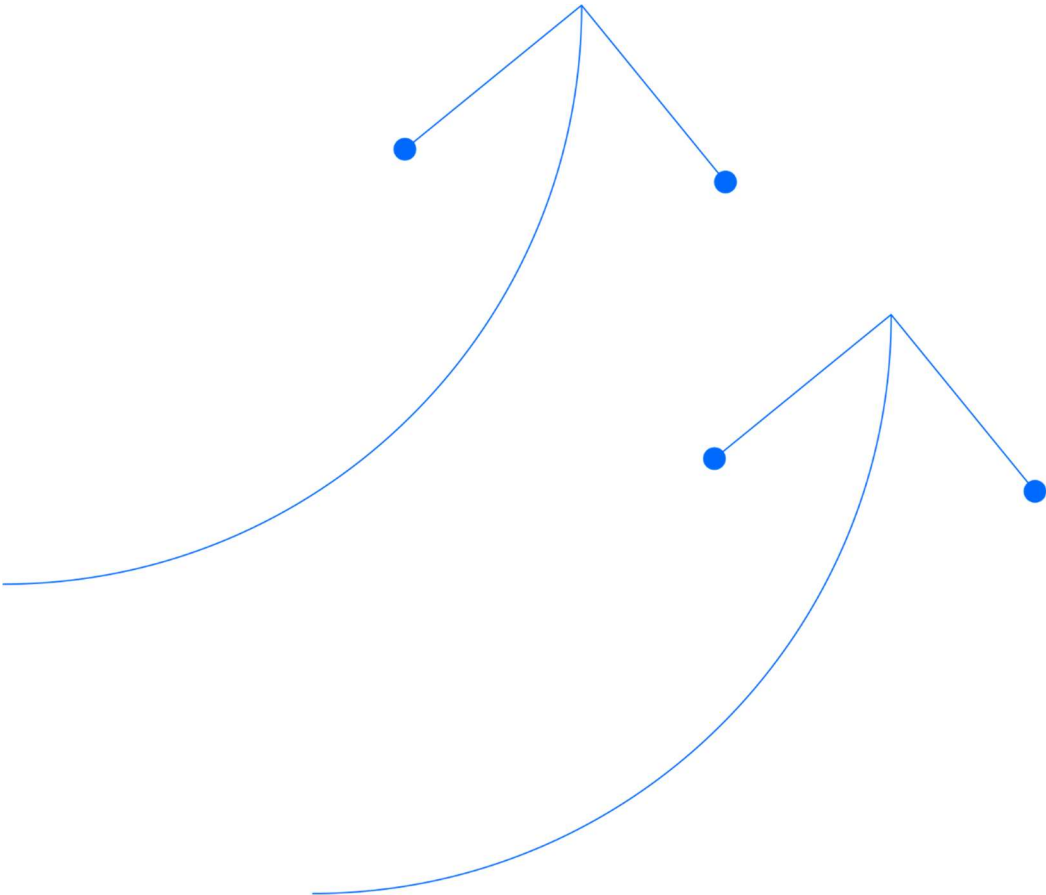


APPENDIX I: SURFACE WATER AND GROUNDWATER MANAGEMENT PLAN

April 2026



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1. Introduction

This Surface Water and Groundwater Management Plan (SWGMP) is in support of the EP 161 Beetaloo Basin Appraisal Activity Environmental Management Plan (EMP).

The *Code of Practice: Onshore Petroleum Activities in the Northern Territory* (Northern Territory Government, 2025) (The Code of Practice) provides a minimum standard that the onshore petroleum industry in the Northern Territory must adhere to. It applies to all regulated activities, including conventional and unconventional oil and gas exploration, appraisal, and production.

The Code of Practice frames the requirements for groundwater monitoring associated with conventional and unconventional oil and gas exploration, appraisal, development and production in the NT. The *Preliminary Guideline Groundwater Monitoring Bores for Exploration Petroleum Wells in the Beetaloo Sub-basin* (Department of Natural Resources, 2018) is referred to as the Preliminary Groundwater Guideline throughout this Plan.

1.1. Purpose of report

The report was prepared to set out the water resources monitoring requirements for the Project in accordance with the requirements of the Code of Practice and the Preliminary Groundwater Guideline.

1.2. Consolidation of previously approved EMPs

This Plan applies to regulated activities proposed under the EP161 Beetaloo Basin Appraisal Pilot EMP and to previously approved disturbance areas and wellsites incorporated into this consolidated EMP, including STO7-4, STO1-4 and STO2-7, where ongoing obligations remain (e.g. rehabilitation, maintenance and monitoring). Activities authorised under the legacy EMPs are largely complete and no additional operational groundwater or surface water management actions are proposed for those legacy activities beyond ongoing monitoring and reporting.

The applicable surface water and groundwater requirements for consolidated sites are managed through compliance with the NT Code of Practice and implementation of the monitoring and reporting program set out in this Plan (quarterly monitoring for at least three years post-HFS for applicable wells and ongoing annual monitoring at older wellsites thereafter).

2. Project overview

Santos is proposing to undertake a series of activities to expand gas exploration and appraisal program within EP161 of Tanumbirini Pastoral lease in the Beetaloo Sub-basin.

The Project proposes to undergo the following activities:

- Clearing and earthworks for two new well pad locations – the clearing and construction to create two new well pads and ancillary infrastructure (as listed below) at well pad locations referred to as Jibera South and Newcastle South.
- Drilling – up to 12 appraisal wells, being either vertical or horizontal well types, distributed across the Jibera South and Newcastle South well pads.
- Operating, testing, maintenance and decommissioning – up to 12 installed wells distributed across Jibera South and Newcastle South well pads.
- Hydraulic Fracture Stimulation (HFS) and well testing – up to 12 appraisal wells will be tested with an average of 60 stages of HFS for horizontal wells and four stages for verticals.
- Wastewater management – each well pad will include open-top and closed-top tanks, storage tanks, drilling sumps, cutting pits and any transfer infrastructure within the well pad. This also includes transportation onsite and disposal of these wastes (unless otherwise approved for reuse or burial).

- Ancillary infrastructure and activities – infrastructure and activities required to support the appraisal activities includes:
 - Water supply bores – up to ten bores installed at each well pad.
 - Clean water storage – onsite tanks or dams.
 - Groundwater monitoring bores – impact and control bores (included as part of total new bores proposed to be installed).
 - Borrow pits.
 - Airstrip operations.
 - Office, workshop and laydowns.
 - Bulk material transport and storage.
 - Installation and operation of camps at each the Jibera South and Newcastle South well pads.
 - Traffic Management.
 - Flaring – is a routine activity during the well testing phase, such as an IP30 test.

3. Description of existing environment

3.1. Location

The Project occurs within Tanumbirini Perpetual Pastoral Lease ('Tanumbirini Station'), which is within Santos's exploration permit (EP)161. The Project is accessed via the Carpentaria Highway and along access tracks on Tanumbirini Station. The Project Disturbance Footprint is divided into two well pad sites (each covering an area of 15 hectares), residing north and south of the Carpentaria Highway, approximately four kilometres west and 25 kilometres south-east of Tanumbirini, in the EP161; the north and south well pad sites are identified as Jibera South and Newcastle South, respectively.

3.2. Hydrology

The Jibera South site is located within the Newcastle South sub catchment, while the Newcastle South site is located within the October Creek sub catchment. No watercourses are within the vicinity of the Jibera South or Newcastle South Well Pad. The nearest watercourse to the Jibera South Site is a first order intermittent stream tributary of Snake Creek approximately two point five kilometres to the northwest, while the nearest watercourse to the Newcastle South Site is first order intermittent stream tributary of October Creek approximately two point seven kilometres to the southeast. Flooding across the Well Pad is unlikely, due to the flat landscape as well as the distance from watercourses. This is confirmed from the hydrology modelling completed, included in Section 4 of the EMP.

3.3. Hydrogeology

The major regional groundwater system within the Beetaloo Sub-basin occurs within the Cambrian Limestone Aquifer (CLA). The CLA is a vast interconnected carbonate system. It is composed of interlayered limestone and mudstone units that form large, karstic (dissolving cave-like) aquifer, which occurs within the top 20 to 400 metres of the natural surface (Department of Environment, Parks and Water Security, 2022). The CLA is subdivided into:

- The upper CLA, which comprises the Anthony Lagoon Formation, is characterised by siltstone interbedded with thin, karstic limestone and dolomite sequences. It is mapped at thicknesses of up to 200 metres.
- The lower CLA, which includes the Gum Ridge Formation, consists predominantly of fractured and karstic limestone and dolomite. It can reach thicknesses of up to 400 metres and may sub crop in areas where

the upper CLA is absent. The Gum Ridge Formation, within the lower CLA, is identified as the primary water bearing unit occurring within the project.

The Mesoproterozoic shale units targeted by unconventional gas exploration (i.e. the Velkerri Formation) are significantly deeper in the Project area and are separated from the CLA by one or more aquitards. Below the planned well pads, a separation depth of around 2,800 metres is recorded between the CLA (Gum Ridge Formation) and the target gas bearing shale units of the Velkerri Formation.

The CLA does not outcrop within EP161 and is overlain by unsaturated Cretaceous age siltstone and claystone of the Carpentaria Basin. These deposits have been observed to be greater than 80 metres thick in bores drilled in the vicinity of EP161.

At the location of the proposed activities, the CLA is the only aquifer present (Anthony Lagoon and Gum Ridge formations). This was confirmed by hydrogeologists from the Department of Environment and Natural Resources (DENR). No other formations in this area are classified as aquifers.

Regional characteristics of the CLA are summarised below:

- Groundwater level: 32 to 123 metres below ground level (mbgl), with deeper levels observed toward the southwestern basin margin (Fulton, 2018)

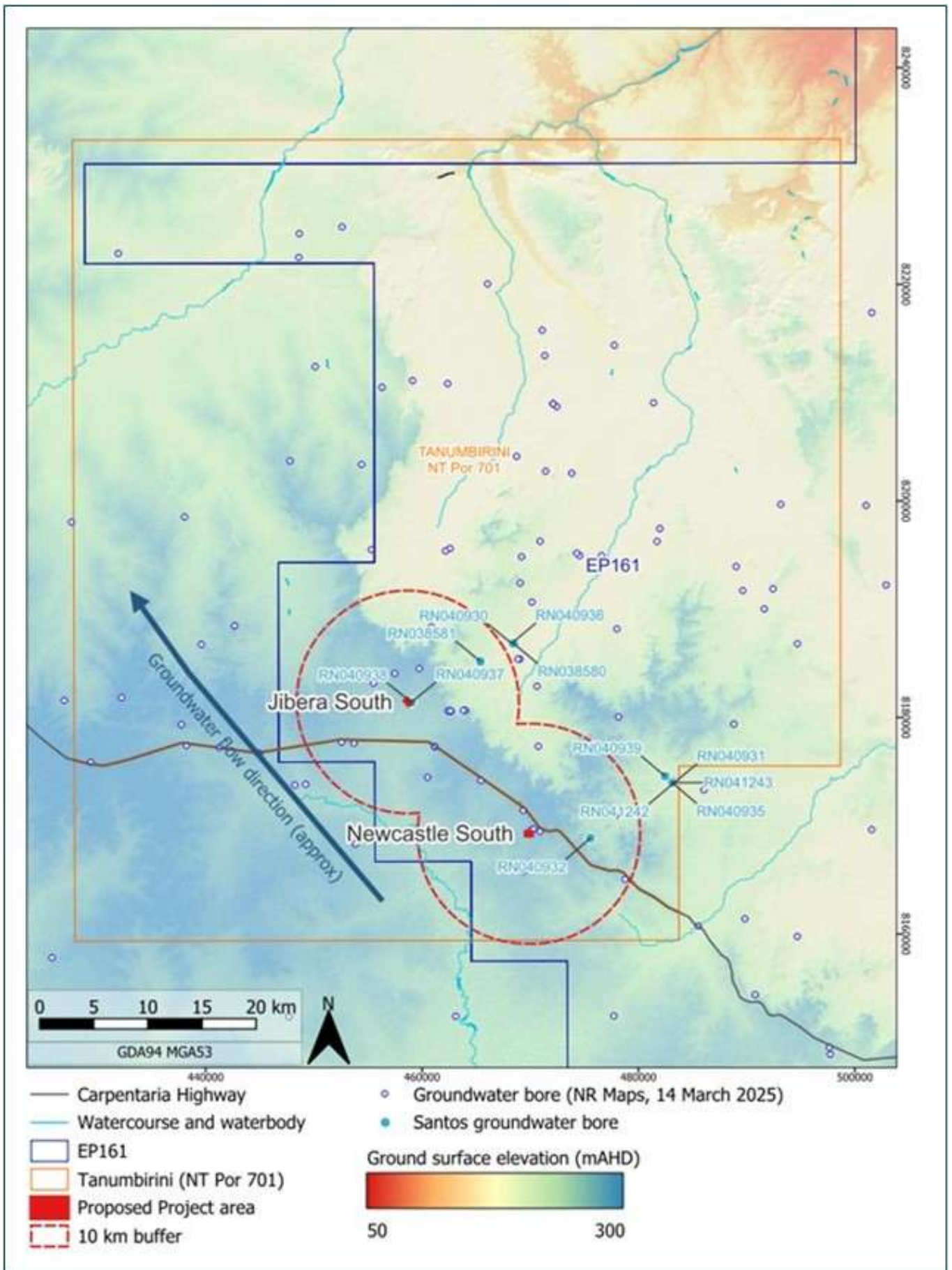


Figure 3: Groundwater bores in the vicinity of the Project Area

- Flow direction: Regional groundwater flow is to the northwest (refer to Figure 1 and Figure 2).
- Discharge: The aquifer discharges into the Roper River approximately 100 km northwest of the Beetaloo Sub-basin, supporting important groundwater dependent ecosystems.
- Gradient: Flow gradients are extremely flat (around 0.0001), with little change in elevation over long distances (this relates to the high aquifer hydraulic properties of the karst limestone aquifer).
- Recharge: Recharge to the Gum Ridge Formation is conceptualised to occur via seepage from seasonal creeks where they traverse outcrops, potentially through dolines located within creek beds. During large rainfall events, runoff into streams and the filling of endorheic lakes can also contribute to recharge where these surface water features are in direct contact with outcropping formations.

3.3.1. Groundwater use and quality

A total of 25 bores registered with the Northern Territory Government are located within a five kilometre search radius of each well pad and around existing Santos licenced water supply bores (Figure 3). Of the 25 registered bores identified, 20 target the Gum Ridge Formation, two target the Anthony Lagoon Formation, two are recorded to target 'Gum Ridge Formation or Anthony Lagoon Formation', and one is unknown. These bores have recorded water levels ranging from 9.1 (RN006645) to 125 mBGL (RN029025), with an average depth of 86.8 mbgl.

Groundwater quality in the CLA is typically good with electrical conductivity (EC) in the CLA ranging from 1170 - 2260 $\mu\text{S}/\text{cm}$ (average of 1580 $\mu\text{S}/\text{cm}$) and a neutral pH (6.3 - 7.3) (Fulton 2018). Santos has established groundwater monitoring bores at the Mount Brown-1/2H location and Inacumba-1/1H location. The groundwater from these bores is fresh, ranging between 800-1000 mg/L TDS. Groundwater quality is summarised in Table 1.

Table 1: Groundwater quality of Beetaloo Sub-basin aquifers¹

Aquifer	Number of samples	Conductivity ($\mu\text{S}/\text{cm}$)	Lab pH (mean)	Major ion concentration (mg/L)*					
				Na	Ca	Mg	HCO ₃	SO ₄	Cl
Gum Ridge	144	350-3,000 (1,390)	7.5	2-440 (130)	16-200 (86)	11-116 (53)	56-680 (440)	6-650 (150)	2-6,209 (160)
Anthony Lagoon	86	670-6,470 (1,590)	7.6	9-380 (150)	12-300 (88)	25-134 (57)	86-530 (330)	18-980 (230)	16-570 (210)

* Mean concentration in brackets

¹ Source Fulton and Knapton 2015, Tickell and Bruwer 2017

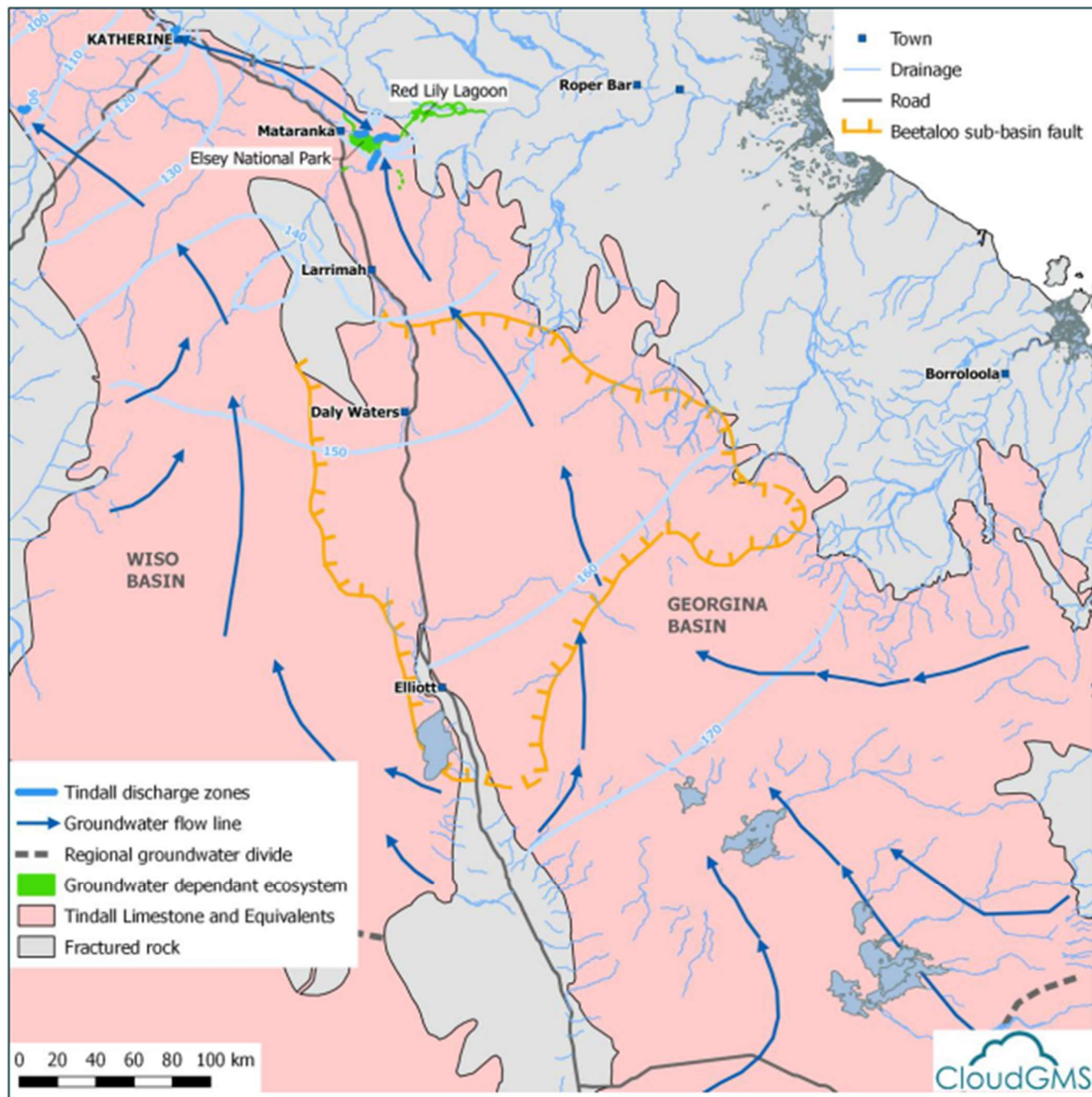


Figure 1: CLA groundwater flow pattern

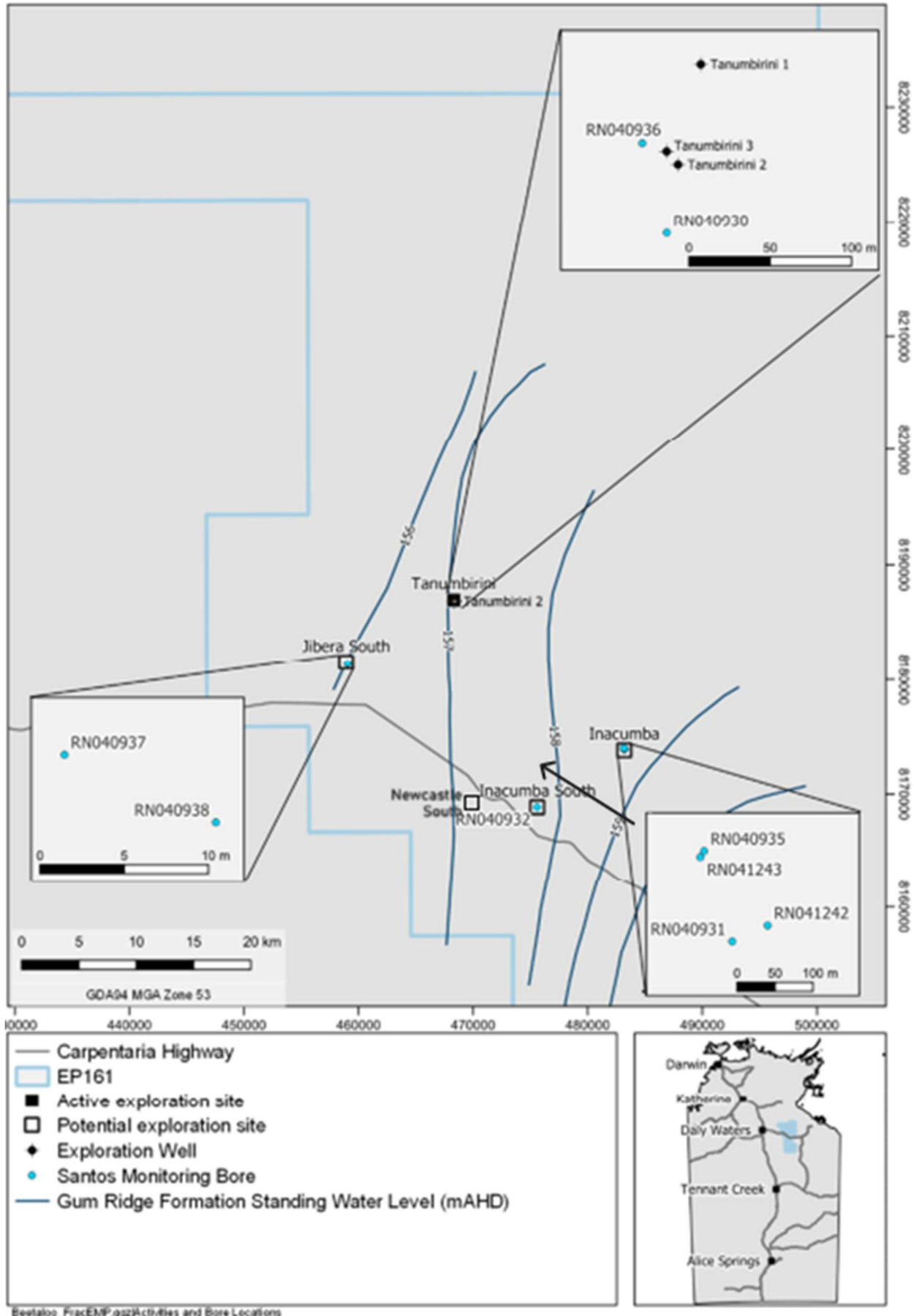


Figure 2: EP161 Gum Ridge Formation Standing Water Level (Source: RDM Hydro, 2024)

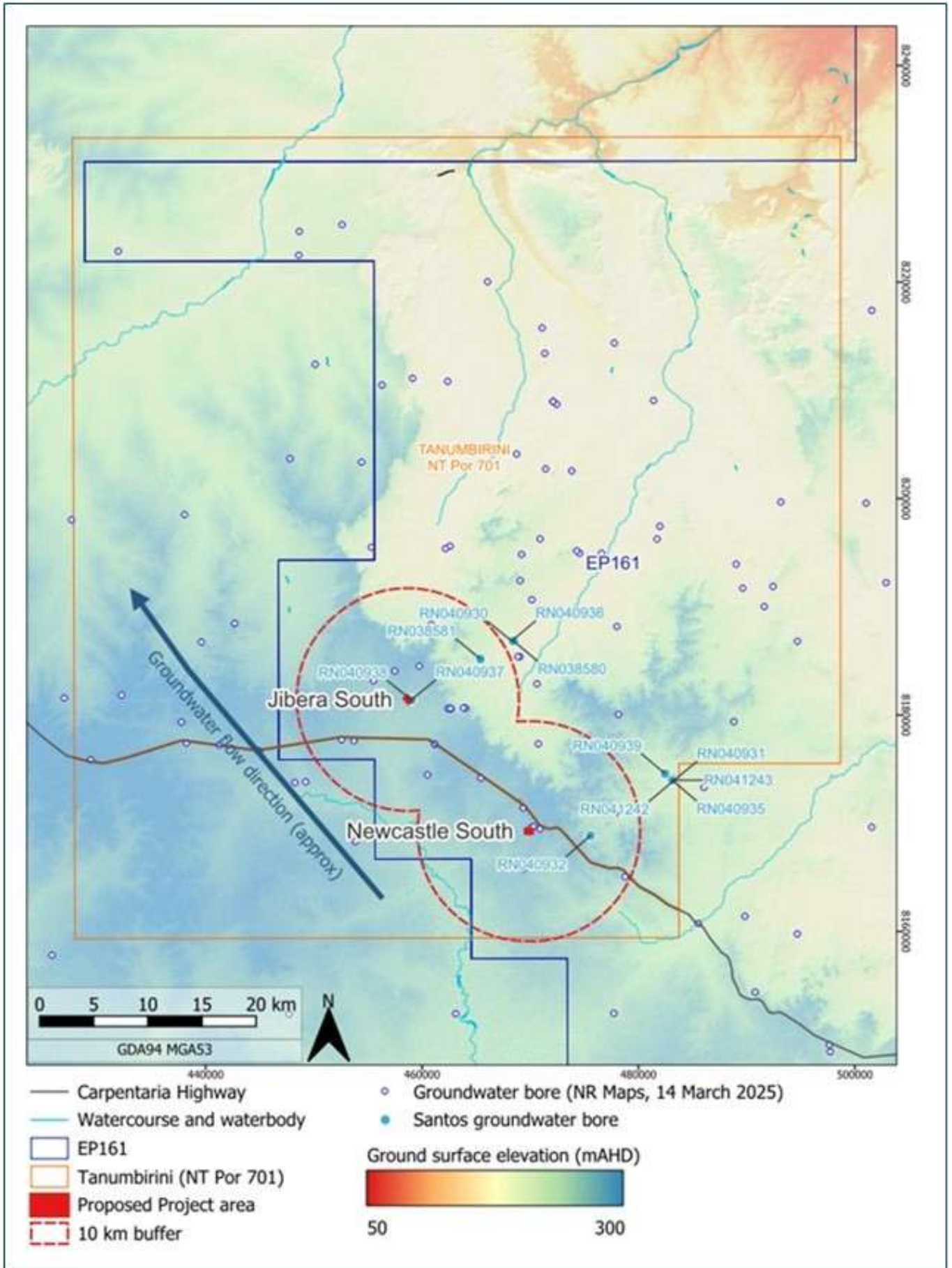


Figure 3: Groundwater bores in the vicinity of the Project Area

4. Surface water monitoring

No permanent or ephemeral surface water bodies are present within two point five kilometres and two point seven kilometres of the two well pads. The risk assessment presented in the EMP does not identify that surface water monitoring is necessary for the risk to surface water to be ALARP and acceptable. Therefore, no surface water monitoring will be conducted as part of the monitoring program.

5. Groundwater monitoring

5.1. Requirements

As detailed below, the groundwater monitoring requirements for petroleum activities in the Northern Territory are described within the Code of Practice and the Preliminary Groundwater Guideline.

5.2. Aquifers to be monitored

An aquifer is defined within the *Code of Practice: Well Integrity* as a unit which is currently supplying a beneficial use, or potentially being able to provide a beneficial use, as defined in section 4(3) of the *Water Act 1992 (NT)*.

The main hydrostratigraphic units related to the project include the CLA (water supply for the project and local users). Other non-contiguous and localised aquifers are known to occur in the region, both above and below the CLA, either as perched (Cretaceous sediments) aquifers near the ground surface or as fractured rock below the CLA (DEPWS, 2022). A review of the groundwater conditions, including quantity and quality, of the lithological units intersected by the project appraisal bores indicate that the sandstone units below the CLA, due to the significant depth and poor water quality, are not classified as viable aquifers. These units are therefore not included in the project groundwater monitoring program.

The major aquifers within the CLA include:

- The upper CLA Anthony Lagoon Formation, which is characterised by siltstone interbedded with thin, karstic limestone and dolomite sequences.
- The lower CLA Gum Ridge Formation, which consists predominantly of fractured and karstic limestone and dolomite

The Preliminary Groundwater Guideline states that monitoring of the CLA is required for exploration petroleum wells in the Beetaloo Sub-basin. Based on the information currently available, the Anthony Lagoon Formation within the Upper CLA and the Gum Ridge Formation within the lower CLA, are the only aquifers that will be targeted by the groundwater monitoring program. The interpreted stratigraphy for the Project is presented below in Figure 4 and Figure 5.

Stratigraphic Prognosis		Assumed Surface Temperature:		22.00	°C	Ground Level:	Taken from Lidar Data		
		Geothermal Gradient:		0.032	°C/m	Rig Height:	233.59		
		Pressure Gradient:		0.5	Psi/ft	RT:	242.59		
Formation	Target	Primary Lithology	Depth (mTVDS)	TVD (mRT)	MD (mRT)	Error (+/- m)	BHT (°C)	Reservoir Pressure psi	Expected in-situ Fluids
Rig Height			242.59	0.00	0.00				
GL - Surficial Deposits (K-age)	-	Unconsolidated sands and clays	233.59	9.00	9.00	0	22	15	
Anthony Lagoon Beds	-	Sandstone, siltstone & Dolomitic limestones	97.59	145.00	145.00	30	27	238	Water (potable)
Gum Ridge Fm	-	Limestone	-82.41	305.00	305.00	30	32	500	Water (potable)
Un-named Sst Unit	-	Sandstone	-182.41	425.00	425.00	30	36	697	
Cox Fm	-	Interbedded siltstone & mudstone	-246.97	489.56	489.56	100	38	803	
Bukalara Sandstone	-	Sandstone	-883.79	1126.38	1126.38	100	58	1847	
Kyalla Fm	-	Interbedded siltstone & mudstone	-1038.78	1281.37	1281.37	100	63	2101	
Lower Kyalla	-	Interbedded siltstone & mudstone							
Moroak Sandstone	-	Sandstone	-1770.75	2013.34	2013.34	100	86	3301	
Wyworrie Mbr (VELK)	-	Interlaminated mudstone & siltstone	-2184.16	2406.75	2406.75	100	99	3945	
Amungee Mbr	-	Interlaminated mudstone & siltstone							
(C Shale)		Shale	-2673.87	2916.46	2917.22	100	115	4781	Dry Gas
(B Shale)	Primary	Shale	-2873.93	3116.52	3205.79	100	122	5109	Dry Gas
TOTAL DEPTH			-2882.8	3125.39	6294.00	100	122	5124	

Figure 4: Interpreted stratigraphy (formation) depth, pressure and temperature – Jibera South (Source: Santos, 2024a)

Stratigraphic Prognosis		Assumed Surface Temperature:		22.00	°C	Ground Level:	Taken from Lidar Data		
		Geothermal Gradient:		0.032	°C/m	Rig Height:	235.84		
		Pressure Gradient:		0.5	Psi/ft	RT:	244.84		
Formation	Target	Primary Lithology	Depth (mTVDS)	TVD (mRT)	MD (mRT)	Error (+/- m)	BHT (°C)	Reservoir Pressure psi	Expected in-situ Fluids
Rig Height			244.84	0.00	0.00				
GL - Surficial Deposits (K-age)	-	Unconsolidated sands and clays	235.84	9.00	9.00	0	22	15	
Anthony Lagoon Beds	-	Sandstone, siltstone & Dolomitic limestones	152.84	92.00	92.00	50	25	151	Water (potable)
Gum Ridge Fm	-	Limestone	106.84	138.00	138.00	50	26	226	Water (potable)
Un-named Sst Unit	-	Sandstone	-13.16	258.00	258.00	50	30	423	
Cox Fm	-	Interbedded siltstone & mudstone	-232.89	477.73	477.73	100	37	783	
Bukalara Sandstone	-	Sandstone	-994.96	1239.80	1239.80	100	62	2032	
Kyalla Fm	-	Interbedded siltstone & mudstone	-1109.93	1354.77	1354.77	100	65	2221	
Lower Kyalla	-	Interbedded siltstone & mudstone	-1455.98	1700.82	1700.82	100	76	2788	
Moroak Sandstone	-	Sandstone	-1755.98	2000.82	2000.82	100	86	3280	
Wyworrie Mbr (VELK)	-	Interlaminated mudstone & siltstone	-2076.75	2321.59	2321.59	100	96	3806	
Amungee Mbr	-	Interlaminated mudstone & siltstone	-2576.04	2820.88	2820.88	100	112	4624	
(C Shale)	Secondary	Shale	-2639.04	2883.88	2883.88	100	114	4728	Dry Gas
(B Shale)	Primary	Shale	-2840.66	3085.50	3085.50	100	121	5058	Dry Gas
(Lower B Shale)	Primary	Shale	-2920.99	3165.83	3165.83	100	123	5190	Dry Gas
(A Shale)	Secondary	Shale	-2982.81	3227.65	3227.65	100	125	5291	Dry Gas
Kalala Mbr	-	Interlaminated mudstone & siltstone	-2992.81	3237.65	3237.65	100	126	5308	
TOTAL DEPTH			-3072.81	3317.65	3317.65	100	128	5439	

Figure 5: Interpreted stratigraphy (formation) depth, pressure and temperature – Newcastle South (Source, Santos 2024b)

5.3. Monitoring bore design and construction

The Preliminary Groundwater Guideline describes how groundwater monitoring bores should be designed and located, to detect potential changes to groundwater due to petroleum and gas well operations and describes two types of groundwater monitoring bores. These are Control Monitoring Bores and Impact Monitoring Bores, the purpose of which are outlined below:

- Control Monitoring Bore – To derive site-specific aquifer system information and to provide a basis for understanding natural trends that may occur at the site and therefore help differentiate between background and project attributable changes. If water is not to be sourced at the well site, the first Control Monitoring Bore should be drilled to the base of the deepest recognised aquifer unit to provide the required stratigraphy data.
- Impact Monitoring Bore – Should be at the down hydraulic gradient of the well pad array and is installed to detect any impacts to the aquifer. Data obtained from Impact Monitoring Bores are to be assessed with consideration of data and trends at corresponding control monitoring bore(s).

In accordance with the Preliminary Groundwater Guideline, both Impact Monitoring Bores and Control Monitoring Bores require one bore for each discrete aquifer unit, which is screened near the top, middle and bottom of the vertical extent of that unit (or continuously as appropriate).

Control Monitoring Bores have been previously installed at the Jibera South Site. The design details of the existing Control Monitoring Bores are summarised below in Table 2. The location (existing or indicative) of these bores are presented on the proposed well pad layout figures provided in Engineering drawings (Appendix P of the EMP).

Table 2: Jibera South Control Monitoring Bores - existing

RN	Distance from well pad (m)	Easting	Northing	Date completed	Unit	Top of screen (m)	Bottom of screen (m)	SWL (m)
RN040937	<10	459046	8181384	12/08/2019	Anthony Lagoon Beds	118.0	132	117
RN040938	<10	459045	8181380	04/09/2019	Gum Ridge Formation	143.8*	276*	116.6

* Open hole construction

Suitable Control Monitoring Bore(s) will be constructed in accordance with the Code of Practice and Guideline, within 100 metre up-hydraulic gradient of the Newcastle South well pad.

Impact Monitoring Bores will be constructed in accordance with the Code of Practice and Preliminary Groundwater Guideline. The monitoring bore array for each well pad will consist of an Impact Monitoring Bore and Control Monitoring Bore for the Gum Ridge Formation and the Anthony Lagoon Beds, respectively. Further details regarding the timing and location of monitoring bore construction is provided below.

5.3.1. Bore location and timing of construction

The location and timing requirements for construction of the Control and Impact Monitoring Bores, as stipulated in the Preliminary Groundwater Guideline, is summarised below in Table 3. The planned location and timing is also summarised in Table 3.

The Control Monitoring Bores are already constructed at the location of Jibera South and will have been monitored for more than 6 months prior to well drilling.

The Control Monitoring Bores on Newcastle South will be constructed prior to well drilling, but may not be in place for a full six months before the well is drilled, but will be in place for at least six months prior to the first HFS activity at that location. This deviation from the guideline is deemed reasonable because weekly samples will be collected to accelerate the establishment of baseline conditions in the bore prior to drilling. At least six samples

will be collected prior to drilling. Long term groundwater monitoring results from Mount Brown and Jibera South, monitored at least quarterly since 2018, demonstrate that this is a reasonable approach for establishing baseline monitoring conditions in Control Monitoring Bores because groundwater conditions are temporally very stable and do not significantly vary year-to-year.

The Impact Monitoring Bores will be constructed following completion of well drilling, and at least prior to HFS, in accordance with the Preliminary Groundwater Guideline requirements. The Impact Monitoring Bore will be located within 20 metres and down-gradient of the first petroleum well, with subsequent wells on the well pad preferably drilled upgradient of the first well. This means that subsequent wells may be more than 20 metres up-gradient of the Impact Monitoring Bore.

The Preliminary Groundwater Guideline also states that the location of the Impact Monitoring Bore array may be varied on a case-by-case basis 'with approval from DENR' (i.e. DLPE). If the location of the Impact Monitoring Bore need to be greater than 20 metres from the first well on the well pad, whilst remaining generally down-hydraulic gradient of the surface locations of the wells, written approval will be sought from DLPE.

Multiple Impact Monitoring Bores, monitoring separate formations will be placed approximately ten metres apart, perpendicular to the groundwater flow direction and generally down-gradient of the wells.

Table 3: Groundwater monitoring bores location and timing

Monitoring bore type	Required location	Planned location	Required timing	Planned timing
Control Monitoring Bore	Within 100 m up-gradient of the Well Pad.	As indicated in Appendix P.	At least six months prior to well drilling.	Jibera South – as required. Newcastle South - prior to well drilling, and at least six months prior to HFS.
Impact Monitoring Bore	Within 20 m and down-gradient of the first petroleum well, with subsequent wells on the well pad preferably drilled upgradient of the first well.	As indicated in Appendix P.	Following completion of well drilling and prior to hydraulic fracturing.	As required.

5.4. Monitoring program

Monitoring of the Control Monitoring Bores will commence at least six months prior to commencing drilling of the first well on the corresponding well pad, with at least one sample taken each month.

If drilling is planned to commence within six months following construction of the Control Monitoring Bore, then more frequent sampling may be undertaken to establish baseline conditions. In this instance, monitoring will occur no less than weekly, with at least six monitoring events required to establish baseline conditions.

After baseline conditions have been established, groundwater monitoring (refer to Section 5.5) of the Control Monitoring Bores and Impact Monitoring Bores will occur at least once each quarter, for at least three years after HFS has occurred on any well on the corresponding well pad.

Consistent with the standard approach, following the completion of the minimum three-year period of quarterly groundwater monitoring after HFS, the frequency of groundwater monitoring at well sites (including wells authorised under STO2-7) will be reduced to annual monitoring.

Electrical conductivity will be measured as soon as practicable after the completion of construction of the monitoring bore(s) and will continue until three years after HFS of any wells on the corresponding well pad.

5.5. Monitoring methodology

As per the Preliminary Groundwater Guideline, groundwater samples will be taken in general accordance with protocols detailed in the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality field sampling program* (Commonwealth of Australia, 2025). The following is noted as requirements for the monitoring and sampling program methodology:

- Water sampling must be undertaken by suitably qualified and trained competent personnel².
- Prior to sampling a water bore, wherever practicable, the volume of stagnant water within the bore casing must be calculated. Water quality samples must only be collected after:
 - three times the volume of stagnant water in the bore casing and the discharge piping (including a sufficient additional volume to account for any error in volume calculations) have been purged, and
 - when the field water quality parameters (e.g., pH.) have stabilised, indicating the bore is producing formation water.
- Water quality samples must have a unique identification number that can be cross-referenced to the monitoring location and time of sampling.
- Sample preservation measures are to be documented and comply with analytical laboratory requirements and relevant standards (e.g., AS/NZS 5667.1:1998).
- Sample integrity must be maintained using chain of custody procedures and documentation in accordance with Section 3.7 of Monitoring and Sampling Manual 2009 —Environmental Protection (Water) Policy 2009.
- Sample analysis should be undertaken by a laboratory that is National Association of Testing Authorities (NATA) approved for that analysis.

Monitoring wells top of casing (TOC) reference levels are to be surveyed to Australian Height Datum (AHD) to allow calculation of groundwater elevation and interpretation of groundwater flow direction.

5.6. Sample preservation and logistics

Groundwater samples will be placed in laboratory supplied pre-preserved containers suitable for the required analytical suite. Immediately upon collection, samples containers will be placed in an esky and stored on ice while on-site and in transit to the laboratory. Samples were transported to the selected laboratory with the earliest available courier. It is noted that holding times may be exceeded due to the remote nature of the site and the distance to a suitable NATA accredited laboratory. Every effort will be made to ensure timely dispatch of samples and samples remain chilled for the duration of transit.

5.7. Field and laboratory analytical testing

During each groundwater monitoring event (GME), a manual measurement of the standing water level (SWL) will be conducted at each monitoring well. Ex-situ measurements of groundwater field parameters of pH, dissolved oxygen (DO), reduction potential (redox), electrical conductivity (EC), and temperature will be recorded using a calibrated water quality meter.

The laboratory analytical suite for each monitoring bore groundwater sample is presented below in Table 4.

Table 4: GME analytical suite

Category	Parameter	Units	Limit of Reporting (LOR)
General	Standing Water Level ³	Metres below top of casing (mbTOC)	NA
	Groundwater Pressure	kPa	NA
	pH	pH units	NA
	Electrical Conductivity (EC) ⁴	µS/cm	10

² A competent person is someone who has the knowledge, skills, and abilities to perform a task or role effectively and safely. They have acquired this competence through training, qualifications, or experience, and can demonstrate the ability to apply their knowledge to the specific task at hand.

³ Monitoring wells TOC relative level are to be surveyed to allow calculation of groundwater elevation in mAHD.

⁴ Refer Section 5.7 regarding requirement for real-time logging of electrical conductivity.

Category	Parameter	Units	Limit of Reporting (LOR)
	Total Suspended Solids (TSS)	mg/L	1
	Total Dissolved Solids (TDS)	mg/L	10
	Total Alkalinity	mg/L CaCO ₃	1
Radionuclides	Gross Alpha	Bq/L	0.05
	Gross Beta	Bq/L	0.1
Anions	Chloride	mg/L	1
	Fluoride	mg/L	0.1
	Sulphate	mg/L	1
	Nitrate	mg/L	0.1
	Nitrite	mg/L	0.1
Cations	Calcium	mg/L	1
	Magnesium	mg/L	1
	Sodium	mg/L	1
	Potassium	mg/L	1
Metals	Chromium	mg/L	0.1 - 100
	Copper	mg/L	0.1 - 100
	Iron	mg/L	0.1 - 100
	Lead	mg/L	0.1 - 100
	Manganese	mg/L	0.1 - 100
	Mercury	mg/L	0.1 - 100
	Silver	mg/L	0.1 - 100
	Arsenic	mg/L	0.1 - 100
	Barium	mg/L	0.1 - 100
	Boron	mg/L	0.1 - 100
	Cadmium	mg/L	0.1 - 100
	Lithium	mg/L	0.1 - 100
	Selenium	mg/L	0.1 - 100
	Silica	mg/L	0.1 - 100
	Strontium	mg/L	0.1 - 100
Zinc	mg/L	0.1 - 100	
Hydrocarbons	Total Recoverable Hydrocarbons (TRH)	µg/L	20 – 100
	Polycyclic Aromatic Hydrocarbons (PAHs)	µg/L	2 – 4

Category	Parameter	Units	Limit of Reporting (LOR)
	Benzene, Toluene, Ethylbenzene, Xylenes	µg/L	1 – 5
	Dissolved Methane	µg/L	1
	Dissolved Ethane	µg/L	1
	Dissolved Propane	µg/L	1

5.8. In situ continual groundwater data logging

Due to the remote nature of the site and the associated limitations with access and oversight of monitoring wells, in situ continual data logging will be implemented. Once monitoring wells are established and the monitoring program commenced, loggers will be deployed to measure and record groundwater pressure, temperature and EC at no longer than 12 hour timestep intervals. A barometric logger will be installed at a nearby location and used to correct data for barometric pressure changes.

The Preliminary Groundwater Guideline states that EC should be measured in real-time as an indicator providing ‘early warning’ of contamination, with the results telemetered for Santos’s oversight and to be the provided regulator. It is recognised by the DLPE that this may be difficult to implement in the first stages of exploration, but proponents should provide a plan and timetable to meet this requirement, preferably before HFS occurs.

5.9. Data management and reporting

Monitoring data will be managed in accordance with the requirements of the Preliminary Groundwater Guideline. This period allows for sample handling and logistics, lab analysis, quality assurance and control, and data assessment (see Section 6).

Groundwater monitoring data will be collated, interpreted and reported annually as part of the Annual Groundwater Monitoring Data Review.

6. Data assessment

Baseline groundwater monitoring (water level and quality) data is to be compiled and utilised for comparison during appraisal activities.

The objective of the groundwater monitoring, compared to baseline, is to validate control measures. This will be done through evaluating that groundwater levels and chemistry generally remain within background ranges and show no significant changes attributable to hydraulic fracturing activities on EP 161. The evaluation of groundwater monitoring will include triggers, which may instigate investigation. These investigation thresholds are included in Table 5.

Groundwater monitoring results will be reported annually through the Groundwater Monitoring Data Review report and the annual environmental performance report, in accordance with Section 8.6.3 of the EMP.

Table 5: Groundwater monitoring triggers

Monitoring program	Purpose	Parameters	Frequency	Investigation thresholds
Groundwater – control and impact bores	Detect changes in groundwater resulting from drilling and HFS	Water level and salinity (EC)	<ul style="list-style-type: none"> Quarterly. Continuous level and EC logging before, during and one month after HFS. 	N/A
		Temperature, EC, pH	<ul style="list-style-type: none"> Monthly, commencing six months prior to drilling first well on corresponding well pad. Then quarterly for three years after latest HFS on corresponding well pad. 	N/A
		Water monitoring suites (Table 4)	<ul style="list-style-type: none"> Monthly, commencing six months prior to drilling first well on corresponding well pad. Then quarterly for three years after latest HFS on corresponding well pad. 	BTEX and Dissolved Methane - outside of the baseline, control bore and 1 standard deviation

7. Plan review and update

This plan may be reviewed from time to time to ensure it is fit for purpose, aligns with updated or amended guidelines, or in response to an assessment recommendation or investigation finding. Amendment of this plan will be in accordance with *Petroleum (Environment) Regulations 2016*, as it relates to amendment of an EMP.

8. References

- Commonwealth of Australia. (2025). *Field Sampling Program*. Retrieved from *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Retrieved from <https://www.waterquality.gov.au/anz-guidelines/monitoring/field-sampling-program>
- Department of Environment, Parks and Water Security. (2022). *Regional Report: Strategic Regional Environmental and Baseline Assessment for the Beetaloo Sub-basin*.
- DEPWS. (2022). Regional Report, Strategic Regional Environmental and Baseline Assessment (SREBA) for the Beetaloo Sub-basin. Department of Environment, Parks and Water Security.
- Department of Natural Resources. (2018). *Preliminary Guideline: Groundwater Monitoring Bores for Exploration Petroleum Wells in the Beetaloo Sub-basin*.
- Santos. (2025). *INITIAL CONCEPT SELECT BASIS FOR WELL DESIGN - JIBERA SOUTH 1 & 1DW1 B-Shale Horizontal McArthur Basin EP 161 2026 Appraisal Campaign*.
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