

Advice to decision maker on coal seam gas project

IESC 2021-129: Gas Supply Security Project (EPBC 2020/8856) – Expansion

Requesting agency	The Australian Government Department of Agriculture, Water and the Environment
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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 Origin Energy Upstream Operator Pty Ltd (operating as Australia Pacific LNG Pty Ltd) Gas Supply Security Project 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 Gas Supply Security Project (the project) is a proposed extension of the existing Australian Pacific LNG (i.e., Origin Energy) coal seam gas (CSG) developments (EPBC 2009/4794). The project area is located within the Surat and Bowen basins in central and southern Queensland and covers approximately 476,492 ha adjacent to the existing developments. There are five development areas, referred to as Mahalo, Denison, Spring Gully, Peat and Ironbark (Origin Energy 2021, pp. 25-26).

The project will involve the construction, operation, decommissioning and rehabilitation of up to 7,700 CSG wells and associated infrastructure, including 6,800 km of gas and water pipelines, 16 combined gas processing and water management facilities and supporting infrastructure (accommodation, access tracks, maintenance facilities, laydown areas and utilities) (Origin Energy 2021, p. 38). Gas production will

target the Walloon Coal Measures, Bandanna Formation (including the Baralaba Coal Measures), and Reids Dome Beds (Origin Energy 2021, App. F, p. i). Locations for site infrastructure, including for CSG wells, gas pipelines, water infrastructure (e.g., storages) and access tracks are not provided in the documentation supplied to the IESC, hindering the Committee's assessment of potential site-specific impacts of the project on water resources.

Construction for the project is expected to begin in 2024 with operations to begin in 2025 and continue until approximately 2061 (Origin Energy 2021, pp. 2, 39), although the proponent also gives an end date of 2075 (Origin Energy 2021, App. F, p. 23). The draft public environment report (PER) for the project presents a 'maximum development scenario' assuming that there will be commercial quantities of recoverable gas across the whole project area. The proponent claims that the final size of the project will be smaller (Origin Energy 2021, p. 2). Regardless, the IESC notes the size of the project and its potential to significantly contribute to regional environmental impacts via the addition of 7,700 wells to the 8,600 (OGIA 2021, pp. iii, 15) wells currently located across the Surat Cumulative Management Area (CMA).

The *Environment Protection and Biodiversity Conservation Amendment Act 2013* identifies all water resources (as defined by the *Water Act 2007*, e.g., wetlands, rivers, groundwaters), as a Matter of National Environmental Significance (MNES) in relation to CSG and large coal mining developments. Under this 'water trigger' legislation, environmental impact assessments must assess the risks of all potential impacts to all water resources. Although the current assessment addresses the project's risks to several EPBC Act-listed springs, it does not comprehensively assess the risk of potential impacts to other water resources such as ephemeral streams and groundwater-dependent vegetation at either local (development areas) or regional (Surat CMA) scales. Further, because of the substantial spatial and temporal extent of the project (7,700 wells over 4765 km² for up to 50 years), there is a high risk of cumulative impacts exceeding threshold ecohydrological requirements ('tipping points') of one or more of these water resources protected under the 'water trigger', potentially causing irreversible environmental harm.

Key potential impacts from this project are:

- extraction of 72.4 GL of groundwater over the life of the project, contributing to project-specific and cumulative drawdown impacts on eight known springs (including three EPBC Act-listed springs), 21 watercourse springs, terrestrial groundwater-dependent ecosystems (GDEs), 13 private bores, and possibly subterranean GDEs (including stygofauna);
- local (development area-specific)- and regional-scale reductions in water availability to other water resources (e.g., ephemeral streams, riparian and floodplain ecosystems) as a result of groundwater drawdown, altered alluvial recharge and changes to surface runoff caused by infrastructure such as access tracks;
- changes to surface water quality due to the intentional and unintentional releases of treated produced water and use of waste drilling fluids on-site, noting that the proponent has provided little information on these aspects; and
- legacy issues of substantial volumes (up to 9,500 ML) of brine and other contaminated byproducts of produced water.

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

• provide sufficient detail on project infrastructure (e.g., locations of CSG wells, pipelines, water management infrastructure, access tracks);

- ground-truth potential terrestrial and aquatic GDEs within the development footprints and further consider impacts to these GDEs within and near each development area where drawdown and altered alluvial recharge may occur;
- provide information on produced water treatment and disposal of liquid and solid (e.g., brine) wastes, all of which occurs offsite, and potential impacts to surface water flow regime, water quality and ecosystems;
- evaluate the risk of project-specific and total cumulative subsidence across each development area and associated change of slope at the ground surface that may impact on surface water flow regimes. If subsidence is likely to exceed background trends, then it is recommended that appropriate remote-sensing or airborne monitoring be designed and implemented across development areas at risk;
- provide development area- and project-specific ecohydrological conceptual models of how the project may impact the quality and functioning of water-dependent assets, taking into account the project's contribution to potential cumulative impacts at broad spatial and temporal scales; and
- review and update the project-specific management plans following collection of appropriate baseline and subsequent monitoring data that informs further assessment of project impacts. These management plans will need to be specific to each of the five development areas and their infrastructure footprints, acknowledging the hydrogeological and ecological differences among them and identifying where site-specific strategies will be required. These plans should also be integrated with the project-specific management plans, and the plans for offsite disposal of solid and liquid waste, to capture the regional context and cumulative impacts.

Context

The Surat CMA contains existing and proposed large-scale CSG developments. Modelling of cumulative groundwater impacts within the Surat CMA is undertaken by the Office of Groundwater Impact Assessment (OGIA) who publish their findings in the Underground Water Impact Reports (UWIR). Impacts to water-dependent assets under the UWIR are managed by the responsible tenure holder (RTH) assigned to the asset. Noting that the Surat CMA currently has approximately 8,600 CSG wells (OGIA 2021, pp. iii, 15), the project (up to 7,700 wells) represents a substantial increase in gas production in the area. The proposed project extends over 4765 km² and plans to extract CSG for up to 50 years.

The project is located in the Great Artesian Basin, in the Condamine-Balonne surface water basin and in the Brigalow Belt Bioregion. Water-dependent assets in and around the project area include springs (including three that are EPBC Act-listed), watercourses (creeks and rivers), watercourse springs (baseflow-fed reaches of watercourses), wetlands and potential subterranean and terrestrial GDEs.

The main impacts of the proposal relate to groundwater drawdown and potential changes to surface water quality due to release of produced water offsite, noting that limited information on releases is provided. The proposal is predicted to extract a total of 72.4 GL of water, with a peak water production rate of approximately 6 GL/year in three of the years between 2034-2039 (Origin Energy 2021, App. F, pp. 23-24). Cumulative drawdown is predicted to impact 13 bores, eight known springs (including three EPBC Act-listed ones located within 50 km of the proposal), and 21 known watercourse springs (Origin Energy 2021, App. F, pp. 2021, App. F, pp. 2021, App. F, pp. 2021, App. F, pp. ii-iii, 135-136). Extensive clearing of vegetation is proposed, including parts of some Threatened Ecological Communities (TECs) and riparian zone vegetation (e.g., creek crossings).

Under the 'water trigger', environmental impact assessments of CSG and large coal mining developments must comprehensively assess the risk of potential impacts to all water resources. The IESC considers that the current assessment does not fully address potential impacts to water resources such as ephemeral streams and groundwater-dependent vegetation at local (development areas) and regional

(Surat CMA) scales. The project's substantial spatial and temporal extent means that there is a high risk of cumulative impacts exceeding 'tipping points' of one or more of these water resources protected under the 'water trigger', potentially causing irreversible environmental harm.

Response to questions

Question 1: Does the IESC consider the key potential risks and impacts of the proposed action on water resources and water-related assets (as defined by the Commonwealth *Water Act 2007*) have been adequately identified and assessed? In particular, does the IESC consider that the proponent has adequately considered impacts related to:

- a. the extent of drawdown;
- b. subsidence;

c. groundwater-dependent ecosystems in the area, including, but not limited to, Great Artesian Basin Springs;

d. surface water, groundwater and groundwater-surface water interactions due to drawdown; and

e. discharge and the disposal of water-treatment by-products.

- 1. The IESC considers that the key potential risks and impacts of the proposed action on water resources and water-related assets have not been adequately identified and assessed. The proponent has not provided an adequate risk assessment of the project under the 'water trigger' and has not considered all potential project impacts to all water resources. As locations of site infrastructure (e.g., CSG well pads, access tracks, water management infrastructure including storages) were not provided, and the proponent has assessed a maximum impact scenario that they state may not reflect the final project (Origin Energy 2021, p. 2), the IESC considers that the project's potential impacts on water resources at local (development areas) and regional (Surat CMA) scales have not been adequately assessed.
- 2. Noting that additional work is required, detailed responses to Question 1 a. to e. are provided in the response to Question 2.

Question 2: If not, what additional work does the IESC consider is required to identify and assess the key risks and impacts?

Extent of drawdown

- 3. The IESC considers that the OGIA groundwater model is appropriate for identifying regional-scale impacts (IESC 2019). Although data on the number, placement and type of wells were provided to OGIA for inclusion in the regional groundwater model (Origin Energy 2021, App. F, p. 44), this information was not made available to the IESC, hampering the Committee's evaluation of the predicted drawdown extent.
 - a. Noting that the proponent claims that the final project's well layout will differ from that of the 'maximum development scenario' presented (Origin Energy 2021, p. 2), the IESC is concerned that the current project scenario simulated by the groundwater model is not appropriate for predicting its regional impacts. Any updates to the project scenario should be included in the proponent's assessment of project impacts (Paragraphs 15 and 16).
 - b. The proponent has provided site-specific hydrogeological conceptualisations (Origin Energy 2021, App. F, pp. 4, 77-87 and Apps. III-VII) and presented the results of an uncertainty analysis (Origin Energy 2021, App. F, App. XI) in an attempt to relate the regional-scale

OGIA model to potential local-scale impacts. However, if the proposed local-scale ecohydrological conceptual models (ECMs) (Paragraph 15) indicate development area-specific impact pathways and risks to water-dependent assets protected under the 'water trigger', then additional development area-specific data on hydraulic parameters (e.g., vertical hydraulic conductivity) with the final well layout are needed to develop appropriate local-scale groundwater models to complement the OGIA groundwater model.

Subsidence

- 4. The proponent states that potential impacts from subsidence are considered to be negligible in terms of impacts to water resources, and has summarised some subsidence monitoring results across the Surat CMA. However, a recent subsidence assessment across the south-east of the Surat Basin (OGIA 2021, Chapter 7 and Appendix F) presented observations of up to 90 mm of total subsidence since 2015 within heavily developed gasfields (based on InSAR remote sensing data). The rate of subsidence is likely higher early in development and gradually stabilises over 3 to 7 years (OGIA 2021, p. 124). The UWIR assessment also presented predictions for future subsidence based on modelled groundwater drawdown and geomechanical data input into a 3D geomechanical model. Risks for aquatic ecosystems and aquifer integrity were noted, although observed and predicted changes in surface slopes due to subsidence were very small (10 to 40 mm over 1 km), and are unlikely to materially change surface flows to watercourses at the regional scale.
- 5. Evaluating the risk of project-specific and cumulative subsidence effects across each development area is required to supplement the regional scale assessment of subsidence. If the risk of subsidence exceeds background trends (e.g., natural ground movement of soils), then it is recommended that appropriate remote-sensing or airborne monitoring be designed and implemented across development areas at risk. This may require additional monitoring to the current subsidence evaluation programs undertaken by OGIA, Geoscience Australia and industry, with a combination of appropriate monitoring methods (OGIA 2021, Table 7.1 and Appendix F) and numerical models using a vertical and horizontal resolution that is commensurate with the risk of effects on surface water flows.

Groundwater-dependent ecosystems including Great Artesian Basin springs

- 6. The proponent has noted that the project will contribute to drawdown at several EPBC Act-listed springs but has not provided an assessment of the likely ecological impacts of this drawdown. Noting the contribution of the project to cumulative impacts, this aspect is discussed further in Paragraph 14. Under the 'water trigger', the proponent should assess the potential ecological impacts of the project on GDEs, in addition to EPBC Act-listed springs, including terrestrial GDEs (Paragraph 7), subterranean GDEs (Paragraph 8) and watercourse springs (Paragraph 9) at both local (development areas) and regional (Surat CMA) scales.
- 7. Ground-truthing has not been undertaken for potential terrestrial GDEs, noting that two of the EPBC Act-listed TECs in the area may be groundwater-dependent and some are located in areas of predicted groundwater drawdown. The distribution of potential terrestrial GDEs and their likely groundwater-dependence should be characterised using appropriate methods (e.g., Doody et al. 2019), especially in areas where the OGIA model predicts drawdown in Layer 1 (alluvium, Cenozoic sediments and basalt). Information from field investigations should be integrated with ECMs (Paragraph 15) to assess the risks to terrestrial GDEs and riparian vegetation at development area and project-specific scales and to guide monitoring and mitigation strategies.
- Likewise, subterranean GDEs (e.g., stygofauna) should be sampled using appropriate methods (e.g., those recommended by Doody et al. 2019). The IESC notes that appropriate stygofauna habitat exists in the project area and that stygofauna are known from the shallow coal seams of the Surat CMA (Origin Energy 2021, App. F, App. III, p. 99, App. IV, p. 77, App. V, p. 118, App. VI, p. 85, App.

VII, p. 84). If species are found at shallow depths, the impact assessment for each development area and cumulatively should consider potential impacts to habitat quality, noting that some drawdown is predicted in model Layer 1 (alluvium, Cenozoic sediments and basalt). Appropriate monitoring and mitigation strategies based on this information can be incorporated into relevant management plans, potentially for each development area.

Surface water, groundwater and groundwater-surface water interactions due to drawdown

9. The proponent has not adequately considered the ecological impacts of groundwater drawdown to surface water, groundwater and groundwater-surface water interactions and surface water assets, mostly focusing their limited assessment on impacts to EPBC Act-listed springs. As perennial sources of water, springs and watercourses act as both ecological refuges and biological hotspots in semi-arid and arid environments, they fulfil ecological roles that extend far beyond their immediate spatial area (Davis et al. 2017). Springs, watercourses and wetlands not only support habitats for aquatic species they provide a mosaic of surface water sites, and linear riparian corridors, that enable terrestrial species to move within and across a region. This connectivity is needed to ensure that EPBC Actlisted and other species persist within landscapes fragmented by resource extraction, agricultural and other industries. Potential impacts of drawdown to all springs, watercourse springs, watercourses, wetlands and any other surface expressions of groundwater in the project area should be considered, especially as the OGIA model is not able to robustly predict local-scale connectivity between surface water ecosystems and hydrogeological processes in Layer 1 at an appropriate scale for predicting ecological impacts.

Discharge and the disposal of water-treatment by-products

- 10. The IESC notes that 72.4 GL of water is expected to be produced (abstracted) over the life of the project (Origin Energy 2021, App F, pp. 23-24), and that produced water is expected to range from highly brackish to saline (Origin Energy 2021, App F, pp. 29, 34). Produced water will be managed through existing infrastructure offsite (Origin Energy 2021, App F, p. iii) and the proponent has existing permits to discharge water into the environment (e.g., Origin Energy 2021, App. F, App. V, p. 20). Further information on treatment, disposal and potential impacts is not provided. The proponent must justify produced water treatment methods, provide locations of discharge sites and assess what impact releases might have on the immediate and downstream receiving environments. Additional details should be provided regarding the water quality of the released water and of water in the receiving environment (if applicable) and regime of release.
- 11. The proponent intends to dispose waste salts and brine in a regulated waste facility if beneficial reuse options are not possible (Origin Energy 2021, App. F, pp. 29-30). The IESC notes that brine may include other contaminants (e.g., metals), particularly if filtration plants' solids are disposed of in brine storages. The IESC is concerned about the legacy issues of brine management and disposal as long-term storage constitutes a risk, particularly from leaks and seepages. Whether this occurs on or offsite is immaterial to these risks and the proponent should provide sufficient information regarding storage facilities to increase confidence that no impacts will occur. Appropriate monitoring of seepage (e.g., volume and water quality) from pond storages should accompany any long-term storage plans.
- 12. The proponent has undertaken a comprehensive risk assessment of drilling, hydraulic fracturing and water treatment chemicals. Although the 'predicted no effects concentrations' for several chemicals tested in water and soil are exceeded, the limited possible exposure pathways (apart from accidental release) suggest that the overall risk of these chemicals to biota is low. However, the proponent should expand their risk assessment to include all relevant geogenic chemicals, including metals, metalloids and naturally occurring radioactive materials.
- 13. Further, the proponent should consider the potential impacts of reuse of waste drilling fluids on-site (Origin Energy 2021, App. I, pp. 8-9) to the receiving environment.

Question 3: Does the IESC consider there is adequate consideration of the proposed action's contribution to cumulative impacts associated with other coal seam gas production and mining activities in the area? If not, what additional work is required to adequately assess the proposed action's contribution to cumulative impacts?

- 14. The proponent considers that, as their contribution to cumulative groundwater drawdown is relatively small, there will not be a significant impact to surface-expression GDEs (Origin Energy 2021, p. 236). The IESC disagrees with this statement because there is not always a direct relationship between the magnitude of hydrogeological processes such as drawdown and the severity of ecological impacts on GDEs. This is especially true when some 'tipping point' for a threshold requirement (e.g., maximum depth of rooting zone for groundwater-dependent vegetation in an area) is exceeded by a small but critical amount of drawdown. Because of the project's large spatial (4765 km²) and temporal extent (up to 50 years), the IESC is concerned that the project's contribution to cumulative impacts has a high risk of exceeding an ecological 'tipping point' for one or more threshold ecohydrological requirements for some of these water-dependent assets. For example, breaching tipping points may alter flow regimes or key ecological processes in specific areas leading to irreversible repercussions on downstream water-dependent assets. There may also be broader regional impacts if critical habitats or assemblages are impacted, affecting the integrity of the ecological mosaic of these ecosystems across the Surat CMA.
- 15. The proponent must provide an ecohydrological conceptualisation of how the project will impact the quality and ecological condition of all water resources in the area, including springs, watercourse springs, watercourses, terrestrial GDES and subterranean GDEs and any associated ecosystems or species. This conceptualisation must evaluate the project's potential contribution to cumulative impacts to all water-dependent assets, specifically consider the unique characteristics of each development area and its components, and predict how the cumulative impacts might have broader effects across the Surat CMA that may persist over time, particularly noting that groundwater drawdown is predicted over several hundred years (Origin Energy 2021, App. F, App. X). This conceptualisation needs to be based on accurate information regarding site infrastructure placement and extent. This ECM should integrate the outputs of local-scale ECMs for each development area and its components.
- 16. Cumulative impacts may also arise from the substantial amount of planned surface infrastructure associated with 7,700 CSG wells such as 6,800 km of gas and water pipelines and 16 combined gas processing and water management facilities, together with clearing of vegetation within the 17,041-ha development footprint. Collectively, these activities are likely to alter local patterns of runoff and alluvial recharge, disrupt the continuity of vegetated riparian corridors along watercourses, and cause fragmentation of broader patches of remnant vegetation. In turn, these processes may change flow regimes in ephemeral streams, alter inundation patterns of floodplains, and impact on the persistence and ecological functioning of aquatic and associated terrestrial ecosystems, especially where fragmentation increases impacts due to edge effects and access to invasive species. The proponent should use the regional ECM of potential impact pathways (Paragraph 15) and field-collected baseline data (Paragraphs 7-9) to assess the likely ecological cumulative impacts of the project on all water-dependent assets protected under the 'water trigger'.

Question 4: Does the IESC consider the proposed monitoring, mitigation and management measures are adequate? If not, what additional measures does the IESC consider are required to monitor, mitigate and manage impacts on water resources?

17. The IESC considers that the proposed monitoring, mitigation and management measures require further work to address the potential site-specific impacts of the project. Monitoring, mitigation and management are proposed to be undertaken using a combination of the UWIR process, project-specific management plans, and standards required under the *Queensland Water Act 2000*. It is

recommended that the local-scale ECMs (Paragraph 15) be used to prepare monitoring, mitigation and management plans for each development area, taking into account the relevant hydrogeological and ecological characteristics. These plans need to be integrated with existing management plans at the offsite disposal locations.

18. Given that the discharge permeate from reverse-osmosis treatment of produced water has an ionic composition that likely differs from the receiving waters, the proponent should undertake direct toxicity assessment of the permeate and monitor water quality of receiving waters at offsite disposal locations.

Date of advice	6 February 2022
Source documentation provided to the IESC for the formulation of this advice	Origin Upstream Operator Pty Limited (Origin Energy) 2021. Draft Public Environment Report [including appendices] EPBC 2020/8856. October 2021.
References cited within the IESC's advice	Davis, JA, Kerezy, A, Nicol, S 2017. Conserving perennial water is critical in arid landscapes. Biological Conservation 211, 30–35. Doody TM, Hancock PJ, Pritchard JL 2019. Information Guidelines Explanatory Note: Assessing groundwater-dependent ecosystems. Prepared for the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development through the Department of the Environment and Energy, Commonwealth of Australia. Available at: https://iesc.environment.gov.au/system/files/resources/422b5f66-dfba-4e89-adda- b169fe408fe1/files/information-guidelines-explanatory-note-assessing-groundwater- dependent-ecosystems.pdf Independent Expert Scientific Committee on Large Coal Mining and Coal Seam Gas (IESC) 2018. Information Guidelines for proponents preparing coal seam gas and large coal mining development proposals. Commonwealth of Australia. Available at: http://www.iesc.environment.gov.au/system/files/resources/012fa918-ee79-4131-9c8d- 02c9b2de65cf/files/iesc-information-guidelines-may-2018.pdf. Independent Expert Scientific Committee on Large Coal Mining and Coal Seam Gas (IESC) 2019. Fact sheet, the role of the Office of Groundwater Impact Assessment and the Independent Expert Scientific Committee on Cal Seam Gas and Large Coal Mining Development in environmental assessments. Commonwealth of Australia. Available at: http://iesc.environment.gov.au/system/files/resources/31feb114-2d09-4a98-8b3f- ad629dbe4b97/files/environmental-assessments-fact-sheet.pdf Office of Groundwater Impact Assessment (OGIA) 2019. Underground Water Impact Report for the Surat Cumulative Management Area. OGIA Brisbane. July 2019. Available at: https://www.rdmw.qld.gov.au/data/assets/pdf_file/0019/1461241/uwir-full-report.pdf Office of Groundwater Impact Assessment (OGIA) 2021. Underground Water Impact Report for the Surat Cumulative Management Area, Consultation Draft. OGIA, Brisbane. Outpace 7021. Available
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