

Advice to decision maker on coal seam gas project

IESC 2021-130: Towrie Gas Development (Queensland) (EPBC 2021/8979) – New Development

Requesting agency	The Australian Government Department of Agriculture, Water and the Environment
Date of request	21 December 2021
Date request accepted	23 December 2021
Advice stage	Assessment

The Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (the IESC) provides independent, expert, scientific advice to the Australian and state government regulators on the potential impacts of coal seam gas and large coal mining proposals on water resources. The advice is designed to ensure that decisions by regulators on coal seam gas or large coal mining developments are informed by the best available science.

The IESC was requested by the Australian Government Department of Agriculture, Water and the Environment to provide advice on the Santos Towrie Gas Development in Queensland. This document provides the IESC's advice in response to the requesting agency's questions. These questions are directed at matters specific to the project to be considered during the requesting agency's assessment process. This advice draws upon the available assessment documentation, data and methodologies, together with the expert deliberations of the IESC, and is assessed against the IESC Information Guidelines (IESC, 2018).

Summary

The Towrie Gas Development (the project) is a new 116-well development targeting coal seam gas (CSG) from the Bandanna Formation, which is overlain by the Rewan Group, a thick aquitard at the regional scale. Peak groundwater production is predicted to be ~2.2 ML/day, with a total of ~2.3 GL abstracted over the lifetime of the project. Hydraulic stimulation is expected to be used on a currently unknown number of wells.

The project is located in the Arcadia Valley, Queensland, north of Injune and in the northern portion of the Surat Cumulative Management Area (CMA). It will share produced water treatment and storage facilities with the Arcadia Gas Project, 16 km to the southwest.

The lower areas of the Arcadia Valley have been and continue to be used for agriculture, including cropping and cattle grazing. Many areas historically associated with agriculture are degraded; however,

corridors of good-quality remnant vegetation and aquatic habitat persist. Higher elevations of the project area will not be cleared and will retain extensive patches of good-quality vegetation.

The project area and immediate vicinity support threatened ecological communities (TECs) including Brigalow (*Acacia harpophylla* dominated and co-dominated) and Poplar Box Grassy Woodland on Alluvial Plains. These TECs may be groundwater-dependent and grow along wetlands and ephemeral watercourses in the project area. Low-potential terrestrial groundwater-dependent ecosystems (GDEs) have been mapped in the north-eastern portions of the project area, and moderate-potential terrestrial GDEs occur immediately to the west of the project area. It is also probable that subterranean GDEs exist in the project area, particularly in the alluvium. These potential GDEs have not been confirmed with field data. Groundwater impacts will be largely managed under the Coal Seam Gas - Joint industry framework (2021). Riparian vegetation is associated with wetlands and ephemeral creeks and may provide habitat for a number of species listed by the Environment Protection and Biodiversity Conservation (EPBC) Act (1999). A constructed wetland in the northeast is used for agriculture but nonetheless provides good-quality aquatic habitat, including for the EPBC Act-listed glossy ibis (*Plegadis falcinellus*) and potentially Australian painted snipe (*Rostratula australis*) and Latham's snipe (*Gallinago hardwickii*).

Key potential impacts from this project are:

- long-term drawdown of the water table that may impact potential terrestrial and subterranean GDEs, possibly including groundwater-dependent TECs;
- overtopping from the Mt Kingsley Dam of produced water that may alter surface water quality in Ironbark Creek and the constructed wetland, possibly impacting aquatic habitat and riparian vegetation;
- altered surface water quality, runoff and flow regimes due to construction activities (including well pads, access tracks and pipelines); and,
- cumulative contributions to fragmentation and impaired ecological condition of water-dependent assets that potentially support multiple EPBC Act-listed species.

The IESC has identified key areas in which additional work is required to address the key potential impacts, as detailed in this advice. These are summarised below.

- Evidence for Rewan Group aquitard integrity within the project area has not provided confidence of possible hydrogeological and impact pathways due to potential local-scale heterogeneity. The proponent should obtain site-specific data on hydraulic properties, particularly vertical hydraulic conductivity, to confirm critical assumptions regarding the aquitard characteristics of the Rewan Group. Modelling uncertainty analysis should consider whether site-specific hydraulic properties (e.g., storativity and anisotropy of hydraulic conductivity) fall outside the range of the uncertainty analysis used by OGIA.
- Depending on the outcome of the above, groundwater modelling that further addresses the heterogeneity within the Rewan Group aquitard, and local-scale modelling, are required to inform risk assessment of the possibility of water table drawdown with impacts to GDEs.
- If the site-specific hydrogeological data and groundwater modelling indicate that the Rewan Group is not an effective aquitard, the proponent should collect baseline data on potentially impacted water-dependent assets such as groundwater-dependent vegetation and subterranean GDEs.
- To address the risk of overtopping of the Mt Kingsley Dam due to the possibility of extreme rainfall events increasing with climate change, the proponent should collect baseline data (e.g., assemblage composition, ecological condition, groundwater-dependence) on surface water quality at potentially vulnerable sites (e.g., constructed wetland and Ironbark Creek) against which

monitoring data can be compared to confirm the proponent's predictions of no impacts from the project. This information would enable assessment of the potential impacts and risks of groundwater drawdown to these GDEs.

- An ecohydrological conceptual model to identify potential impact pathways, associated risks and likely modifying factors is required to guide monitoring and mitigation strategies.

Context

The Towrie Gas Development is a 116-well development targeting coal seam gas (CSG) from the Bandanna Formation, which is overlain by the Rewan Group, a thick aquitard at the regional scale. Peak groundwater production is predicted to be ~2.2 ML/day, with a total of ~2.3 GL abstracted over the lifetime of the project. Hydraulic stimulation is expected to be used on a currently unknown number of wells.

The project is located in the Arcadia Valley approximately 90 km south of the township of Rolleston and 60 km north of Injune, Queensland. The area (87 km²) is located within the Comet River Catchment (part of the Fitzroy River Basin), bounded by the Expedition and Shotover Ranges in the east, the Carnarvon Range in the south and the Buckland Tableland in the west. Most watercourses are ephemeral and typically only flow during and immediately after rainfall events. Key watercourses include Spring, Arcadia, Station and Ironbark creeks. These merge to join the Brown River which subsequently becomes the Comet River.

The project area includes lacustrine, riverine and minor palustrine wetlands. The constructed wetland in the project area's northeast is locally important as it is one of the Arcadia Valley's largest and best quality wetlands. It expands and contracts seasonally and contains aquatic vegetation and diverse microhabitats relative to surrounding dams (AECOM 2021, p. 67). The wetland supports substantial riparian vegetation, particularly on the eastern side, which is likely to provide refugia, breeding and foraging habitat for native fauna. The nearest natural wetland, Lake Nuga Nuga, is an inland intermittent freshwater lake/floodplain approximately 25 km north of the project area. The nearest spring complex is approximately 6 km northwest of the proposed project.

Riparian vegetation is associated with wetlands and ephemeral creeks and may provide habitat for a number of species listed by the Environment Protection and Biodiversity Conservation (EPBC) Act (1999): adorned delma (*Delma torquata*), yakka skink (*Egernia rugosa*), Dunmall's snake (*Furina dunmali*), large-eared pied bat (*Chalinolobus dwyeri*), south-eastern long-eared bat (*Nyctophilus corbeni*), koala (*Phascolarctos cinereus*), northern quoll (*Dasyurus hallucatus*), greater glider (*Petauroides volans*), red goshawk (*Erythrorhynchus radiatus*), grey falcon (*Falco hypoleucos*), squatter pigeon (southern) (*Geophaps scripta scripta*), rufous fantail (*Rhipidura rufifrons*) and painted honeyeater (*Grantiella picta*). Two National Parks (NP) occur within 20 km of the project area: Expedition NP to the east and south and Carnarvon NP to the northeast. Boxvale State Forest lies to the west. Riparian corridors in the project area may provide habitat connectivity between these more vegetated areas.

Response to questions

The IESC's advice, in response to the requesting agency's specific questions is provided below.

Question 1: Has the proponent provided sufficient documentation for the IESC to be confident that any risks to EPBC-listed springs and GDEs arising from the project are very low, low or moderate? In particular, does the IESC consider that the proponent has supplied sufficient evidence to be confident that the integrity of the Rewan Formation is sufficient to limit hydraulic connectivity between the Bandana Formation and overlying formations, thereby protecting the environmental values associated with these formations from drawdown-related impacts?

1. The documentation provided is not sufficient for the IESC to be confident that risks to EPBC Act-listed springs and GDEs fall in the very low – moderate category range. Furthermore, while the regional-scale OGIA model is appropriate for predicting potential cumulative impacts, it is inappropriate for assessing impacts at the local scale. Consequently, comprehensive assessment of the risk to EPBC Act-listed springs and other GDEs is not possible with the documentation provided and the available OGIA model.
2. Project-specific hydraulic data (e.g., vertical hydraulic conductivity, anisotropy of hydraulic conductivity and storativity) are required to confirm the proponent's assumptions that the integrity of the Rewan Group is sufficient to limit hydraulic connectivity between the Bandanna Formation and overlying formations (i.e., is an aquitard) and will constrain downwards groundwater fluxes that may affect the water table, thereby protecting the environmental values associated with these formations from drawdown-related impacts. For example, the current hydraulic parameter data provided by the proponent is derived from bores within 20 km of the project area; however, data from bores located inside the project area do not appear to be available. The range of hydraulic conductivities provided for the Rewan Group varies by several orders of magnitude across only four tests (KCB 2021, p. 71), indicating local heterogeneity that may alter the aquitard characteristics of the Rewan Group in the project area.
3. The current OGIA model cannot reliably predict groundwater dynamics in Layer 1 which are crucial for predicting potential impacts on many water-dependent assets. Furthermore, the proponent has concluded that the regional groundwater system is hydraulically separated from alluvial groundwater, largely based on a single data point in the northeast of the project area, collected in 1969, showing that the water table in the Rewan Group was >21 metres below ground level (mbgl). Water table data from the surrounding region also highlight the considerable variation in water table depth and, therefore, data from one bore should not be relied upon to support this assumption. Additional site-specific water table data (including seasonal variation) and additional supporting evidence on the hydraulic separation between the regional system and alluvial groundwater are required. This information is important as it pertains directly to drawdown risks for GDEs that may be reliant on alluvial groundwater.
4. A local-scale model underpinned by project-specific data will enable a more comprehensive assessment of the risks to water-dependent assets (e.g., terrestrial GDEs). Should this additional information and modelling indicate that the risk of drawdown impacting GDEs is high, then the work outlined in Paragraphs 7, 8 and 9 needs to be conducted.
5. If the assumption that the Rewan Group is a sufficient aquitard cannot be verified with the project-specific hydraulic data (Paragraph 2) and appropriate model uncertainty analysis, then an update to the regional OGIA model is required (to assess the project's contribution to cumulative impacts). Further, groundwater modelling should investigate the role of heterogeneity in the Rewan Group aquitard and its control on limiting drawdown of the water table.
6. It is unclear whether construction of infrastructure (which will cover up to 10% of the tenure) and associated surface water abstractions may reduce recharge rates in aquifers within the project area via altered flow timings or volumes. Rates and spatial patterns of recharge may be particularly important for GDEs associated with alluvial aquifers, with the degree of this reliance corresponding with natural seasonal and interannual fluctuations in recharge volumes. This may be especially relevant in a system where alluvial groundwater is hydraulically separated from the regional water table. Reduced recharge may decrease groundwater availability for GDEs and cause similar material impacts to groundwater drawdown. The proponent has relied on recharge estimates from OGIA, which did not include alluvial data (KCB 2021, p. 74). The proponent should assess recharge rates in the alluvium based on field data and discuss how the project may impact recharge mechanisms (e.g., abstraction of surface water or altered surface runoff and flow regimes due to associated infrastructure).

Question 2: If the IESC is not confident in the above, what are the key potential impacts to matters of national environmental significance associated with the proposal and what additional work needs to be undertaken to quantify key risks?

7. Potentially reduced alluvial recharge and increased drawdown in the shallow aquifers may impact terrestrial GDEs via reduced groundwater availability to phreatic vegetation. If the Rewan Group is not an effective aquitard in the project area (see response to Question 1), drawdown in the Bandanna Formation may also cause downwards groundwater fluxes in formations overlying the Rewan Group, including the alluvium. To better understand risks of a lowered water table to terrestrial GDEs, including possible groundwater-dependent TECs, the proponent should conduct field-based surveys in areas mapped as potential GDEs to identify the degree of groundwater-dependence (if any), identify likely source aquifers, and map GDE distribution in relation to the water table (including seasonal and interannual variations). These surveys could follow the methods described in Doody et al. (2019), and will permit the risk of drawdown-related impacts to potential GDEs to be conceptualised and assessed more accurately, to better quantify the risks to these water-dependent assets.
8. Stygofauna, if present, may be similarly affected by drawdown and reduced alluvial recharge. Stygofauna often facilitate useful ecosystem functions such as nutrient cycling (Saccò et al. 2019) and are likely to be present in shallow aquifers, particularly in the alluvium. However, the proponent has not conducted stygofauna sampling. As stygofauna diversity and abundance may decrease with drawdown, reduced recharge and/or altered groundwater quality, the proponent should sample stygofauna using methods described in Doody et al. (2019) and collect groundwater quality data to derive an appropriate baseline dataset against which to assess potential impacts and quantify risks of the project.
9. The proponent provides a conceptual model of the hydrological and hydrogeological systems of the project area and surrounds, portrayed as a broad diagrammatic cross-section of the project area and the underlying geological formations (Figure 7-30, KCB 2021, p. 102). However, this conceptual model does not illustrate the potential impact pathways, their associated risks and the likely modifying factors associated with the proposed development. The IESC recommends that the proponent provides an ecohydrological conceptual model showing possible impact pathways and their potential environmental consequences, spatially georeferenced to a map of the project area and the current cross-sectional diagram. This would help communicate what and where impacts may occur during and after the project, underpin a quantitative risk assessment and could be used to guide selection and application of cost-effective monitoring and mitigation strategies.
10. Linear infrastructure will cross ephemeral watercourses on-site. The information provided regarding the standard designs and risk assessments relating to this infrastructure does not adequately address the extent to which this infrastructure may impact flow and sediment regimes. Details of these designs should be provided together with a quantitative risk assessment.
11. The IESC notes that the proponent intends to extract water from the constructed wetland for construction purposes, and that the monitoring of this extraction will be undertaken in liaison with landholders. There are insufficient details of this proposed monitoring for the IESC to be able to assess that the constructed wetland's important habitat values will be fully protected and that a quantitative risk assessment can be done. The proponent should outline an appropriate monitoring approach, integrated with assessments of habitat quality and water regime (Paragraphs 12 and 13), to ensure that the cumulative effects of water extraction do not compromise the ecohydrological requirements and aquatic values of this wetland. The results of baseline data and subsequent monitoring information can be used to refine the quantitative risk assessment.

Question 3: In addition to the above, does the IESC consider that risks to MNES relating to surface water storage (including offsite impacts) and hydraulic fracturing have been adequately assessed? In particular, impacts related to overtopping and unintended discharge of produced water and hydraulic fracturing fluid stored in offsite storage ponds.

12. The model used by the proponent to forecast water production was not provided and apparently did not incorporate altered climatic conditions (e.g., frequency and scale of extreme rainfall events) that would be expected to be associated with climate change. This is highly relevant because the main intended water storage facility, Mt Kingsley Dam, has limited freeboard considering the forecasted water production (KCB 2021, p. 33). Should overtopping of this facility occur, surface water quality in the neighbouring Ironbark Creek and the constructed wetland may be impacted, together with riparian vegetation and other biota (Paragraph 13) associated with these water-dependent assets. Given these risks, the IESC recommends that a baseline assessment be undertaken of surface water quality and water regime in the constructed wetland and Ironbark Creek. Subsequently, comprehensive surface water quality monitoring needs to be undertaken for an appropriate period during and following construction to detect and guide mitigation of potential impacts to their riparian vegetation and aquatic habitats.
13. The proponent should conduct field-based sampling for aquatic biota (including invertebrates) in the constructed wetland and, when flowing, Ironbark Creek before, during and for an appropriate time after the proposed project. These data will provide baseline and subsequent monitoring information to allow the proponent to verify the predicted lack of impacts due to reduced water quality, altered flows or volumes, sedimentation and/or riparian zone clearance associated with the project.
14. Although the proponent describes actions to be undertaken following chemical spills and accidents (EHS Support 2021, App. 10), such events are not considered in the risk assessment for chemicals used on-site. Additionally, a key monitoring strategy proposed for hydraulic stimulation activities includes sampling source water, stimulation fluids, and flowback water for geogenic compounds. However, the IESC considers the sampling suite for flowback monitoring is insufficient for ensuring water quality objectives are met, and recommends also monitoring major ions, organics and naturally occurring radioactive materials.
15. The majority of produced water and hydraulic fracturing fluids will be managed and treated using the existing approved Arcadia water management facility in the adjacent petroleum lease. The proponent does not propose discharging produced water to watercourses; however, the following should be clarified to ensure that impacts to surface waters are minimised.
 - a. The proponent has not specified the intended volume or quality of produced water to be held in concrete tanks on-site which will be untreated and used for operational activities such as dust suppression. This should be provided to better understand the risks of potential impacts to surface water quality.
 - b. The proponent intends to dispose of waste salts in off-site licensed facilities (KCB 2021, p. 34). It is very likely that this brine will also include other contaminants, including metals, hydrocarbons and radionuclides, particularly if filtration plants' solids are disposed of in brine ponds. Noting this, the IESC remains concerned about the legacy issues of brine management and disposal because long-term storage constitutes a residual risk, particularly from leaks and seepages. Whether this occurs on- or off-site is immaterial to these risks and the proponent should provide sufficient information regarding their licensed facilities to be confident that no off-site impacts will occur. The IESC recommends that the proponent monitor water quality and volume of leaks and seepages, and continue to investigate beneficial reuse options for the brine.

Date of advice	7 February 2022
Source documentation provided to the IESC for the formulation of this advice	<p>AECOM (2021). <i>Matters of National Environmental Significance - Ecology Assessment</i>. Prepared for Santos Ltd.</p> <p>EHS Support (2021). <i>Chemical Risk Assessment Santos Towrie Development Petroleum Lease (PL) 1059</i>. Prepared for Santos Ltd.</p> <p>Klohn Crippen Berger (KCB) (2021). <i>Santos CSG Pty Ltd – Towrie Development Area, Water Assessment Report</i>. Prepared for Santos Ltd.</p> <p>Santos (2021). <i>Preliminary documentation for EPBC Act assessment</i>.</p> <ul style="list-style-type: none"> ➤ Att_A Additional information requirements ➤ Att_B Environmental Protocol ➤ Att_F Environmental Management Plan ➤ Att_G Significant Species Management Plan ➤ Att_H Rehabilitation Plan ➤ Att_I Relevant approvals
References cited within the IESC's advice	<p>Coal Seam Gas - Joint industry framework (2021). Managing impacts to groundwater resources in the Surat Cumulative Management Area under EPBC Act approvals. March 17, 2021. Available [online]: https://www.awe.gov.au/sites/default/files/documents/csg-joint-industry-framework.pdf.</p> <p>Doody TM, Hancock PJ and Pritchard JL (2019). <i>Information Guideline Explanatory Note: Assessing groundwater-dependent ecosystems</i>. Report prepared for the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development through the Department of Environment and Energy, Commonwealth of Australia.</p> <p>Saccò M, Blyth AJ, Humphreys WF, Kuhl A, Mazumder D, Smith C and Grice K (2019). Elucidating stygofaunal trophic web interactions via isotopic ecology. <i>PLoS ONE</i>, 14, Article e0223982.</p>