

Modification Application – Regulation 23

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| Interest Holder | Santos QNT Pty Ltd | | | EMP Title | NT EP 161 Water Bore Monitoring Program | Unique EMP ID No. | N/A | Mod No. | 5 | Date | 18/08/2020 |
| Brief Description | The Water Resources Division Technical Report 20/2020 confirms the presence of a newly discovered aquifer, referred to as the Inacumba aquifer. Identification of the new Inacumba aquifer at Tanumbirini Station has subsequently triggered a change in the existing environment relevant to this EMP. This EMP modification application is required under Regulation 23 to give the Minister a notice that specifies details of the changes to the EMP. | | | | | | | | | | |
| Geospatial Files Included? | No | | | | | | | | | | |
| Does the change in existing environment result in a new, or increased, potential or actual environmental impact or risk? | If a NEW potential or actual environmental impact or risk, is it provided for in the approved EMP? | If an INCREASE in an existing potential or actual environmental impact or risk, is it provided for in the approved EMP? | Does the change in the existing environment require additional mitigation measures to be included? | Has additional stakeholder engagement been conducted? | Does it require additional environmental performance standards and measurement criteria? | Does it affect compliance with Sacred Site Authority Certificates? | Does it affect current rehabilitation, weed, fire, wastewater, erosion and sediment control, spill or emergency response plans? | Will the environmental outcome continue to be achieved and will the impacts and risks be managed to ALARP and acceptable? | | | |
| No | N/A | N/A | No | No | No | No | No | No | Yes | | |
| Current EMP Text | | | | | | Amended EMP Text | | | | | |
| Table ES-2 Summary of Key Receptors | | | | | | Table ES-2 Summary of Key Receptors | | | | | |
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| Groundwater | The Beetaloo Basin is overlain by the Georgina Basin, a thick carbonate sequence that forms the Cambrian Limestone Aquifer (CLA), an extensive aquifer of regional significance. The CLA is a regional scale aquifer that provides groundwater resources for pastoral enterprises, domestic bores at homesteads and town water supplies at a number of | | | | | Groundwater | The Beetaloo Sub-basin is overlain by the Georgina Basin, which contains the Cambrian Limestone Aquifer (CLA), a thick carbonate sequence that hosts an extensive aquifer of regional significance. The CLA is a regional scale aquifer that provides groundwater resources for pastoral enterprises, domestic bores at homesteads and town water supplies at a number of small communities across the region. In | | | | |

| <p>small communities across the region. The CLA will be the target of the baseline environmental water monitoring required by this EMP.</p> | <p>addition, the Water Resources Division Technical Report 20/2020 confirms the presence of a newly discovered aquifer, referred to as the Inacumba aquifer. Presently, there is limited information available regarding the extent of the Inacumba aquifer. It is only known from a few bores within the vicinity of the Inacumba 1 well lease. The use of this aquifer as a significant groundwater resource is unlikely and to date it is not widely used.</p> <p>Where the CLA is being used to produce extractable volumes, the CLA will be the target of the baseline environmental water monitoring required by this EMP. At the Inacumba 1 location, where the CLA is not being used to produce extractable volumes, the deeper Inacumba unit will be the target of the baseline environmental water monitoring required by this EMP.</p> | | | | | | | | |
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| <p>4.2.2 Groundwater</p> <p>The Beetaloo Basin comprises a thick sequence of flat-lying mudstone and sandstone formations (Roper Group) which is estimated to reach 5000 m in thickness in the centre of the basin and with the exception of the north and eastern margins occurs at an average</p> | <p>4.2.2 Groundwater</p> <p>The Beetaloo Sub-basin comprises a thick sequence of flat-lying mudstone and sandstone formations (Roper Group) which is estimated to reach 5000 m in thickness in the centre of the basin and with the exception of the north and eastern margins occurs at an average</p> | | | | | | | | |

depth of about 500 m. The Roper Group is overlain by the Georgina Basin, which comprises widespread basalts and a thick carbonate sequence that forms the Cambrian Limestone Aquifer (CLA), an extensive aquifer of regional significance.

The CLA is currently utilised for pastoral properties, domestic bores at homesteads and the town water supplies from a number of small communities in the region. Table 4-4 has been adapted from the Final Report and details the status of knowledge about shallow aquifers relevant to the proposed water monitoring bore locations.

Table 4-4 Status of knowledge about shallow aquifers

| Shale Basin | Aquifer | Summary |
|---|--------------------------|---|
| The McArthur Basin Beetaloo Sub-basin East of Stuart Highway | Tindall /Gum Ridge (CLA) | Is the only known aquifer in this region - average depth to the formation is 30 m. Water table is approximately 45 m deep and aquifer expected to be intersected within 15 m of the top of the water table (that is at 60 m). Most of the region is covered by low permeability cretaceous sediments. Surface expression of collapse structures in the underlying limestone exist, but open sinkholes that provide a preferential pathway to the aquifer are rare. |

Local Groundwater Monitoring Results

Santos commissioned an audit to baseline groundwater conditions and bore infrastructure across the central portion of EP 161 in 2017. Results of the baseline survey informed the development of a groundwater monitoring plan for EP 161. The plan details the groundwater monitoring activities that will be undertaken in two discrete sampling rounds timed to coincide with the start and end of the 2018 dry season. Sampling of groundwater levels and quality is ongoing. This activity is scheduled every six months, with the next event scheduled for October 2018.

Groundwater quality samples were collected from equipped pastoral bores on Tanumbirini Station via sampling taps located on the bore headworks. Groundwater samples were analysed for water levels and water quality parameters: alkalinity and hardness, major cations and anions, fluoride, metals (dissolved and total) and dissolved methane. A brief summary of the results of this monitoring is provided below:

- With the exception of one groundwater bore the groundwater levels in May 2018 are near identical to the August 2017 baseline results. .

depth of about 500 m. The Roper Group is overlain by the Georgina Basin, which comprises widespread basalts to the west of the Arnold Arch and a thick carbonate sequence that forms the Cambrian Limestone Aquifer (CLA), an extensive aquifer of regional significance.

The CLA is currently utilised for pastoral properties, domestic bores at homesteads and the town water supplies from a number of small communities in the region. Table 4-4 has been adapted from the Final Report and details the status of knowledge about shallow aquifers relevant to the proposed water monitoring bore locations.

In addition, the Water Resources Division Technical Report 20/2020 confirms the presence of a newly discovered aquifer, referred to as the Inacumba aquifer. Presently, there is limited information available regarding the lateral extent of the Inacumba aquifer. The only bores known to access water from the Inacumba aquifer are located adjacent to the Inacumba 1 well lease.

Table 4-4 Status of knowledge about shallow aquifers

| Shale Basin | Aquifer | Summary |
|---|--------------------------|---|
| The McArthur Basin Beetaloo Sub-basin East of Stuart Highway | Tindall /Gum Ridge (CLA) | In general, the water table is found approximately 45 mbgl (meters below ground level) in the Cambrian aged Gum Ridge Formation with an overburden of low permeability Cretaceous aged mudstones resting unconformably above. Surface expression of collapse structures in the underlying limestone exist, but open sinkholes that provide a preferential pathway to the aquifer are rare. |
| | Inacumba unit | Presently, there is limited information available regarding the extent of the Inacumba unit. Current hydraulic data is limited to bores in the immediate vicinity of the Inacumba 1 well lease. Estimated to be up to 1,500 km ² in stratigraphic extent, very little is known about the vertical and horizontal hydraulic connectivity or regional scale processes of groundwater recharge, flow and discharge. The limestone that the aquifer is best developed in is a relatively hard competent rock with no significant primary porosity. At the location of the Inacumba 1 well lease, airlift yields up to 23 L/s suggest that fractures have been enlarged by dissolution of the limestone. Standing water levels at the Inacumba 1 well lease are approximately 75 m below surface. |

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| <ul style="list-style-type: none"> There is little variation in water quality parameters between the 2017 baseline and the 2018 samples which is consistent with the extensive, regional nature of the aquifer. <p>The monitoring at the three locations associated with this EMP are expected to support the water levels and water quality results captured during the Santos EP 161 Groundwater Monitoring events.</p> | <p>Local Groundwater Monitoring Results</p> <p>Santos commissioned an audit to baseline groundwater conditions and bore infrastructure across the central portion of EP 161 in 2017. Results of the baseline survey informed the development of a groundwater monitoring plan for EP 161. The plan details the groundwater monitoring activities that will be undertaken in two discrete sampling rounds timed to coincide with the start and end of the 2018 dry season. Sampling of groundwater levels and quality is ongoing. This activity is scheduled every six months, with the next event scheduled for October 2018.</p> <p>Groundwater quality samples were collected from equipped pastoral bores on Tanumbirini Station via sampling taps located on the bore headworks. Groundwater samples were analysed for water levels and water quality parameters: alkalinity and hardness, major cations and anions, fluoride, metals (dissolved and total) and dissolved methane. A brief summary of the results of this monitoring is provided below:</p> <ul style="list-style-type: none"> With the exception of one groundwater bore the groundwater levels in May 2018 were near identical to the August 2017 baseline results. There is little variation in water quality parameters between the 2017 baseline and the 2018 samples which is consistent with the extensive, regional nature of the aquifer. Water quality of the Inacumba unit is similar to that encountered in the Gum Ridge Formation. <p>The monitoring at the three locations associated with this EMP are expected to support the water levels and water quality results captured during the Santos EP 161 Groundwater Monitoring events. In particular, the presence of groundwater resource within the CLA at the Inacumba South and Tanumbirini South locations, and the observed absence of a groundwater resource in the CLA at the Inacumba 1 well lease location.</p> |
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