

Advice to decision maker on coal seam gas development

Proposed action: Arrow Surat Gas Project (EPBC 2010/5344) – New Development

Requesting agencies	Department of Sustainability, Environment, Water, Population and Communities; and the Queensland Department of Environment and Heritage Protection
Date of request	22 July 2013
Date request accepted	22 July 2013
Advice stage	Environment Impact Assessment (supplementary)
Summary of request from the regulators	<p>The Department of Sustainability, Environment, Water, Population and Communities (the Department) is currently assessing the proposed project in accordance with the provisions of the <i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act) and the Queensland Department of Environment and Heritage Protection is currently assessing the proposed project in accordance with the <i>Environmental Protection Act 1994</i> (EP Act).</p> <p>The Department and the Queensland Department of Environment and Heritage Protection notify the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (the Committee) of an opportunity to comment on the supplementary Environmental Impact Statement (SEIS). Specifically, the Department and the Queensland Department of Environment and Heritage Protection seek the advice of the Committee on the following:</p> <ol style="list-style-type: none"> 1. Does the supplementary EIS address the Committee's advice of 20 February 2013 on the draft EIS? 2. Are the mitigation and management measures committed to by the proponent in the supplementary EIS adequate? In particular: <ol style="list-style-type: none"> a. Is the proposed investigative program that will help quantify the connectivity between the Condamine Alluvium and Walloon Coal Measures adequate to determine the magnitude of hydrogeological connections between them? b. Are the measures proposed to manage discharge into waterways adequate? c. Are brine and salt management measures adequate? 3. Does the Committee recommend any further water related measures to mitigate and manage impacts, and enhance the protection of matters of national environmental significance? 4. Has Arrow Energy identified the matters that would need to be considered in managing the proposed discharge into waterways? 5. Is the suite of mitigation measures proposed adequate to protect identified waterway

values at and downstream of the discharge sites?

Advice

The Committee has previously considered the Arrow Surat Gas Project (EPBC 2010/5344) during the draft Environmental Impact Statement (EIS) stage. The advice (dated 20 February 2013) is available on the Committee's website.

The Committee has now been requested to provide advice to the Commonwealth and State regulator on the Supplementary Environmental Impact Statement (SEIS) for the Arrow Surat Gas Project in Queensland. This advice draws on aspects of information in the SEIS together with the expert deliberations of the Committee.

The Arrow Surat Gas Project would expand Arrow Energy's coal seam gas operations in the Surat and Clarence Moreton Basins in Queensland. The proposed project's petroleum tenures cover an area of 6,100 km² and extend from Wandoan in the north, Dalby in the east, to Goondiwindi in the south. Arrow Energy has planned for approximately 6,500 production wells through the project area, with an estimated gas production of 1,215 terajoules per day. The proposed project is predicted to produce approximately 510 billion litres of co-produced water, which will generate an estimated 2.3 million tonnes of salt over the 40 year life of the project.

The Committee in line with its Information Guidelines¹ has considered whether the proposed project assessment has used the following:

Relevant data and information: key conclusions

A solid set of hydrogeological data underpins the regional conceptual groundwater model. However, there is insufficient data to inform the degree of connection between the Condamine Alluvium and the Walloon Coal Measures. The preferred location of the majority of infrastructure has also not been finalised, no final disposal option for co-produced water or brine is selected, and no discharge strategy is available. Therefore, the level of information contained within the proponent's assessment documentation is insufficient to provide a clear understanding of the potential risks associated with this project.

Limited water quality and aquatic ecological surveying has been undertaken. The surface water and ecological surveys conducted do not adequately address the spatial, seasonal and temporal variability across the 6,100 km² petroleum tenure area. These limitations are likely to lead to an under-estimation of risks to water resources and aquatic ecosystems. Further assessment should expand the field surveys to allow for thorough assessment of impacts to ecosystems and ecological receptors throughout the development area.

A regional water balance and site-level surface water and groundwater balances are not provided and are needed to accurately assess local and regional scale impacts on water resources and dependent biota.

Application of appropriate methodologies: key conclusions

The proponent has adopted the Queensland Office of Groundwater Impact Assessment's (OGIA) Surat Cumulative Management Area Groundwater Model, which incorporates the smaller scale Condamine Alluvium model. Whilst the OGIA model is the most relevant model available for assessing regional-scale groundwater impacts in the Surat Basin, the model has limited ability to predict localised impacts outside of the Condamine Alluvium. Development of a combined surface water-groundwater model and monitoring systems that enable early detection of potential impacts would facilitate improved identification and proactive management of potential impacts at a localised scale.

Identification and differentiation of flux between the Condamine Alluvium, the Walloon Coal Measures and other underlying aquifers would facilitate a more spatially accurate prediction of drawdown within the Alluvium. The potential for flow reversal from the Condamine Alluvium to underlying aquifers should be considered explicitly.

Quantification of potential compression in the Springbok Sandstone would enable further evaluation of the risks to the structural integrity of this aquifer and overlying aquifers, and the prediction of subsidence effects.

Integrated flood modelling across each catchment area would ensure that risks to the environment and adjacent landholders arising from the development of project infrastructure have been adequately identified and mitigated.

A regional level approach has been applied to identifying and assessing the sensitivity of environmental values. This approach has limited ability to protect local environmental values and has led to conflicting allocation of sensitivity classifications.

The assessment of cumulative impacts did not consider aquatic ecology, impacts from infrastructure development, discharges (other than co-produced water) and updated information on the potential impacts to groundwater dependent ecosystems.

Reasonable values and parameters in calculations: key conclusions

The updated groundwater model does not incorporate all of the proposal's tenement areas. Therefore, the magnitude and extent of groundwater drawdown and volume of co-produced water and brine generated from production in these areas are likely to be underestimated.

Details of the reservoir model, used to estimate the total, average and peak volumes of co-produced water generated over the life of the project, have not been provided. There are no defined confidence limits on the predicted volumes of co-produced water generated.

The assessment of predicted impacts on hydrology, geomorphology and aquatic ecology has been based on assumptions regarding the quality and discharge rates of co-produced water. As the actual quality, quantity and discharge rates have not yet been finalised, impacts may have been underestimated.

Question 1: Does the supplementary EIS address the Committee's advice of 20 February 2013 on the draft EIS?

Based on a review of SEIS documentation, one matter previously raised by the Committee, relating to the potential impacts from well failure, was addressed in full and the remaining matters were partially addressed. Observations and advice in relation to partially addressed matters are provided below.

1. *Groundwater model:* The Committee recognises that the OGIA groundwater model is the most relevant model available for assessing regional scale groundwater impacts in the Surat Basin. Coupled with the Condamine Alluvium groundwater model, it has the ability to provide a better assessment of impacts at a smaller scale within the Condamine Alluvium. By adopting the OGIA model as a basis for their assessment of groundwater depressurisation, the proponent has, compared to the draft EIS, provided a higher level of confidence in its ability to predict impacts resulting from the proposed project. However, the use of both single phase groundwater flow and dual phase reservoir models has resulted in a significant discrepancy in the prediction of co-produced water which needs resolution. Whilst it is acknowledged that the OGIA model will be subject to ongoing review and updates to address outstanding areas of uncertainty, consideration should be given to the following matters when evaluating the proposed project:
 - a. Incorporation of all of the proponent's tenement areas in the model to ensure that potential impacts are not underestimated;
 - b. Discrepancies between the groundwater and reservoir models require reconciliation and resolution;
 - c. Development of a combined surface water-groundwater model would enhance the proponent's ability to assess potential impacts on water resources and dependent ecosystems in an integrated manner;
 - d. The groundwater monitoring program should be designed to facilitate early detection of potential impacts on environmental assets at a local scale, particularly where greater drawdown than predicted may result in more adverse impacts on environmental values and other groundwater users. This may require expansion of the proponent's groundwater monitoring responsibilities beyond those identified in the Underground Water Impact Report (QWC, 2012)² and collaboration with other coal seam gas developers in the Surat Basin;
 - e. Current uncertainties about aquifer/aquitard properties in the Condamine Alluvium could mean that groundwater drawdown in the Alluvium will potentially be different than predicted in the SEIS. The results of the Condamine Interconnectivity Research Project will be critical to reducing uncertainty about aquifer/aquitard properties and refining the hydrogeological conceptualisation and groundwater model. If the research project identifies a greater degree of connectivity than modelled in the SEIS, groundwater drawdown within the Alluvium should be re-modelled and mitigation

measures need to be reviewed.

- f. Lack of flux differentiation between underlying aquifers and the Condamine Alluvium may result in more spatially variable drawdown within the Condamine Alluvium than predicted in the SEIS;
 - g. The potential for flow reversion may manifest in areas where direct contact between the Walloon Coal Measures and the Condamine Alluvium exists, or in areas where the transition layer between the Walloon Coal Measures and the Condamine Alluvium is relatively thin. It is recommended that the potential for flow reversal is considered during interconnectivity investigations.
2. *Structural integrity and subsidence*: The impacts of significantly depressurising one component of a pressurised system, whilst leaving the rest of the system pressurised, are unknown and may lead to further issues about the structural integrity of the overlying aquifers. Dewatering of the Springbok Sandstone may cause compression and loss of structural integrity within this aquifer, which may translate to overlying aquifers. Quantification, appropriate sensitivity and uncertainty analyses are needed to accommodate the possible facies variation.
 3. *Subsidence Effects*: The risk of subsidence effects on surface water resources and dependent ecosystems resulting from loss of structural integrity in the Springbok Sandstone should be reconsidered in the context of the results of the investigation.
 4. *Co-produced water*: Details of the proponent's reservoir model used to predict co-produced water volumes have not been provided in the SEIS. Methods applied to derive co-produced water volumes should be made explicit to improve confidence in predicted water production volumes. The discrepancies in volumes produced should be reconciled and incorporated in the OGIA groundwater model.
 5. *Groundwater dependent ecosystems*: The SEIS adopts the OGIA groundwater model findings but this does not enable a comprehensive assessment of potential impacts on groundwater dependent ecosystems, particularly those that have not been itemised in the Underground Water Impact Report (QWC, 2012)². Confidence in the conclusions and management measures proposed in the SEIS would be improved by integrating existing knowledge with the results of field-based validation and assessment, and using the updated groundwater model to explicitly assess potential cumulative impacts on groundwater dependent ecosystems. The following specific activities are recommended:
 - a. Conduct a revised cumulative impact assessment which integrates groundwater model outputs with known and potential groundwater dependent ecosystems and presents the outputs in map form. Maps should clearly identify potentially impacted ecosystems;
 - b. Inclusion of a confidence interval assessment for localised groundwater drawdown impacts;
 - c. To confirm the source aquifer for Spring Complex 584, consider the results of additional field investigations recommended by KCB (2012)³ as soon as they become available;
 - d. Field-based investigations to assess the hydrogeological and ecological characteristics of potentially impacted watercourse springs;
 - e. Inclusion of the potential groundwater dependent ecosystems identified by Halcrow in 2012 and 2013 (as referenced in the SEIS) in the revised cumulative impact assessment recommended in paragraph 5(a) above. The results of field-based investigations to validate the groundwater dependency of these ecosystems should be incorporated into the proponent's (and OGIA's) groundwater model as soon as they become available;
 - f. Incorporation of data from the Queensland Department of Environment and Heritage Protection's groundwater dependent ecosystem mapping dataset;
 - g. Identification of predicted changes in stream connectivity with the underlying aquifer; for example, where groundwater drawdown may cause a 'low gaining' reach to become a 'losing' reach;
 - h. Review the assumption that losing streams do not support groundwater dependent ecosystems, as this does not account for ecosystems that may rely on sub-surface expression of groundwater. Assess potential impacts on non-spring based ecosystems with a moderate to high potential for interaction with the sub-surface expression of groundwater prior to commencement of production;
 - i. Conduct a program of field-based investigations to determine the groundwater-dependency of ecosystems, where uncertainty exists; and

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- j. Ensure that the groundwater monitoring and management program allows for early detection of potential impacts on groundwater dependent ecosystems and contains adequate management responses. As a precautionary measure, the monitoring program should extend to Lake Broadwater and the Long Swamp wetland to confirm any dependence on groundwater.
6. *Water balance:* A regional water balance should be developed for the major river basins and sub-basins in the development area. The water balance should quantify significant point source and diffuse inputs, outputs, exchanges of water between surface water and groundwater, and demonstrate how the regional surface water system will interact with the proposed Surat Gas Project and other regional coal seam gas and coal mining developments. In this regard, it is noted that groundwater drawdown may change the connection status of a water course where the water table is close to the riverbed elevation. This may affect the regional surface water balance. Once the location of infrastructure is known, a site-specific water balance would aid in the assessment of localised changes to the storage or flow of water, and inform the development of the water management strategy.
7. *Water quality and aquatic ecology:* Whilst sampling methods for the surveys conducted for the SEIS appear appropriate, the overall survey effort does not provide an adequate basis for characterisation of baseline water quality and ecological conditions across the proposed project's area of influence. In relation to the additional sampling proposed in the SEIS, the Committee suggests that:
- Additional representative ecological monitoring sites are surveyed to improve confidence in the baseline characterisation and the allocated sensitivity classes of aquatic ecosystems; particularly for the Dawson River, upper Balonne River and Border Rivers catchments;
 - Seasonal and multi-year sampling is completed prior to commencement of construction activities to gain an understanding of baseline intra and inter-annual variability of water quality and ecological systems in these water courses; and
 - Water quality and aquatic ecology baseline sampling extends a sufficient distance downstream from discharge locations to enable impacts on aquatic ecosystems to be identified and compared with reference or background conditions along the length of any mixing zones.
8. *Cumulative impacts:* Given the combined scale and potential impacts of the current coal seam gas developments in the region (Santos, EPBC 2008/4059; Australia Pacific LNG, EPBC 2009/4974; and Queensland Gas Company, EPBC 2008/4398), the Committee notes:
- This development will contribute to the cumulative impacts of three already approved projects that represent a significant perturbation of the hydrological balance. Understanding cumulative impacts is especially important for determining the full extent of impacts on the Condamine Alluvium;
 - Given that the proponent predicts that generation of co-produced water from coal seam gas developments in the Surat Basin is currently expected to peak at approximately 550 ML/d in 2015*, cumulative impacts to surface water and dependent ecosystems are likely to be significant and adverse if co-produced water and brine are not considered and managed across the Surat Basin in an integrated manner;
 - To increase confidence in the predictions, consideration should be given to the development of an integrated assessment of cumulative impacts on surface water and groundwater resources, and dependent ecosystems, incorporating relevant activities and impacts from all existing and proposed coal seam gas and mining developments in the region; and
 - Collaboration on data and monitoring between all coal seam gas and coal mine operators in the Surat Basin would facilitate assessment of cumulative impacts at a site and regional level.
9. *Discharge Strategy:* The Discharge Strategy has not been finalised. Analysis of the proponent's preliminary water management studies are provided in the responses to Questions 2 and 3.

Question 2(a): Are the mitigation and management measures committed to by the proponent in the supplementary EIS adequate? In particular: Is the proposed investigative program that will help quantify the connectivity between the Condamine Alluvium and Walloon Coal Measures adequate to determine the magnitude of hydrogeological connections between them?

10. Based on the information available to the Committee and presented in the SEIS, it appears that the Condamine Interconnectivity Research Project is appropriate to determine the magnitude of

hydrogeological connection between the Condamine Alluvium and the Walloon Coal Measures. It is recommended that connectivity between these formations is subject to ongoing assessment and review based on monitoring data collected by the proponent. The results of this study will be fundamental to determining the impacts on the water resources within the Condamine Alluvium.

Question 2(b): Are the measures proposed to manage discharge into waterways adequate?

11. As the Discharge Strategy has not been finalised, the adequacy of proposed measures to manage discharge cannot be evaluated. The Discharge Strategy will contain details of the quantity, quality and timing of proposed discharges. These factors are critical for assessing potential impacts on receiving watercourses and ecosystems and for developing measures to avoid or minimise adverse outcomes. The following points provide an evaluation of relevant preliminary studies presented in the SEIS.
12. The proponent's Preliminary Environmental Flows Assessment, which forms the initial stage of development for the Discharge Strategy, was based on limited hydrological, water quality, and ecological data. The SEIS contained recommendations to address these knowledge gaps but in many cases the recommended investigations were not incorporated into the proponent's Strategic Environmental Management Plan. Matters to be considered in managing the discharge of co-produced water have been identified at a high level in the proponent's assessment documentation. However, the proposed investigations to fill site-specific knowledge gaps may reveal additional matters for consideration. Further matters may also be identified when there is more certainty about the volume and quality of water that will be discharged. In addition to the matters identified within the SEIS, consideration should also be given to:
 - a. The end of valley salinity targets for the Condamine-Balonne River referred to in the Murray Darling Basin Plan;
 - b. The results of published studies, such as the Queensland Murray Darling Basin Aquatic Conservation Assessment (Fielder et al, 2011)⁴, which identify areas of high aquatic conservation value in the vicinity of proposed discharge locations;
 - c. Conducting additional water quality testing to enhance understanding of the quality of co-produced water across the development area;
 - d. The potential for altered flow regimes in receiving waters to increase susceptibility to flood-induced erosion of creek channels downstream of discharge points; and
 - e. Potential cumulative impacts with other developments within the catchments of watercourses that will receive co-produced water discharges.

A consolidated, detailed plan for development of the Discharge Strategy needs to be provided and considered as part of the approval process to enable its scope and methodology to be assessed.

13. The SEIS draws a number of conclusions about potential impacts on channel geomorphology, water quality and aquatic ecology based on assumptions about the quantity, quality and timing of discharges. However, as the proponent has retained the options of varying discharge rates from those assumed and releasing untreated co-produced water, the magnitude and downstream extent of impacts, and therefore the environmental assets that may be affected, cannot be accurately determined. Management measures that have been developed on the basis of these conclusions may need to be revised if the underlying assumptions prove to be incorrect.
14. Discharges that change the flow regime of a watercourse have the potential to cause adverse outcomes for aquatic ecosystems, particularly those adapted to seasonal periods of low and no flow. Therefore, discharges that result in a reduced duration or number of natural cease to flow events may not be appropriate for ephemeral watercourses, such as Bottle Tree Creek. Additionally, depending on the selected discharge strategy, aquatic ecosystems may be significantly impacted during the proposed project's operational phase and then again after decommissioning of the project. Site-specific investigation would enable assessment of the long-term ecological impacts of flow regime variation on aquatic ecosystems.
15. One EPBC-listed species (*Maccullochella peelii peelii* (Murray Cod)) and several other species of conservation significance were recorded downstream of proposed discharge locations during field investigations conducted for the SEIS. The Condamine River population of *Maccullochella peelii peelii* has been assessed as an 'important population' according to the definition provided by the EPBC

Significant Impact Guidelines. Explicit consideration should be given to the life-cycle sensitivities of species of conservation significance, as well as the water quality needs of other downstream water users to ensure that co-produced water discharges do not result in adverse impacts on sensitive receivers.

Question 2(c): Are brine and salt management measures adequate?

16. While a number of permanent disposal options were presented and a preferred beneficial use option was identified, the proponent's studies and conclusions in relation to the feasibility of each option were not made available to the Committee for consideration. As such, the SEIS does not provide sufficient information on brine and salt management measures or disposal options to enable a scientifically based analysis of their adequacy to be undertaken.
17. The proponent proposes to design the storage capacity of brine dams to be sufficient until a feasible permanent disposal option is identified and operational. The proponent's intention to design dams in accordance with Queensland Government requirements is noted. However, design details for the brine dams are not provided and are needed to assess capacity, the risk of leakage, breakage and overtopping, and the consequences to downstream aquatic ecosystems and receptors.
18. Based on the large volume of brine that would be generated and the presence of drinking water sources and species of conservation significance downstream of proposed brine storage areas, stringent in-built environmental controls, monitoring and inspection systems, and emergency response procedures are recommended. In addition to monitoring of groundwater in the vicinity of brine and salt storage areas as a leak detection measure, management measures should include routine monitoring of surface water quality upstream and downstream of containment areas, and soils down-wind of salt storage areas.
19. Given the significant risks to the environment and adjacent stakeholders in the event that brine and salt are not appropriately managed in this landscape, it is recommended that a selected option for permanent disposal of waste brine and salt is identified and all relevant arrangements and permits are finalised before brine is produced. Options analysis should include an assessment of the impacts of feasible disposal strategies and identification of mitigation and management measures to avoid or reduce impacts to acceptable levels for the selected option. Ecotoxicity testing to evaluate the impacts of brine disposal options may be needed.

Question 3: Does the Committee recommend any further water-related measures to mitigate and manage impacts, and enhance the protection of matters of national environmental significance?

In addition to the recommendations provided elsewhere in this advice, the following measures would enhance protection for matters of national environmental significance:

20. *Rheodytes leukops* (Fitzroy River Turtle): Provide evidence-based justification to support the proponent's conclusion that this species is not present within the proposed development's area of influence. Current conclusions were based on limited field investigations in the Dawson River catchment and did not appear to consider the noted potential for this species to occur in the upper Dawson River by URS (2010)⁵ or the potential for Roche Creek and Juandah Creek to support groundwater dependent ecosystems. The habitat assessment should include consideration of potential habitat that may be affected by groundwater drawdown, subsidence and/or downstream impacts of infrastructure development and maintenance, including where these extend beyond the proponent's petroleum tenure boundaries. Field-based investigations are needed where there is uncertainty about the presence of this species.
21. *Maccullochella peelii peelii* (Murray Cod): When evaluating the proponent's Discharge Strategy, afford a high level of protection to the Condamine River population of this species, given its status as an 'important population'.
22. *Rostratula australis* (Australian Painted Snipe): Undertake targeted surveys for this species in wetlands within the proposed project area to identify foraging, roosting and breeding habitat. Confirmed foraging, roosting or breeding habitat should be protected from disturbance or changes in water quality that may impact on food sources for this species.
23. *Lake Broadwater and Long Swamp*: Given the hydrological connection between Lake Broadwater and the Long Swamp wetland and that the latter is a possible breeding location for *Rostratula australis* (Australian Painted Snipe), it is recommended that the Long Swamp wetland is allocated a 'high' sensitivity ranking and that development activities that may impact on the environmental values of this wetland are avoided. Additionally, the Committee supports the recommendation to assess and avoid potential negative impacts that could change the flood hydrology or geomorphology of Lake Broadwater

and suggests that this requirement is extended to the Long Swamp wetland.

24. *Sensitivity classification*: While the proponent's sensitivity classification system is useful at a regional scale, it does not adequately capture the variety of environmental values at the site level nor account for the connectedness or inherently variable nature of water resources and their dependent ecosystems. These issues are of significance as sensitivity classifications have been used as the basis for application of management and mitigation measures. The ability of this classification system to protect environmental values would be improved by:
- a. Undertaking the additional baseline surveys discussed in paragraph 7 of this advice;
 - b. Providing evidence from published literature to support the adopted sensitivity criteria and banding thresholds;
 - c. More clearly linking the environmental value with the sensitivity criteria;
 - d. Incorporating the findings of published studies that identify areas of high aquatic conservation value, such as the Queensland Murray Darling Basin Aquatic Conservation Assessment (Fielder *et al*, 2011)⁴ and areas designed as 'high ecological value' (HEV) in the Dawson River Sub-basin Environmental Values and Water Quality Objectives plan (DEHP, 2011)⁶;
 - e. Resolving the discrepancy between sensitivities given to watercourse types and the ecological communities that live within them;
 - f. Amending the criteria to reflect the understanding that resilience to change is dependent on the type of change that is experienced and the environmental value that is being measured. For example, ecosystems adapted to ephemeral water courses may be more resilient to some degradation in water quality but are likely to be less resilient to changes that turn the ephemeral flow regime into a perennial flow regime; and
 - g. Developing a process to allocate sensitivity classes and assess the significance of impacts at an appropriate scale for development of site-based management, mitigation and monitoring measures for each environment value/asset.
25. *Flooding*: The SEIS has not comprehensively considered flood risks to the environment or adjacent landholders arising from development of project infrastructure. A comprehensive flood study, which incorporates all elements of the proposed development that may change flood paths, duration and spatial extent and identifies potential impacts on the environment or adjacent landholders is needed to deal with these risks. Flood modelling to the 1:1000 year average recurrence interval event should be conducted and project infrastructure with the potential to cause significant contamination, such as raw co-produced water and brine dams, should be protected from these events.
26. In addition to the management measures identified elsewhere in this advice, the Committee suggests that the Strategic Environmental Management Plan addresses the following points:
- a. Prohibiting the use of untreated co-produced water for dust suppression on areas subject to long-term land disturbance, such as the central gas processing facilities, due to the potential for salt and other contaminant build up and subsequent erosion and deposition in waterways;
 - b. Inspecting erosion and sediment controls on a regular basis to ensure that they are in place and effective in the event of unforeseen rainfall or storm events;
 - c. Including performance criteria for aquatic ecology to reflect the intent for no adverse impacts on species and/or populations of conservation significance;
 - d. Monitoring of aquatic ecosystems not be limited to water treatment facilities but should reflect the proposed project's potential impacts from subsidence, groundwater drawdown, gas migration due to depressurisation, infrastructure development, and other discharges, for example from sewage treatment facilities;
 - e. Monitoring of water intended for disposal and/or beneficial use options to ensure that it is fit for purpose prior to release. It is recognised that different qualities of water may be needed for different reuse or disposal options and it is recommended that these differences are taken into account during detailed design of the water treatment facilities; and
 - f. Publicly releasing monitoring results to facilitate a greater understanding of regional and cumulative impacts and provide community confidence in the effectiveness of the proponent's

mitigation and management measures.

Question 4: Has Arrow Energy identified the matters that would need to be considered in managing the proposed discharge into waterways?

27. As noted in the response to Question 2(b), the matters to be considered in managing the proposed discharge into waterways have been identified at a high level in the SEIS and the Committee recommends that the additional matters noted in paragraph 12 are considered during development of the Discharge Strategy. Additional matters may be identified as further baseline surveying is conducted, investigations to fill site-specific knowledge gaps are completed and there is more certainty about the quality and volume of water that will be discharged.

Question 5: Is the suite of mitigation measures proposed adequate to protect identified waterway values at and downstream of the discharge sites?

28. The SEIS does not provide sufficient information on the quantity, quality or timing of co-produced water discharges to enable a robust, scientific evaluation of the ability of proposed mitigation measures to protect downstream waterway values. However, it is noted that a number of sensitive receivers have been identified downstream of discharge sites including drinking water sources and species of national and regional conservation significance. Acting on the recommendations contained in this advice will provide a higher level of protection for waterway values downstream of discharge sites. In particular, early consolidation and evaluation of the methods and activities proposed for developing the Discharge Strategy are needed.

29. The Committee notes that the Northern Inland Catchment and the Clarence-Moreton Basin have been identified as Bioregional Assessments priority regions. Given that the proposed project is located within this region, the Committee considers that data and relevant information from this project should be made accessible for these Bioregional Assessments.

Date of advice 22 August 2013

Source documentation available to the Committee in the formulation of this advice Coffey Environments (2013) Supplementary Environmental Impact Assessment for the Surat Arrow Gas Project, prepared for Arrow Energy Pty Ltd

References cited within the Committee's advice

¹ Information Guidelines for Proposals Relating to the Development of Coal Seam Gas and Large Coal Mines where there is a Significant Impact on Water Resources available at: <http://www.environment.gov.au/coal-seam-gas-mining/project-advice/pubs/iesc-information-guidelines.pdf>.

² Queensland Water Commission (QWC), 2012. Underground Water Impact Report for the Surat Cumulative Management Report. (Now known as the Office of Groundwater Impact Assessment).

³ Klohn Crippen Berger (KCB) (2012) Hydrogeological Attributes Associated with Springs in the Surat Cumulative Management Area, Queensland Water Commission.

⁴ Fielder DP, Davidson W & Barratt PJ. (2011). Aquatic Conservation Assessments (ACA), using AquaBAMM, for the wetlands of the Queensland Murray–Darling Basin. Brisbane: Department of Environment and Resource Management.

⁵ URS (2010) Dawson River Beneficial Use Discharge Scheme. Report prepared for Santos Ltd.

⁶ Department of Environment and Heritage Protection (2011) Dawson River Sub-basin Environmental Values and Water Quality Objectives – WQ1308 – Upper Dawson River Sub-basin.

* Coffey Environments (2013) Supplementary Environmental Impact Assessment for the Surat Arrow Gas Project, prepared for Arrow Energy Pty Ltd: Appendix 4: Groundwater
