wells, 22 drilled by CH4 and Arrow from 2009 to 2013 and 1 drilled by MGC Resources in 1993. Arrow wells are SR, NP, PD and SJ wells (20 of 22 P&A), MGC Resources well was Phillips Creek 1 (P&A).
PCA 263	Granted	None	30-Oct-18	8-May-20	7-May-27	CH4 PTY LTD	Arrow Energy	Saraji South	13 CSG wells drilled by Arrow from 2009 to 2012 including SJ, SRJ and NP wells. 7 of 13 P&A.
PCA 258	Granted	None	30-Oct-18	27-Mar-20	26-Mar-25	CH4 PTY LTD	Arrow Energy	Wards Well	21 CSG wells, 20 drilled by Arrow from 2009 to 2010 and 1 drilled by MGC Resources in 1992. All Arrow wells are WW, MGC Resources well is Dabbin Holding 1. All 21 P&A.
PCA 259	Granted	None	30-Oct-18	8-May-20	7-May-27	ARROW ENERGY PTY LTD	Arrow Energy	Codrilla	4 CSG wells drilled by Arrow in 2008 to 2012. CO and Codrilla wells. All P&A.
PCA 286	Granted	None	15-Feb-19	17-Nov-20	16-Nov-35	AIRLIE ENERGY PTY LTD	Airlie Energy	Tilbrook	16 Tilbrook and Bald Hills wells drilled by Westside in 2004 to 2009.
PCA 284	Granted	None	15-Feb-19	17-Nov-20	16-Nov-35	AIRLIE ENERGY PTY LTD	Airlie Energy	Mount St. Martin - B	1 Mount Saint Martin CSG wells drilled by Westside in 2010. P&A.
PCA 285	Granted	None	15-Feb-19	17-Nov-20	16-Nov-35	AIRLIE ENERGY PTY LTD	Airlie Energy	Mount Leslie	1 Mount Leslie CSG wells drilled by Westside in 2010. P&A.
PCA 287	Granted	None	15-Feb-19	17-Nov-20	16-Nov-35	AIRLIE ENERGY PTY LTD	Airlie Energy	Mount St. Martin - A	6 Mount Saint Martin CSG wells drilled by Westside in 2009 to 2010. 3 P&A and 3 cased and suspended.
PCA 330	Application	None	22-Jun-22			NEW SOUTH OIL PTY LTD	QGC	PCA 1 ATP811	5 Foxleigh CSG wells drilled by QGC in 2011 to 2013. All still active.
ATP 688	Granted	None	27-Mar-00	26-Feb-03	28-Feb-31	AIRLIE ENERGY PTY LTD	Airlie Energy		Refer to PCA284, PCA285, PCA286 and PCA287.
ATP 742	Granted	None	19-Jun-02	14-Feb-13	28-Feb-25	CH4 PTY LTD	Arrow Energy		Refer to PCA266 and PCA260.
ATP 759	Granted	None	3-Mar-03	19-Oct-04	31-Oct-24	ARROW ENERGY PTY LTD	Arrow Energy		Refer to PCA259.
ATP 811	Granted	Renewal Lodged	4-Nov-04	9-Dec-05	31-Aug-22	NEW SOUTH OIL PTY LTD	QGC		Refer to PCA330.

ATP 814	Granted	Renewal Lodged	17-Nov-04	2-Feb-06	28-Feb-18	EUREKA PETROLEUM PTY LTD	Blue Energy		Includes the areas for PCA213, PL1038, PL1034, PCA201, PCA199, PL1045 and 1 other area that has no activity to date.
ATP 1031	Granted	None	4-Aug-08	24-Feb-09	10-Aug-29	BOW CSG PTY LTD	Arrow Energy		Refer to PCA130, PCA133, PCA131, PCA132 and PCA129.
ATP 1103	Granted	None	10-Dec-10	23-Dec-10	31-Dec-25	CH4 PTY LTD	Arrow Energy		Includes PCA136, PCA135, PCA139, PCA263, PCA262, PCA144, PCA151, PCA141, PCA152, PCA142, PCA255, PL485, PCA143, PCA145, PCA149, PCA257, PCA140, PCA138, PCA150, PCA147, PCA265, PCA258, PCA146, PCA148 and parts of PL486.
PL 191	Granted	None	7-Dec-01	21-Mar-02	20-Mar-32	CH4 PTY LTD	Arrow Energy		684 CSG wells, 665 drilled by CH4 and Arrow from 2000 to 2022. Arrow wells are M, Moranbah, GR, GM, Q, Grosvenor, and P wells, 11 Broadmeadow wells drilled by C B Resources in 1987 to 1988, 5 Broadwater wells drilled by North Queensland Energy in 1989 and 3 wells drilled by MGC Resources from 1992 to 1993 (Teviot Brook 1, Broadmeadow 14, and Moranbah 1).
PL 196	Granted	None	29-Oct-02	16-Dec-04	15-Dec-24	CH4 PTY LTD	Arrow Energy		66 CSG wells, 65 drilled by CH4 and Arrow from 2003 to 2007 and 1 drilled by MGC Resources in 1994. Arrow wells are GR, GM, P, GML, M and TRD wells (1 well P&A and 8 with unknown status), MGC Resources well was Moranbah 2 (suspended).
PL 223	Granted	None	14-Oct-04	16-Dec-04	15-Dec-24	CH4 PTY LTD	Arrow Energy		23 CSG wells, 18 drilled by CH4 and Arrow from 2004 to 2011 and 5 drilled by MGC Resources in 1992 to 1994. All Arrow wells are AN, MGC Resources wells are Wontonga 1, Annandale 1 to 3 and Smoky Creek 1. 9 of 23 are P&A.
PL 224	Granted	None	14-Oct-04	18-Jun-08	30-Jun-28	CH4 PTY LTD	Arrow Energy		19 CSG wells drilled by CH4 and Arrow from 2004 to 2009. All M wells except one DDG 103. 2 of 19 P&A and 7 with unknown status.
PL 485	Granted	None	19-Jul-12	10-Dec-14	9-Dec-44	SOUTH32 EAGLE DOWNS PTY LTD	South32		1 Arrow CSG well (PD 44C) drilled in 2010. P&A.
PL 486	Granted	None	9-Aug-12	21-Dec-18	20-Dec-48	ARROW CSG (ATP 364) PTY LTD	Arrow Energy		78 CSG wells drilled by CH4 and Arrow from 2004 to 2020. Wells are RH, Red Hill and 1 GR. 35 of 78 P&A and 4 with unknown status.
PL 504	Granted	None	14-Feb-14	3-Dec-15	2-Dec-41	PEABODY (BOWEN) PTY LTD	Peabody		No activity to date.

PL 1015	Granted	None	21-Jul-16	5-Feb-18	4-Feb-48	PEABODY COPPABELLA PTY LTD	Peabody	Coppabella	No activity to date.
PL 1034	Application	None	9-Jun-17			EUREKA PETROLEUM PTY LTD	Blue Energy	Sapphire PL	6 CSG wells (Sapphire and GR 59) drilled by Arrow and Blue Energy in 2007 to 2011. P&A except for 2 wells.
PL 1038	Application	None	27-Oct-17			EUREKA PETROLEUM PTY LTD	Blue Energy	Central	1 CSG well (Kerlong 1) drilled by Blue Energy in 2010. Cased and suspended.
PL 1045	Application	None	20-Dec-17			EUREKA PETROLEUM PTY LTD	Blue Energy	Lancewood	No activity to date.

Supplementary Table 4 – Northern Bowen Basin Area B Summary

Permit number	Permit status	Permit sub-status	Lodge date	Grant date	Expiry date	Authorised holder name	Operator	Permit name	Comments
PCA 153	Granted	None	2-Dec-13	26-Jun-14	25-Jun-29	DENISON GAS (QUEENSLAND) PTY LTD	Denison Gas		2 CSG wells drilled by Santos in 2013 P&A, 2 conventional Yamala wells, 1 drilled by OCA in 1997 and 1 by Santos in 2005
PCA 154	Granted	None	2-Dec-13	26-Jun-14	25-Jun-29	DENISON GAS (QUEENSLAND) PTY LTD	Denison Gas		1 CSG well drilled by Santos in 2009 and 1 conventional well drilled by OCA in 1997
PCA 163	Granted	None	11-Apr-17	1-Sep-17	31-Aug-22	OME RESOURCES AUSTRALIA PTY. LTD.	QGC	PCAA 2	6 Dingonose and Summit wells drilled by QGC in 2008 to 2013.
PCA 162	Granted	None	11-Apr-17	1-Sep-17	31-Aug-22	BNG (SURAT) PTY. LTD.	QGC	PCA 8	5 Atria CSG wells drilled by Sunshine Gas in 2008. All P&A.
PCA 167	Granted	None	11-Apr-17	1-Sep-17	31-Aug-22	BNG (SURAT) PTY. LTD.	QGC	PCAA 9	4 Atria CSG wells drilled by Sunshine Gas in 2007/2008. All P&A.
PCA 256	Granted	None	30-Oct-18	27-Mar-20	26-Mar-35	BOW CSG PTY LTD	Arrow Energy	Blackwater North	21 CSG wells drilled by Bow/Arrow Energy in 2009 to 2013.
PCA 264	Granted	None	30-Oct-18	27-Mar-20	26-Mar-35	BOW CSG PTY LTD	Arrow Energy	Blackwater South	21 CSG wells drilled by Bow/Arrow Energy in 2009 to 2011 and 1 CSG well from MIM Holdings Ltd in 1992.
PCA 261	Granted	None	30-Oct-18	8-May-20	7-May-35	BOW CSG PTY LTD	Arrow Energy	Comet	3 CSG wells drilled by Bow/Arrow Energy in 2009 to 2010. All P&A.
PL 237	Granted	None	8-Feb-06	22-Jun-06	21-Jun-32	OAKY CREEK HOLDINGS PTY LIMITED	Glencore		1 CSG well drilled by OCA in 2001 P&A Overlays German Creek and Aquila
PL 324	Granted	Renewal Lodged	6-Jan-10	8-Feb-11	30-Jun-20	OAKY CREEK HOLDINGS PTY LIMITED	Glencore		
ATP 684	Granted	Renewal Lodged	26-Nov-99	1-Aug-01	31-Jul-22	BNG (SURAT) PTY. LTD.	QGC		Refer to PCA162 and PCA167
ATP 758	Granted	Renewal Lodged	19-Sep-02	19-Oct-04	31-Aug-22	OME RESOURCES AUSTRALIA PTY. LTD.	QGC		Refer to PCA163/PCA331
ATP 806	Granted	Renewal Lodged	3-Mar-03	30-Apr-07	16-Jul-22	OME RESOURCES AUSTRALIA PTY. LTD.	QGC		Refer to PCA327 and PCA328
ATP 1025	Granted	None	4-Aug-08	24-Feb-09	28-Feb-33	BOW CSG PTY LTD	Arrow Energy		Refer to PCA261, PCA256 and PCA264
ATP 1177	Granted	None	22-Apr-13	29-Nov-13	30-Nov-25	DENISON GAS (QUEENSLAND) PTY LTD	Denison Gas		Refer to PCA153 and PCA154.
ATP 2063	Granted	None	9-Jul-20	7-May-21	6-May-27	COMET RIDGE MAHALO FAR EAST PTY LTD	Comet Ridge	no name	Only a small section in Area B with no activity to date. Refer to Area C for more.
PCA 327	Application	None	21-Jun-22			OME RESOURCES AUSTRALIA PTY. LTD.	QGC	ATP 806 PCA 1 WEST	1 CSG well drilled by QGC in 2011 and 3 CSG wells drilled by MIM Holdings Ltd in 1992 to

									1993. All P&A.
PCA 328	Application	None	21-Jun-22			OME RESOURCES AUSTRALIA PTY. LTD.	QGC	1 East ATP 806	46 CSG wells drilled by Pure Energy and QGC in 2007 to 2013. Includes Duckworth, Dingonose and Liberty. Also 1 CSG well drilled by MIM Holdings Ltd in 1992.
PCA 329	Application	None	22-Jun-22			BNG (SURAT) PTY. LTD.	QGC	1 ATP 684	Is a reapplication covering both PCA167 and PCA162.
PCA 331	Application	None	24-Jun-22			OME RESOURCES AUSTRALIA PTY. LTD.	QGC	1 WEST ATP758	Is a reapplication for PCA163.

Supplementary Table 5 – Northern Bowen Basin Area C Summary

Permit number	Permit status	Permit sub-status	Lodge date	Grant date	Expiry date	Authorised holder name	Operator	Permit name	Comments
PCA 112	Granted	None	22-Jul-11	26-Jun-14	25-Jun-29	SANTOS TOGA PTY LTD	Santos		3 CSG wells drilled by Santos in 2006 to 2012. 2 P&A, 1 cased and suspended (Glen Idol 1).
PCA 113	Granted	None	22-Jul-11	26-Jun-14	25-Jun-29	SANTOS TOGA PTY LTD	Santos		2 CSG wells drilled by Santos in 2007 to 2011. 1 P&A, 1 cased and suspended (Bundaburra 1).
PCA 215	Granted	None	28-Feb-18	17-May-19	16-May-34	BRONCO ENERGY PTY LIMITED	Santos	Red Rock Gully	2 CSG wells drilled by Santos in 2013 to 2018. All P&A.
PCA 298	Granted	None	19-Sep-19	8-Apr-20	7-Apr-25	SANTOS QNT PTY. LTD.	Santos	PURBROOK	3 conventional wells drilled in the 1960s and all P&A. 1 CSG well drilled by APLNG in 2012 (Comet River 2) P&A.
PCA 300	Granted	None	19-Sep-19	8-Apr-20	7-Apr-30	SANTOS QNT PTY. LTD.	Santos	INDERI	6 conventional wells drilled in the 1960s and 70s. All P&A.
PCA 301	Granted	None	19-Sep-19	8-Apr-20	7-Apr-30	SANTOS QNT PTY. LTD.	Santos	WARRINILLA NORTH	3 conventional Warrinilla and Warrinilla North wells. All P&A. 2 Checkers CSG wells drilled in 2009 to 2013.
PCA 302	Granted	None	19-Sep-19	8-Apr-20	7-Apr-25	SANTOS QNT PTY. LTD.	Santos	LOWESBY WEST	2 Sirius Road CSG wells drilled by Comet Ridge in 2018 to 2019.
PCA 303	Granted	None	19-Sep-19	8-Apr-20	7-Apr-25	SANTOS QNT PTY. LTD.	Santos	LOWESBY	1 conventional well.
PCA 304	Granted	None	24-Sep-19	8-Apr-20	7-Apr-25	SANTOS QNT PTY. LTD.	Santos	Humboldt Creek	1 conventional well and 1 CSG well.
PCA 317	Granted	None	30-Sep-20	24-Sep-21	23-Sep-31	SANTOS TOGA PTY LTD	Santos	PCA ATP 2012 (Dawson Block)	14 CSG wells drilled from 1994 to 2012 by Tri-Star, Tipperary, and Santos. Includes Basalt Creek, Basalt Creek North, Bungawarra and Dawson wells.
PCA 316	Granted	None	30-Sep-20	24-Sep-21	23-Sep-31	SANTOS TOGA PTY LTD	Santos	PCA ATP 2012 (Mount Aldis Block)	2 Mount Aldis wells drill by Tipperary in 2002 to 2003.
ATP 745	Granted	None	3-Mar-03	13-Oct-03	31-Oct-23	SANTOS TOGA PTY LTD	Santos		Refer to PCA112 and PCA113.
ATP 804	Granted	None	3-Mar-03	23-Mar-06	31-Mar-30	BRONCO ENERGY PTY LIMITED	Santos		Refer to PCA215.
ATP 1079	Granted	None	27-Sep-10	17-Jan-13	31-Jan-25	TRI-STAR FAIRFIELDS PTY LTD	Tri-Star		1 deep gas well drilled in 2019 and 4 CSG wells drilled from 2002 to 2019. Fairfields wells.
ATP 1191	Granted	None	30-Jan-15	25-Sep-15	30-Sep-23	SANTOS QNT PTY. LTD.	Santos		Refer to PCA302, PCA303, PCA304, PCA300, PCA298, PCA301 and PL1062. There is also

									PCA299 that is further south.
ATP 2012	Granted	None	18-Aug-15	28-Sep-16	31-Oct-24	SANTOS TOGA PTY LTD	Santos	Name not supplied by Applicants	Refer to PCA316 and PCA317.
ATP 2050	Granted	None	8-Aug-19	19-Dec-19	31-Jan-26	GALILEE ENERGY SURAT PTY LTD	Galilee Energy	no name	7 conventional wells. 4 SH Cedar wells drilled in 2000. AGL Wandana 1 drilled in 1992 and 2 wells drilled by Santos in 2001 and 2005. All P&A or converted to water bores.
ATP 2049	Granted	None	8-Aug-19	21-May-20	20-May-26	DENISON GAS LIMITED	Denison Gas	No Name	4 conventional wells drilled from 1970 to 1999. All P&A or converted to water bores. 1 CSG well drilled by Origin in 2012. P&A. Targeting the Bandanna Formation and Kaloola Member.
ATP 2048	Granted	None	8-Aug-19	29-Apr-20	28-Apr-26	COMET RIDGE MAHALO NORTH PTY LTD	Comet Ridge	N/A	4 CSG wells. Two CSG wells, Mahalo North 1 and 2 drilled in 2021. 2 CSG wells, one drilled by Sunshine Gas in 2004 and one drilled by QGC in 2013. Both P&A. Sunshine Gas well (Luton 2) targeting the Bandanna and Mantuan coal seams. QGC well (Belle 1) targeting the late Permian Fair Hill Formation and early Permian Reids Dome beds. 6 conventional wells including 4 Zerogen wells drilled in 2006 to 2008 for CO2 storage trials.
ATP 2061	Granted	None	9-Jul-20	25-Sep-20	24-Sep-26	COMET RIDGE MAHALO EAST PTY LTD	Comet Ridge	no name	No activity to date.
ATP 2062	Granted	None	9-Jul-20	1-Oct-20	30-Sep-26	STATE GAS LIMITED	State Gas	No Name	2 conventional wells both P&A. 5 CSG wells, 3 drilled by Conoco in the 1990s and P&A, 2 Rougemont wells drilled by State Gas in 2021.
ATP 2063	Granted	None	9-Jul-20	7-May-21	6-May-27	COMET RIDGE MAHALO FAR EAST PTY LTD	Comet Ridge	no name	2 CSG wells drilled by MIM Holdings Ltd in 1992 targeting the Rangal Coal Measures. Both P&A.
ATP 2068	Granted	None	1-Mar-22	11-Jul-22	10-Jul-28	SANTOS QNT PTY. LTD.	Santos	no name	2 conventional wells drilled in the 1950s and 60s. Both P&A. 1 CSG well drilled by Santos in 2013 targeting the Bandanna Formation, P&A.
ATP 2069	Application	None	1-Mar-22			SANTOS QNT PTY. LTD.	Santos	no name	1 CSG well drilled by Santos in 2009 targeting the Bandanna Formation. P&A.
PL 41	Granted	None	26-May-89	15-Jun-89	31-Oct-24	DENISON GAS (QUEENSLAND) PTY LTD	Denison Gas		Old OCA conventional acreage - Arcturus and Springton. Also 1 Springton CSG well drilled in 2008.
PL 42	Granted	None	26-May-89	15-Jun-89	31-Oct-24	DENISON GAS	Denison Gas		Old OCA conventional acreage - Rolleston plus

						(QUEENSLAND) PTY LTD			1 Rolleston CSG well.
PL 54	Granted	None	6-Dec-90	28-Mar-91	31-Oct-24	DENISON GAS (QUEENSLAND) PTY LTD	Denison Gas		One conventional well (Moorooloo 1) drilled in 1984 by AAR Limited.
PL 67	Granted	None	12-May-93	24-Jun-93	31-Oct-24	DENISON GAS (QUEENSLAND) PTY LTD	Denison Gas		Old OCA conventional acreage - Turkey Creek plus 1 Turkey Creek CSG well.
PL 90	Granted	None	26-Apr-95	30-Nov-95	29-Nov-29	SANTOS TOGA PTY LTD	Santos		Very Northern part of Fairview. 6 CSG wells in the bit not overlapping with the Surat Basin. 5 Ironbark Gully wells and 1 Fairview well.
PL 219	Granted	None	1-Oct-04	16-Dec-04	15-Dec-54	AUSTRALIA PACIFIC LNG PTY LIMITED	Origin	Membrane	Origin Membrane drilled 2014 first well drilled in 2003
PL 220	Granted	None	1-Oct-04	16-Dec-04	15-Dec-54	AUSTRALIA PACIFIC LNG PTY LIMITED	Origin	Lonesome	1 conventional well drilled in the 1980s, P&A. 2 CSG wells drilled in the section not overlapping with the Surat Basin. 1 by Santos in 1993 and 1 by APLNG in 2014.
PL 231	Granted	None	6-May-05	15-Dec-05	14-Dec-35	STATE GAS LIMITED	State Gas		17 other wells such as Reids Dome and Nyanda. 5 recent CSG wells (Serocold, Nyanda and Aldinga East 1).
PL 233	Granted	None	14-Jun-05	15-Dec-05	31-Dec-35	SANTOS TOGA PTY LTD	Santos		Only a small section of the tenement does not overlap with the Surat Basin. No activity in this area.
PL 234	Granted	None	14-Jun-05	15-Dec-05	31-Dec-35	SANTOS TOGA PTY LTD	Santos		57 CSG wells including Kaimanna, Lonesome, Tarcoola Station and Hillyvale.
PL 235	Granted	None	14-Jun-05	15-Dec-05	31-Dec-35	SANTOS TOGA PTY LTD	Santos		Clematis Creek and New Country. 18 CSG wells drilled by Tipperary and Santos from 2002 to 2012.
PL 236	Granted	None	14-Jun-05	15-Dec-05	31-Dec-35	SANTOS TOGA PTY LTD	Santos		
PL 420	Granted	None	3-Sep-10	16-Sep-14	15-Sep-44	SANTOS TOGA PTY LTD	Santos		86 CSG wells including Hilltop, Castle Hill, Mount Kingsley, Arcadia, Bottle Tree and Sunnyholt.
PL 421	Granted	None	3-Sep-10	13-Oct-14	12-Oct-44	SANTOS TOGA PTY LTD	Santos		161 CSG wells including Castle Hill, Arcadia Valley, Linga Longa, Sunnyholt, Mount Kingsley, Bottle Tree, Kaimanna and Arcadia.
PL 440	Granted	None	29-Sep-10	16-Sep-14	15-Sep-44	SANTOS TOGA PTY LTD	Santos		Cattle Creek wells in the north, Mount Kingsley, and AC wells in the south.
PL 450	Granted	None	17-Dec-10	19-Sep-17	18-Sep-32	SANTOS QNT PTY. LTD.	Santos		6 conventional Warrinilla wells + 2 CSG wells
PL 451	Granted	None	17-Dec-10	19-Sep-17	18-Sep-32	SANTOS QNT PTY. LTD.	Santos		
PL 1017	Granted	None	26-Jul-16	30-Aug-21	29-Aug-51	SANTOS TOGA PTY LTD	Santos	Arcadia Branch	7 Arcadia Branch wells drill by Tipperary and Santos from 2002 to 2012.
PL 1059	Granted	None	17-Dec-18	23-Feb-22	22-Feb-52	SANTOS CSG PTY LTD	Santos	Towrie	2 conventional wells drilled in the 1930s and 50s. Both P&A. 1 CSG well drilled by Santos in 2019 targeting the Bandanna Formation,

									then cased and suspended.
PL 1083	Granted	None	4-Sep-19	30-Jun-20	29-Jun-50	AUSTRALIA PACIFIC LNG PTY LIMITED	Origin	Mahalo	1 conventional well drilled in the 1960s, P&A. 11 CSG wells drilled from 2004 to 2018 including Mahalo and Struan.
PL 1082	Granted	None	4-Sep-19	30-Jun-20	29-Jun-50	AUSTRALIA PACIFIC LNG PTY LIMITED	Origin	Humboldt	11 CSG wells drilled from 2006 to 2018 including Mira, Scrubber Gully, and Humboldt/Humboldt South.
PL 1086	Granted	None	25-Oct-19	12-Apr-21	11-Apr-26	DENISON GAS (QUEENSLAND) PTY LTD	Denison Gas	No Name	Old OCA conventional acreage - Yandina
PL 1062	Application	None	4-Jan-19			SANTOS QNT PTY. LTD.	Santos	Arcadia West	5 exploration appraisal CSG wells drilled by Santos from 2011 to 2014.

Supplementary Table 6 – Northern Bowen Basin Area D Summary

Permit number	Permit status	Permit sub-status	Lodge date	Grant date	Expiry date	Authorised holder name	Operator	Permit name	Comments
PL 1050	Application	None	30-Apr-18			WestSide Mungi Pty Limited	Westside	Theodore	6 CSG wells drilled by C B Resources, MIM Holdings, OCA, Anglo Coal, Lowell Petroleum and Harcourt Petroleum from 1988 to 2013. Includes Kianga Creek 1, Banana, HR, and Harcourt wells.
PL 1061	Application	None	21-Dec-18			WestSide Mungi Pty Limited	Westside	Timmy	10 CSG wells drilled by Conoco Australia, OCA, and Lowell Petroleum from 1995 to 2012. Includes Timmy wells, Gunyah 1, Tim Shay 1 and Isla 1.
PCA 196	Granted	None	24-Oct-17	20-Dec-17	19-Dec-22	WESTSIDE ATP 769P PTY LTD	Westside	Paranui Project, ATP769P	16 CSG wells drilled by MIM Holdings, Conoco Australia, Westside and QGC from 1995 to 2013. Includes Paranui wells and Thisit 1. 13 of 16 P&A.
ATP 602	Granted	None	28-Jul-94	13-Dec-94	31-Dec-18	WestSide Mungi Pty Limited	Westside		Refer to PL1061.
ATP 769	Granted	None	6-Nov-03	14-Nov-05	19-Dec-22	WESTSIDE ATP 769P PTY LTD	Westside		Refer to PCA196.
ATP 2027	Granted	None	7-Jun-17	13-Nov-17	30-Apr-18	WestSide Mungi Pty Limited	Westside	ATP 564 Replacement Tenure	Refer to PL1050.
ATP 2058	Granted	None	9-Jul-20	21-Jul-22	20-Jul-28	SENEX QLD EXPLORATION PTY LTD	Senex	no name	No activity to date.
PL 94	Granted	None	15-Dec-95	18-Apr-96	17-Apr-31	WESTSIDE CSG A PTY LTD	Westside		281 CSG wells and 1 other well. The other well, MR 54L looks to be incorrectly labelled, it is a CSG well.
PL 1048	Granted	None	12-Apr-18	20-Apr-20	19-Apr-50	WestSide Mungi Pty Limited	Westside	Mungi North	16 CSG wells drilled by C B Resources, MIM Holdings, OCA, Anglo, Lowell Petroleum and Harcourt Petroleum from 1988 to 2013. Includes Banana, Harcourt, and Kianga Creek 1. 10 of 16 P&A.
PL 1049	Granted	None	26-Apr-18	22-Sep-20	31-Aug-51	WestSide Mungi Pty Limited	Westside	Mungi West	12 CSG wells drilled by MIM Holdings, Conoco Australia, OCA, Origin Energy and Harcourt Petroleum from 1992 to 2013. Includes Banana, Kinma, Gibihi, Moura, Mungi, Bindaree 2 and Harcourt. 3 other wells drilled from 1969 to 1976.