

20. RESPONSE TO DERM SUBMISSION

This chapter provides Arrow's response to the submission by the Queensland Department of Environment and Resource Management on the Surat Gas Project Environmental Impact Statement.

DERM comments were submitted on behalf of the Departments of Environment and Heritage Protection; Natural Resources and Mines; National Parks, Recreation, Sport and Racing; and Science, Information Technology, Innovation and the Arts.

Arrow's response is provided in Table 20.1.

Table 20.1 Response to DERM Submission

Issue No.	Issue	Reference	Response
1a	<p>Issue: Lack of detail</p> <p>The conceptual gas project design detail is inadequate to assess cumulative, regional, site and local impacts of the project, particularly impacts of major infrastructure.</p> <p>The purpose of the EIS is to assess: the potential adverse and beneficial environmental, economic and social impacts of the project; the management, monitoring, planning and other measures proposed to minimise any adverse environmental impacts; and to give enough information to State authorities (EP Act). The Terms of Reference for the project require that the EIS addresses 'the level of detail of information required meeting the level of approval being sought.' (TOR, s1. Introduction, p5).</p> <p>Recommendation</p> <p>Arrow Energy to provide sufficient detail on the location of major infrastructure such as quarries, gas compression and water treatment plants to enable assessment of local impacts.</p>	<p>SREIS</p> <p>Chapters 5 to 15</p>	<p>The EIS presented the 'staged' approach of development that Arrow proposes to implement, which accounts for the lifespan of the project (nominally 35 years) and the progressive nature by which exploration and production results will inform the field development plan. The EIS included a conceptual schedule and site locations for the production facilities which allowed the impact assessment to be conducted drawing on factors that are known to Arrow, e.g., the technology, methods and experience with coal seam gas development. On this basis, the range of potential impacts that may result across the landscape have been identified.</p> <p>In line with the outcome of discussions with EHP following the public exhibition period of the EIS, Arrow has identified potential locations for four of eight currently proposed central gas processing facilities, two water treatment facilities and one construction camp in the supplementary report to the EIS (SREIS), including the findings of additional field work conducted at these locations; see SREIS Chapters 5 to 15, where applicable. These facilities represent the coal seam gas and water processing requirements for the first five years of project development.</p>
1b	<p>Issue: Conceptual design</p> <p>The nature of coal seam gas development and the associated land requirements, as well as the implications for environmental, social, cultural and economic aspects, are known from existing operations. Thus, the EIS has assessed a conceptual design. A conceptual design does not permit the specific impacts of this project to be assessed. The environmental, social and cultural constraints will need to be resolved in the detailed design.</p> <p>Recommendation</p> <p>Arrow Energy to provide sufficient detail on the location of major infrastructure such as gas compression and water treatment plants, and quarries to enable assessment of impacts, at least for the Dalby, Wandoan and Millmerran/Kogan development regions which are being developed from 2014-2022, as illustrated in Table 2 (page 10). The EIS should provide sufficient level of detail to inform the Environmental Management Plan which in turn forms the basis for environmental authorities for the project.</p>	<p>EIS</p> <p>Attachment 5</p> <p>SREIS</p> <p>Attachment 2</p>	<p>As per Item 1a above, the environmental framework has been developed to address the progressive development of project facility and infrastructure locations.</p> <p>As described in EIS Attachment 5, Environmental Management Plan and SREIS Attachment 2, Strategic Environmental Management Plan (Strategic EMP), the Strategic EMP has been developed drawing on the findings of the EIS, the SREIS and the commitments Arrow has made to ensure the potential impacts identified can be managed to an acceptable level. The Strategic EMP aims to identify the high level controls that need to be implemented in the construction and operations environmental management plans prepared for the project, and will inform the statutory information requirements to support the application for an environmental authority (EA) or an EA amendment, in accordance with EHP Guideline "Application requirements for petroleum activities".</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
1c	<p>Issue: Alternative power distribution</p> <p>The EIS states that power is required at production wells and facilities. These facilities will consume electricity continuously 24 hours a day, 365 days a year except for scheduled and unscheduled maintenance shutdowns.</p> <p>It states that 60kW of peak power will be generated at each production well, using a coal seam gas-fired generator. However it also notes that Arrow is carrying out studies to assess viability of an alternative power supply option drawing on power from the Queensland electricity grid.</p> <p>Figure 5.18 (From Chapter 5 - Project description) shows the alternative power supply option, illustrating the potential for overhead power (distribution) lines running to wellheads.</p> <p>The definition of 'Limited Petroleum Activities' includes such activities as communication and powerlines necessary for the undertaking of petroleum activities.</p> <p>Recommendation</p> <p>That Arrow Energy examines issues associated with alternative power (distribution) lines within Environmentally Sensitive Areas including Category C ESAs. This should include evaluation of options and the impacts of each option (for example underground versus overhead electrical infrastructure), including clearing and disturbance required for different options, fire management issues, visual amenity issues, and mitigation and management measures associated with each option.</p> <p>Background</p> <p>Overhead power line networks on ESA Category Cs e.g., state forest, can significantly constrain forest management activities, including harvesting of timber; increase the risk of wildfires within the affected state forests; create fire management and safety issues for staff, other users of the forest and neighbours. With the potential natural hazards of wildfires and tree-falls onto powerlines there could be disruption to the electricity supply and underground powerlines would reduce this risk.</p> <p>Workplace Health and Safety Queensland prescribe practices for working safely near powerlines when undertaking timber harvesting. These include the establishment of a (tree) felling zone and exclusion zones for conducting forest harvesting activities near live powerlines.</p>	<p>SREIS</p> <p>Chapter 3, sections 3.4.5 and 3.6.5</p>	<p>The revised power supply and distribution is presented in SREIS Chapter 3, Project Description, sections 3.4.5 and 3.6.5. Grid connection with distribution via both overhead power lines and underground cables is proposed, depending on landholder requirements and constraints imposed by environmental values.</p> <p>The location and type of distribution infrastructure will be determined in detailed design of the gas fields and through negotiation with landholders.</p> <p>Any potential impacts on Category C environmentally sensitive areas (ESAs) from power distribution infrastructure will be described as part of the statutory information requirements to support the application for an environmental authority (EA) or an EA amendment, in accordance with EHP Guideline "Application requirements for petroleum activities".</p> <p>Arrow understands it is required to apply for a permit to clear native vegetation in state forests in accordance with the requirements of the <i>Vegetation Management Act 1999</i> (Qld).</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
1c (cont'd)	Generally the Department of Agriculture, Fisheries and Forestry's timber harvesting practices require that power lines are de-energised prior to the commencement of timber harvesting activities. If de-energising lines is not possible (with a 24 hours-a-day, 365 days per year operation), a significant amount of commercial timber (a buffer twice the height of the tallest tree in the felling zone) may become unavailable to the State, unless the area adjacent to the proposed powerline is harvested prior to construction.		
1d	<p>The text states that Arrow Energy will produce detailed development plans for each development region. These plans should contain much of the required information on the location of impacts and water production and management that is missing from the current EIS. It is not clear when these development plans be available and will these be submitted as part of the EIS assessment process.</p> <p>Recommendation:</p> <p>If these plans cannot be made available during the EIS timeframe, then Environmental Authority information requirements should include specific details of the development as contained in these plans, or as they become available.</p>	<p>SREIS Chapter 2 and Chapters 5 to 15</p>	<p>As set out in SREIS Chapter 2, Project Approvals, coal seam gas development is progressive, extending over the life of the project, which is estimated at 35 years. Unlike conventional gas resources, coal seam gas resources are extensive requiring widespread development to recover the resource. The yield from target coal seams is variable across the resource. The number, timing and location of wells required to dewater the coal seams and extract the gas will be refined as the field development plan is progressed and subsequent approvals are obtained (including agreements with landholders). Selection of the ideal location of infrastructure required to treat the coal seam gas water and process the gas is driven by exploration results and optimisation of well placement and water and gas gathering systems.</p> <p>In line with the outcome of discussions with EHP following the public exhibition period of the EIS, Arrow has identified potential locations for four of eight currently proposed central gas processing facilities, two water treatment facilities and one construction camp in the supplementary report to the EIS (SREIS), including the findings of additional field work conducted at these locations; see SREIS Chapters 5 to 15, where applicable. These facilities represent the coal seam gas and water processing requirements for the first five years of project development. Further information will be supplied as part of the statutory information requirements to support the application for an environmental authority (EA) or an EA amendment, in accordance with EHP Guideline "Application requirements for petroleum activities".</p> <p>Subsequent development plans will be made available with environmental authority (EA) or EA amendment applications for each stage of proposed development, as applicable.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
1e	<p>Issue: Subsidence</p> <p>Arrow energy and other gas companies are presently conducting detailed surveys of the land surface to detect areas where there is potential subsidence. The EIS doesn't contain any information to details what actions Arrow will take should its actions cause subsidence.</p> <p>Recommendation</p> <p>Arrow Energy to document what measures it will implement should subsidence occur on irrigated floodplains, another commitment should be included.</p>	<p>SREIS</p> <p>Chapter 8 and Chapter 9</p>	<p>EIS Appendix G, Groundwater Impact Assessment, Section 8.4 presents a literature review of available publications relevant to subsidence as a result of coal seam gas extraction. No local examples were available.</p> <p>As part of the SREIS, a desktop assessment of additional information available since the EIS has been undertaken and included in SREIS Chapter 8, Groundwater and Chapter 9, Surface Water. The desktop study includes examples of potential subsidence associated with coal seam gas extraction, and presents the results of a collaborative baseline surface deformation study conducted by coal seam gas proponents within the Surat Cumulative Management Area (Altamira Information. 2012a). The information has been used to expand on the description provided in the EIS that subsidence as a result of coal seam gas extraction is unlikely to occur in the region.</p> <p>SREIS Chapter 9, Surface Water provides and assessment of potential impacts associated with subsidence.</p> <p>Arrow will review information from knowledge of projects when made available from the Australian Government's Office of Water Science (a group within SEWPaC) in relation to subsidence to further enhance its understanding of potential impacts of subsidence.</p>
2a	<p>Issue: Occupation of state forest</p> <p>Section 35 Forestry Act 1959 requires occupiers of State forest to hold an authority to occupy (including P&G tenement holders). Whilst there is a reference to Attachment 4 – Project Relevant Legislation, Arrow need to be aware of this significant requirement when dealing with State forests. This function is led by QPWS in the Department of National Parks, Recreation, Sport and Racing.</p> <p>Recommendation</p> <p>The EIS should specifically include the Occupation of State forest under the Forestry Act 1959 as an Additional Key Permits and Approval under 2.3 of the EIS.</p>	<p>SREIS</p> <p>Attachment 7</p>	<p>SREIS Attachment 7, Legislation and Policy, outlines the applicable legislation and approvals required for the Surat Gas Project. This includes authority to occupy areas of state forest under the <i>Forestry Act 1959</i> (Qld).</p>
2b	<p>Issue: Removal and Use of State Owned Terrestrial Quarry Material</p> <p>Section 45 and 46 Forestry Act 1959 gives the State ownership of forest products and quarry materials, and the right to sell. A resource company acting under the P&G Act has no right to use State owned quarry material unless it holds a Forestry Act 1959 authority and royalties are paid.</p> <p>In Table 5.4 it is stated that total aggregate volumes of rock gravel, sand and soil will be 1,099,500 m3 for the project. Existing borrow pits and quarries do not have resources to meet this demand. As stated in s2.3 a riverine protection permit is required for extraction of sand and gravel from a watercourse and for other disturbance of the physical integrity of the watercourse.</p>	<p>SREIS</p> <p>Attachment 7</p>	<p>SREIS Attachment 7, Legislation and Policy, outlines the applicable legislation and approvals required for the Surat Gas Project. The requirement for a licence to remove quarry material from a state forest or crown land is included under the <i>Forestry Act 1959</i> (Qld).</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
2b (cont'd)	<p>Recommendation</p> <p>The EIS should specifically include the removal and use of quarry material under the Forestry Act 1959 as an Additional Key Permits and Approval under 2.3 of the EIS.</p>		
3	<p>Issue</p> <p>EMP Page 4-80, Existing environment and environmental values</p> <p>Second paragraph: Summary of the existing environment does not represent exactly what the specialist report stated. This statement when read alone is misleading.</p> <p>For example the EMP states “In general, the aquatic environments within the project development area are moderate to highly disturbed as a result of many decades of modification to terrestrial environments and altered drainage basin processes.”</p> <p>While this is partly accurate, the specialist report also states on page 62: “Taken holistically, aquatic ecosystems within the study area are in moderately good health, although the Myall Creek system (Sites 6 and 23) and Braemar Creek (Site 40) were in particularly poor health due to significant oxygen depletion.”</p> <p>On page 48 the reports reads: “Combined, the OE50 and OE50 Signal scores indicate that while the sampling sites have been substantially impacted by current catchment activities, pollution-sensitive taxa are still abundant, suggesting the most significant impact to the system is water extraction, rather than a combination of water extraction and pollution caused by anthropogenic influences such as poor management of agricultural runoff (Figure 4.3).”</p> <p>Recommendation</p> <p>Replace first paragraph and replace with summary on page 62 of the specialist report to represent the balanced findings of the specialist report (i.e., that the environment, regardless of many decades of modification, still has pockets of significant environmental values).</p>	<p>SREIS</p> <p>Chapter 9, Appendix 8 and Attachment 2</p>	<p>Noted. The EIS presented a highly modified system that still contains significant aquatic ecology values that require consideration when planning development. This is reflected through identification of MNES species, i.e., Murray cod, Fitzroy River turtle. Attachment 2 of SREIS Appendix 8, Supplementary Aquatic Ecology Assessment provides species specific dossiers for MNES and locally significant species which have been identified through desktop assessment. Further details of the environmental values of surface water within the project development area are discussed in SREIS Chapter 9, Surface Water.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
4a	<p>Issue: In-fill wells</p> <p>The EIS states that throughout the life of the project (35 years expected), about 7,500 production wells will be drilled across the project development area at a rate of approximately 400 wells per year.</p> <p>Category C ESAs only allow for 'limited petroleum activities'. The conditions for well sites as defined in 'Limited Petroleum Activities' allow for single well sites not exceeding 1 ha of disturbance and multi-well sites not exceeding 1.5 ha of disturbance.</p> <p>Arrow proposes to install production wells on an 800-m-grid spacing. Based on a 65-ha-block-centred layout (approximate 800-m-grid spacing), this equates to indicative production well densities of:</p> <ul style="list-style-type: none"> • Forty wells in an area 5 km by 5 km. • One hundred fifty wells in an area 10 km by 10 km. • Three hundred wells in an area 14 km by 14 km. <p>Chapter 5 – Project Description, 5.2.1 Production Wells, state s- as gas production ramps down, in-fill wells may be drilled between existing well locations to improve gas recovery and production.</p> <p>Recommendation</p> <p>Arrow Energy to provide more information about in-fill wells (including for example total well densities expected), with particular emphasis on works and the potential impacts expected on Environmentally Sensitive Areas including Cat C ESAs.</p>	<p>EIS</p> <p>Chapter 17, Figure 17.2 and Appendix K, Figure 14</p> <p>SREIS</p> <p>Chapter 3</p>	<p>An updated estimate of production well requirements is set out in SREIS Chapter 3, Project Description. The anticipated number of production wells has reduced to 6,500 over the 35-year project life through the relinquishment of approximately 30% of the project development area. On average, it is expected that drilling will still occur at a rate of approximately 400 wells per year.</p> <p>The EIS conceptualised that vertical wells would be drilled with a separation distance between wells averaging a minimum of 800 m across the project development area. Arrow has introduced deviated drilling into its design basis. The use of deviated drilling technology may allow the surface well pad sites for multi-well pads will be separated over a distance of up to 2,000 m where possible.</p> <p>Production wells may be drilled sequentially, or in stages, to take into account monitoring results and the performance of the first wells to be drilled. These initial wells may have a wide spacing, and remaining wells will be drilled to complete the grid of production wells (a process known as infilling). Infilling does not infer that wells will be drilled at a spacing less than the stated average (i.e., a minimum 800 m grid spacing).</p> <p>ESAs identified in the project development area were included in the constraints mapping that identified no go areas and areas of high, moderate and low constraint to development (EIS Attachment 10, Preliminary Constraints Maps and SREIS Attachment 8, Constraints Mapping Update). EIS Chapter 17, Terrestrial Ecology, Figure 17.2 and EIS Appendix K, Terrestrial Ecology Impact Assessment, Figure 14 presents all Category C Environmentally Sensitive Areas (ESAs) within the project development area.</p>
4b	<p>Issue: Water discharge</p> <p>It appears that most of the water associated with CSG extraction will end up at the integrated processing facilities. What needs to be made clearer is what happens to the water after the integrated processing facility. For example, what are the estimated volumes of water that may be discharged to watercourses, although one of the least preferred options for wastewater disposal (Executive summary.pdf; Figure 7; pdf page 24)? The EIS suggests that Arrow may discharge up to 0.5 GL per annum to watercourses (Appendix I, p 34), which is a significant volume. Arrow have commented in their information session (11th May; 9 -12; 400 George Street) that water will be discharged to waterways in an “emergency”, where an emergency release as defined by Arrow as a heavy rainfall events or if other management strategies are not available (11th May; 9 -12; 400 George Street and Chapter 5 - Project Description.pdf; pdf pages 54-55).</p>	<p>SREIS</p> <p>Chapter 3, Section 3.7, Chapter 9 and Chapter 10</p>	<p>As described in SREIS Chapter 3, Project Description, Section 3.7, within the Surat Basin, it is possible that the full range of coal seam gas water management options will need to be utilised including beneficial use and disposal, via distribution, injection and discharge, as follows:</p> <ul style="list-style-type: none"> • Distribution to existing and new users for beneficial use. • Injection into a suitable aquifer. • Discharge to watercourses and/or the ocean under defined conditions. <p>Disposal to watercourses and the ocean are not preferred options but variability in rainfall between seasons and from year to year and demand for coal seam gas water over time will determine the volumes of coal seam gas water that can be managed through application of the identified options. Water demand, land use, weather, watercourse type and morphology, and aquatic ecosystems will dictate how the management options may be utilised at each water treatment facility site.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
4b (cont'd)	<p>If Arrow can demonstrate that CSG associated water will be directed to beneficial use without the need for continuous planned release of (treated or untreated) CSG water to waterways the risk to surface water ecosystems is significantly reduced.</p> <p>Recommendation</p> <p>Arrow should provide a detailed explanation of the likelihood, the circumstances and potential discharge volumes (maximum or worst case scenario at least or confirm whether 0.5 GL per annum is the worst case scenario) of treated and or untreated volumes of CSG water to waterways.</p>		<p>Further detailed site-specific surveys have been undertaken at the locations of two potential discharge locations. SREIS Chapter 3, Project Description, Section 3.7.4 presents conceptual water management at the conceptual water treatment facilities at CGPF2 and CGPF9. SREIS Chapter 9, Surface Water and Chapter 10, Aquatic Ecology identified the additional potential impacts following discharge at these locations, and propose further mitigation measures to minimise potential impacts.</p> <p>The specific details for coal seam gas water management options will be developed further through detailed engineering design. Chosen management options will be detailed in the coal seam gas water management plan required for the EA or EA amendment application. The management plan will include detailed coal seam gas water and brine impact assessments and management strategies in accordance with the EHP Guideline "Application requirements for petroleum activities".</p>
4c	<p>Issue: Defining and measuring a "high rainfall" event. Water management strategies should already be in place to reduce the likelihood of discharges to waterways, including measures to store associated water whilst third party agreements are being negotiated. An inability to achieve suitable third party arrangements should not be considered an emergency. If it is anticipated that controlled releases will be required to mitigate the risk of uncontrolled overflows from such water storage facilities, such as in anticipation of high rainfall events, then it is recommended that discharge-related license conditions are developed and proposed, including at which environmental flow rates should discharges commence and cease, and any mixing ratios requirements that will be necessary to mitigate any potential environmental risks associated with the discharges. In any case it is recommended that some measures and controls are put in place to stipulate how "high rainfall events" (pdf page 34, Appendix I - Surface Water Part B Water Quality Impact Asses.pdf) i.e. high flow), will be set and measured.</p> <p>Recommendation</p> <p>If approval was being sought for a controlled release to be licensed then the following information would be required:</p> <ol style="list-style-type: none"> provide information relating to under what storage dam conditions would release of CSG associated water (treated and untreated) be necessary; provide information on which release management measures will be adopted to mitigate or eliminate any potential risks to the receiving environment and; provide information on how high rainfall (i.e. high flow events) for emergency or unplanned release will be defined and measured. 	<p>SREIS Chapter 9, Section 9.6.4, Attachment 5, Appendices 5, 6, 7</p>	<p>Coal seam gas water may now be discharged during normal operating conditions as well as emergency conditions. Beneficial use distribution via watercourses and disposal of coal seam gas water via watercourses are both options being considered (SREIS Attachment 5, Coal Seam Gas Water and Salt Management Strategy).</p> <p>Since the publication of the EIS, Arrow has identified two potential water treatment facility sites and associated coal seam gas water discharge points. Investigations of these sites have been conducted for the SREIS. SREIS Chapter 9, Surface Water, Section 9.6.4 provides recommendations for preliminary guidelines for initial discharge within which impacts to erosion are likely to be negligible. Recommendations have also been made for water quality monitoring programs at these sites, in accordance with the Queensland Water Quality Guidelines (DERM, 2009b). The findings of surface water (SREIS Appendices 5 to 7) and aquatic ecology (SREIS Appendix 8) studies will be used to inform Arrow's discharge strategy.</p> <p>The specific details for coal seam gas water management options will be developed further through detailed engineering design. Chosen management options will be detailed in the coal seam gas water management plan required for the EA or EA amendment application. The management plan will include detailed coal seam gas water and brine impacts assessments and management strategies in accordance with the EHP Guideline "Application requirements for petroleum activities".</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
5	<p>Issue: No assessable areas of impacts</p> <p>The methodology used in the EIS does not identify specific areas which may be impacted by its activities. The project potentially will impact area of 5,181 ha of mapped terrestrial ecology based on Table 1 below, which does not include pipelines required with this infrastructure.</p> <p>Table 1: Calculation of impact areas Infrastructure / Number Required / Ha Impact / Total Impact Area (Ha) Wells / 7,500 / 0.5 / 3750 Field Compression Facility / 6 / 0.5 / 3 Central Processing Facility / 6 / 18 / 108 Integrated Processing Facility / 6 / 220 / 1320 Total Impact 5,181 ha</p> <p>To adequately assess the environmental impacts of the Surat Gas Project, where the impact distribution is a mosaic throughout the project area, it is necessary to assess the actual impacts. This EIS does not adequately address the TOR requirements in this regard.</p> <p>As a part of the EIS, it is noted that there is no planned areas of impact for any of the well sites, field compression plants, central gas plants or integrated plants. From an environmental perspective, where the location of these facilities can impact the overall environmental and biodiversity impacts for this project in an area of already highly impacted environment, the discussion of these issues in this report is not sufficient. An appropriate assessment of environmental impacts cannot be carried out fully with the information supplied in this EIS.</p> <p>Recommendation:</p> <p>The EIS should include areas of impact for the life of the project, to allow for an informed assessment of the environmental values impacted over the life of the project. Include within the Supplementary EIS, details of any known project impacts. As a part of the Environmental Management Plan (EMP), a rigorous spatial analysis of impacts for the local environment and cumulative impacts should be included, as well as a rigorous site assessment of proposed impact areas, to ensure impact assessments are done at the required level. This information has not been presented within this document.</p>	<p>EIS Attachment 10 SREIS Chapter 2 and Attachment 8</p>	<p>The EIS provides a detailed assessment of the type and nature of impacts associated with project activities including the potential severity of the impacts on environmental values. The overall significance of impacts has been assessed based on the sensitivity of the values to disturbance and/or the impacts of project activities.</p> <p>As set out in SREIS Chapter 2, Project Approvals, coal seam gas development is progressive, extending over the life of the project, which is estimated at 35 years. Unlike conventional gas resources, coal seam gas resources are extensive requiring widespread development to recover the resource. The yield from target coal seams is variable across the resource. The number, timing and location of wells required to dewater the coal seams and extract the gas will be refined as the field development plan is progressed and subsequent approvals are obtained (including agreements with landholders). Selection of the ideal location of infrastructure required to treat the coal seam gas water and process the gas is driven by exploration results and optimisation of well placement and water and gas gathering systems. Consequently, this progressive process of investigation, design, planning, verification and implementation will extend over the life of the project in approximately five-year planning phases. It is not possible to define the actual location of infrastructure and impacts for the entire project development area.</p> <p>The EIS and SREIS provide the results of constraints mapping that has and will be used to guide site and route selection (EIS Attachment 10, Preliminary Constraints Mapping and SREIS Attachment 8, Constraints Mapping Update). The EIS also sets out the process for verifying the type, extent and severity of impacts through ecological and preclearance surveys, which are key inputs to the final decision on the location of infrastructure. The specific location of coal seam gas infrastructure will be determined in detailed design of the gas fields and through negotiation with landholders, and presented in development plans required as part of the regulatory process.</p> <p>Incremental development of the gas field will require that technical supporting information be lodged to support applications for environmental authority (EA) or EA amendment(s) in accordance with EHP Guideline "Application requirements for petroleum activities", be addressed.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
6a	<p>Issue: Omission of potential impacts to aquifers Chapter 12, Section 12.4, pp. 12-27, 28, 30 and Appendix E</p> <p>Presently the EIS lists potential impacts to geology, landform and soils values including land degradation, land contamination and disturbance, and accidental damage to recognised fossil sites. However, potential impacts to aquifers, especially recharge areas, are omitted.</p> <p>Recommendation: In the Supplementary EIS, include aquifers in the list of potentially impacted values, or if this is discussed in another part of the EIS, insert a reference to this part of the EIS.</p>	<p>EIS Chapter 14</p> <p>SREIS Chapter 8</p>	<p>Noted. The potential impacts to aquifers have been discussed in EIS Chapter 14, Groundwater. The outcomes of further groundwater modelling are presented in SREIS Chapter 8, Groundwater.</p>
6b	<p>Issue: No consideration of the Burunga fault There is no discussion about the Burunga Fault near Wandoan (Appendix E, Section 3.1.2, pg.16).</p> <p>Recommendation: In the Supplementary EIS, include a discussion on the Burunga Fault structural geology and identify its type, distribution and age.</p>	<p>EIS Appendix E</p>	<p>EIS Appendix E, Geology, Landform and Soils Impact Assessment, Figure 3.3 displays the faults within the study area, including the Burunga Fault. This was incorrectly referenced in the text as Figure 4.3.</p> <p>Faults and seismic hazard constraints are discussed in EIS Appendix E, Geology, Landform and Soils Impact Assessment, Section 5.1. The Burunga fault is a north-south oriented Triassic thrust fault (Cadman et al, 1998).</p>
6c	<p>Issue: Strategic Cropping Land Act 2011 – appropriate consideration (throughout EIS)</p> <p>On 30 January 2012, a legislative and planning framework commenced to protect Queensland's strategic cropping land (SCL) from developments that lead to permanent impacts or diminished productivity. The framework includes the Strategic Cropping Land Act 2011 (SCL Act), and a new State Planning Policy 1/12 Protection of Queensland's strategic cropping land (SPP 1/12) under the Sustainable Planning Act 2009. The EIS appears to have been prepared prior to the SCL framework that is now place. As an example, the EIS references the draft SPP for strategic cropping land (page 12-2) which is significantly different from SPP 1/12 as enacted and the use of draft strategic cropping land mapping.</p> <p>Where a resource activity contains strategic cropping land (SCL) or potential SCL an approval to impact SCL (protection decision or compliance certificate) is required under the SCL Act before an Environmental Authority can be granted. Until information is provided on how the project proposes to comply with the SCL framework it is not possible to gauge if the proponent has given appropriate consideration to how the SCL framework will impact their proposal and how their proposal with impact SCL or potential SCL.</p>	<p>SREIS Chapter 2 and 7</p>	<p>Noted. At the time that the Surat Gas Project EIS was submitted to DERM for adequacy review against the Terms of Reference, the <i>Strategic Cropping Land Act 2011</i> (Qld) had not been enacted.</p> <p>SREIS Chapter 2, Project Approvals and SREIS Chapter 7, Agriculture discusses the implications of the Strategic Cropping Land Act, including the issues outlined by EHP.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
6c (cont'd)	<p>Recommendation:</p> <p>The proponent should provide details on how the project will comply with the Strategic Cropping Land Act 2011 and State Planning Policy 1/12 Protection of Queensland's strategic cropping land. This detail should include but is not limited to:</p> <ul style="list-style-type: none"> • approvals required under the Strategic Cropping Land Act 2011 for activities where SCL or potential SCL is located on the resource authority. • approvals required under the local government approvals for supporting infrastructure not on the PL requiring a MCU that may also trigger referral agency assessment including for strategic cropping land. • address the requirements of the Strategic Cropping Land Act 2011 as they apply to the components of the project. This should include but is not limited to the following: <ul style="list-style-type: none"> – assess the development's impact on all SCL or potential SCL on the land – identify any constraints on the configuration or operation of the development – address how the development has avoided and minimised the impact on SCL or potential SCL – identify any considerations that have been made to the development (such as to the size/location of the development footprint, well layout, management practices, site boundaries or how the development will operate, etc.) to avoid and minimise impacts on SCL or potential SCL – identify any areas of the development likely to have permanent or temporary impacts on SCL or potential SCL – identify proposed mitigation measures for the areas of SCL or potential SCL that are proposed to be permanently impacted – provide details of the scientifically-based methods proposed, including management practices (e.g. stripping, stockpiling, reinstallation and rehabilitation), timelines, monitoring requirements and performance indicators, to rehabilitate temporarily impacted SCL or potential SCL areas back to their predevelopment condition (i.e. their current condition in respect to the SCL Criteria - particularly soil water storage) within 50 years of those areas being disturbed. Include a calculation of the proposed financial assurance for the temporarily impacted SCL or potential SCL. 		

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
7a	<p>Issue: Reduced productivity and increased costs (13.6.2 and 13.6.3)</p> <p>This section in the EIS fails to mention the impacts on productivity when CSG water (which is likely to be high salinity) spills occur. C103 focuses on the contamination caused by oil and fuels etc. while C038 is more generic. The most likely spill to cause decreased productivity will be saline water which the Contaminated Land guidelines do not address. A more appropriate reference would be: DERM (1995), Guideline values for the Assessment and Management of Saline/Sodic Wastes.</p> <p>There is also potential for reduced productivity in the vicinity of water treatment facilities due to windborne dispersal of salt as an aerosol from the surface of raw water and brine ponds. There is no recognition of this issue in the EIS.</p> <p>Recommendation</p> <p>The EIS should include a commitment to ensure that any spill of coal seam gas water, coal seam gas water concentrate or brine that escapes containment systems and impacts on soils is remediated and monitored to manage the salinity risk produced.</p>	<p>EIS</p> <p>Chapter 12, Section 12.6.3</p>	<p>Noted. The predominant management measure for potential spillage is prevention of the spill through rigorous design and process control. The storage of brine associated with water treatment facilities will occur on Arrow-owned (which is preferred) or leased properties. Brine dams will be designed in accordance with the requirements of the most recent version of Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (EHP, 2012f). Arrow will design, construct, maintain and rehabilitate the gathering system network in accordance with the APIA code of practice Upstream PE gathering networks CSG industry version 2.0, or relevant Australian standards, as revised from time to time (Commitment C444). Landholders will be consulted during field planning to determine land use practices. Pipelines will be buried to a depth that minimises the risk of damage.</p> <p>Well site and remote equipment telemetry systems will be used in conjunction with information from the central gas processing facilities in order to meter gas and water flow, and alert operators to faults within the gathering network.</p> <p>During project activities, the potential for soil contamination resulting from project activities will be reduced by the application of management measures detailed in EIS Chapter 12, Geology, Landform and Soils, Section 12.6.3.</p> <p>Under the <i>Environmental Protection Act 1994</i> (Qld), Arrow is legally required to remediate any contamination caused by project activities. This is detailed in Commitment C038 which states that Arrow will carry out corrective actions immediately upon the identification of any contamination of soil or groundwater that has occurred as a result of project activities. Remediation goals including the identification of proposed land uses will be determined as part of a remediation action plan (RAP).</p> <p>In the case of potential airborne effects of salt on land around brine dams, the only feasible way this could occur is through salt spray (aerosol) generated by strong winds across the dam surface.</p> <p>Salt from a saline water body escapes into the atmosphere as liquid droplets generated by the action of the wind and breaking waves. Surf action is a major source of sea spray on coastlines but is not significant on small dams and lakes. On a relatively small water body such as a brine dam, white caps are the only mechanism for causing spray.</p> <p>After being formed, some spray particles fall back onto the water surface and others are blown downwind, where they can deposit on soils, plants and animals.</p> <p>Evaporation from a brine dam will not generate airborne salt directly. Indirectly, if conditions were suitable, excessive evaporation could dry out a brine dam and leave behind a dry salt crust that could be a source of wind-blown emissions. However, this scenario is not expected to occur.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
7a (cont'd)			<p>Natural salt deposition resulting from oceanic wind and wave activity continues at low rates hundreds of kilometres from coastlines (Cole et al. 2003, Foltescu, Pryor and Bennet, 2005). ISO 9223 (2012) classifies sodium chloride (salt) deposition rates according to environmental conditions. Non-coastal Category S₀ is considered to have a deposition of S ≤ 8 g/m²/year.</p> <p>In Australia, measurements and models of airborne salinity indicate that natural salt deposition due to ocean spray formation is approximately 1.2 g/m²/year at a distance of 200 km from the coast in southern Queensland (Cole et al. 2003). For comparison, measured and modelled salt deposition at Amberley, Queensland is 12 g/m²/year.</p> <p>Salt emission modelling for a brine dam (size 2 km²) using AUSPLUME and considering meteorological data from sites in the southern, central and northern parts of the project development area predicted a total annual emission of salt of 35 kg, using hourly data and equations developed by Piazzola et al. (2002). The predicted rates of salt deposition vary from a maximum of 2 g/m²/year around the southern edge of the dam to less than 0.1 g/m²/year at distances ranging from less than 500 m to about 2 km from the dam, depending on direction.</p> <p>When brine dam deposition rates are added to the estimated natural background deposition of 1.2 g/m²/year, total deposition rates at any distance from the brine dams will remain well within ISO category S₀, typical of non-coastal locations.</p> <p>On the basis of these results, the predicted salt deposition around the brine dams is expected to have no adverse effect on surrounding land use.</p>
7b	<p>Issue: Lack of information on rehabilitation</p> <p>Appendix F and Chapter 13 provide information on potential hazards in relation to soil compaction and other matters, but provides disproportionately less information or detail on soil/land rehabilitation practices and management required to mitigate the identified impacts or hazards.</p> <p>The information provided on rehabilitation relates largely to pipeline trenches, with less or very limited information on rehabilitation of areas associated with the balance of the pipeline corridor, well heads, pump stations, access roads and other infrastructure.</p> <p>There appears to be a reliance on the outcome of yet to be completed rehabilitation trials, which does not provide reasonable confidence at this time that the necessary outcomes can actually be obtained (i.e. the approval is requested on the basis of effectively unproven techniques, which leaves the problem of what happens if the trials show rehabilitation cannot be successfully undertaken).</p>	<p>EIS Chapter 13 and Appendix F</p>	<p>Arrow has shown at consultation and on its website that vertosols (black soils) can and have been successfully rehabilitated and restored to their former use. The example used is the Roma to Brisbane pipeline, which passes through vertosols for part of its length between Dalby and Gatton. The disturbed area along this alignment has been successfully rehabilitated and has been farmed for over 20 years. The layout, design and construction methods used to install production wells and access tracks on vertosols will consider site specific conditions and the outcome of landholder negotiations on particular farming practices.</p> <p>Where Arrow is operating on strategic cropping land it will be required to comply with the Strategic Cropping Land Standard Conditions Code for Resource Activities, which set out the requirements for rehabilitation.</p> <p>Regardless, conditions of Arrow's environmental authority require it to rehabilitate land to the predisturbed land use unless otherwise agreed to between Arrow, the landholder and the administering authority.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
7b (cont'd)	<p>Recommendation</p> <p>Arrow Energy has been operating in the region for more than 10 years. The EIS should provide additional information (including from existing or earlier CSG operations) on the protection and rehabilitation of vertosols and other agricultural soils in the project area for all activities.</p>		
8a	<p>Issue: Incorrect information in the document</p> <p>The EIS has a number of mistakes in relation to groundwater. These are listed below.</p> <p>Page 32 Section 4.3.1 – Walloon Coal Measures</p> <p>One groundwater flow direction is to the east (Lockyer Valley), reaching approximately 50m AHD. This is not what is shown in Figure 2.28.</p> <p>Page 35 Section 4.5.1 – Great Artesian Basin Groundwater Quality</p> <p>In general, GAB groundwater is dominated by sodium-bicarbonate (Na-HCO₃) type water in the eastern and central part of the basin. In the western areas of the GAB, chloride and sulphate dominate the chemistry. Sodium and bicarbonate increase in concentration from the north-eastern margins to the south-western discharge areas along the regional flow path (Herczeg et al., 1991). Sentence 1 contradicts sentence 2.</p> <p>Page 45 Table 4.11 – Registered bores in the project development area</p> <p>The shallow aquifers list includes Bungil Formation and the intermediate aquifers list includes Kumbarilla Beds. Bungil Formation is generally recognised as part of the Kumbarilla Beds.</p> <p>Page 46 Table 4.12 – Licensed bore users in the project development area</p> <p>The bore use category includes the purposes of water harvesting and to divert the course of flow. These relate only to surface water infrastructure, not to groundwater bores.</p> <p>Page 52 Section 5.2.3 – Consumptive or productive use of groundwater</p> <p>For assessing the suitability for drinking water supply it is appropriate to apply the Australian Drinking Water Guidelines (National Health and Medical Research Council & Natural Resource Management Ministerial Council (NHMRC & NRMCC), 2004). The Australian Drinking Water Guidelines were updated in 2011 and should be used.</p>	<p>EIS</p> <p>Chapter 14</p> <p>SREIS</p> <p>Chapter 8</p>	<p>The sections of the EIS referred to in this issue are finalised documents and will not be reproduced.</p> <p>The comment indicating that the Bungil Formation should be included as part of the intermediate groundwater system and the Kumbarilla Beds is considered to be incorrect. The Kumbarilla Beds include Jurassic-Cretaceous units of non-marine origin and are only recognised near areas of outcrop where weathering makes individual units indistinguishable. The Bungil formation is not described as being part of the Kumbarilla Beds by Exon (1976).</p> <p>The remaining comments raised do not result in a material change to the identification of environmental values, nor the impact assessment.</p> <p>SREIS Chapter 8, Groundwater, provides a summary of changes or updates to relevant legislation.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
8a	<p>Recommendation</p> <p>The EIS document should be reviewed and incorrect information, as identified above, corrected.</p> <p>Please note: The Minimum Construction Standards for Water Bores in Australia (referred to in Table 9.7) were updated in February 2012, and come into force in June 2012.</p>		
8b	<p>Issue: Reduced groundwater supply to existing or future groundwater users</p> <p>It is stated that Arrow's adaptive management framework and the hierarchy of mitigation, monitoring and management measures will result in a very low magnitude of impact for the shallow and intermediate groundwater systems, a low residual magnitude of impact of CSG groundwater system, and a very low to low residual impact for the deep groundwater system. The preferred option in the hierarchy of mitigation is substitution. There is no information on how substitution will take place.</p> <p>Recommendation</p> <p>The EIS should provide detailed information on how substitution will take place, as this practice has the potential to create significant issues. Information that is required includes how water will be delivered (e.g. pipelines, water trucks) and stored, and the potential impacts this will have on environmental values.</p>	<p>EIS</p> <p>Chapter 5 and Attachment 9</p> <p>SREIS</p> <p>Chapter 3, Chapter 8 and Attachment 5</p>	<p>Arrow's substitution strategy was described in Section 5.6.4 and Attachment 9 of the EIS. Potential impacts associated with the substitution network are considered to be consistent with impacts associated with the construction, operation and decommissioning of underground water gathering lines and storage dams, which are assessed in the EIS.</p> <p>SREIS Chapter 3, Project Description and Attachment 5, Coal Seam Gas Water and Salt Management Strategy provide additional information on the substitution strategy, namely that Arrow will enter into commercial water off-take agreements with third parties to facilitate the provision of a specified volume of coal seam gas water, at a specific quality and over a given time period in lieu of the third party's access to groundwater allocations from the Condamine Alluvium. These sections of the SRIES also provide additional context on the proportions of coal seam gas water management options within the vicinity of the two water treatment facilities, based on land use, seasonal water supply and demand patterns and the potential for new uses to emerge during the life of the project.</p> <p>Arrow has used the OGIA model and updated it to include the current development case. This model has been used to predict groundwater drawdown under a cumulative scenario, and the results are presented in SREIS Chapter 8, Groundwater. The revised development case includes a scenario using substitution of groundwater allocations from the Condamine Alluvium to offset Arrow's component of modelled likely flux impacts to the Condamine Alluvium in the area of greatest predicted drawdown, as a result of coal seam gas water extraction from the Walloon Coal Measures. Modelled likely flux impacts are defined as those simulated in the calibrated Office of Groundwater Impact Assessment (OGIA) Surat Cumulative Management Area (CMA) Groundwater Model realisation, occurring over the period referred to in the Underground Water Impact Report for the Surat CMA (OGIA, 2012) i.e., the next 100 years. This scenario which predicts the response in the Condamine Alluvium in response to the application of the substitution strategy. Substitution will be presented in the context of a modelled water balance and will rely on end users signing up to substitution.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
8c	<p>Issue: Make-good agreements</p> <p>The EIS does not describe how water will be supplied to landholders once “make good agreements” are enacted. Supplying large quantities of water to individual landholders has the potential to create significant impacts on environmental values (e.g. extra truck movements, new water pipelines, storage facilities). These impacts have not been acknowledged in the EIS. There is also no explanation of how make-good water will be supplied to affected landholders once CSG operations have ceased in the area.</p> <p>Recommendation</p> <p>The EIS should provide detailed information on how make-good measures will be implemented, particularly how water will be supplied to landholders in the short term, and how this will be achieved once operations cease.</p>	<p>SREIS Attachment 5</p>	<p>Commitment C146 states that Arrow will implement make good measures in accordance with the Water Act 2000. Additional detail on how make good measures will be implemented cannot be provided because make good measures are determined on a case by case basis, as defined in the Water Act. Arrow's make good obligations will be determined under the Water Act independently of the gas production time frame.</p> <p>SREIS Attachment 5, Coal Seam Gas Water and Salt Management Strategy presents Arrow's hierarchy of make good options, which predominantly involves modifying the pumping infrastructure, deepening the bore, or drilling a new bore in preference to supplying an alternative source of water (including treated or untreated coal seam gas water). Therefore the impacts associated with the provision of water via trucks, pipelines or surface storage features do not require assessment.</p>
8d	<p>Issue: The groundwater monitoring program is lacks detail</p> <p>The Terms of Reference (Section 4.5.1.2) state that Arrow must “Develop and describe a monitoring program, including a network of observation points that would satisfactorily monitor groundwater resources both before and after the commencement of operations (EIS cross reference Section 14.6 and 14.8)”. Only a very general, non-descript monitoring program is outlined in the EIS. The EIS must provide details of the monitoring program, including the number of monitoring locations.</p> <p>Recommendation</p> <p>The EIS should describe in detail the groundwater monitoring that will take place in the targeted coal seams and the underlying and overlying aquifers. The frequency of monitoring (both water levels/pressure and water quality) also needs to be outlined. As a minimum the groundwater monitoring program (not including shallow “pond monitoring”) should include 80 monitoring sites. Sixty of these monitoring sites should include 3 monitoring points:</p> <ul style="list-style-type: none"> • 60 monitoring points in the targeted coal seams • 60 monitoring points in the consolidated aquifers above the targeted coal seams • 60 monitoring points in the consolidated aquifers below the targeted coal seams and <p>The other 20 monitoring sites should have monitoring points located in the Condamine Alluvium</p>	<p>SREIS Attachment 5</p>	<p>Arrow will implement a groundwater monitoring plan in consultation with, and regulated by the Office of Groundwater Impact Assessment (OGIA) as part of the Surat Cumulative Management Area (CMA) and the associated draft Underground Water Impact Report (UWIR). Details of the monitoring plan, including the approximate locations of monitoring wells, the frequency of monitoring and the type of data to be collected will be provided in statutory information requirements to support the application for an environmental authority (EA) or EA amendment, in accordance with EHP Guideline “Application requirements for petroleum activities”.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
8e	<p>Issue: Inadequate information on monitoring wells at water storage dams Chapter 5, pg. 17 - The EIS does not state the parameters or frequency of monitoring of the groundwater wells associated with water storage dams, or what will occur to these wells at end-of-tenure. The EIS also does not indicate the depth below ground that the groundwater wells will monitor.</p> <p>Recommendation: In the Supplementary report to the EIS, provide the monitoring plan and end-of-tenure intentions for the groundwater monitoring wells associated with water storage dams. Also state the depth below ground that will be monitored.</p>	<p>SREIS Attachment 5</p>	<p>Arrow has committed to install groundwater monitoring bores near dams as a leak detection measure, as detailed in commitment C504. Groundwater monitoring programs will be required as a condition of the environmental authority. As such, the details of the monitoring plan associated with water storage dams, including the approximate locations of monitoring wells, their depth, the frequency of monitoring and the type of data to be collected will be provided to support the application for an environmental authority or an environmental authority amendment, in accordance with EHP Guideline "Application requirements for petroleum activities".</p>
8f	<p>Issue: Currency of groundwater model predictions Chapter 14, pg. 7, Table 14.2 - The groundwater model is now over 12 months old. The EIS has not made clear whether investment decisions in the last 12 months are reflected in the predicted Arrow and third party extraction data.</p> <p>Recommendation: That Arrow Energy to confirm whether or not investment decisions made in the last 12 months are reflected in the predicted Arrow and third party extraction data. If not, the model must be updated including scenarios 2 and 3 to reflect final investment decisions as at 31 January 2012.</p>	<p>SREIS Chapter 8</p>	<p>The cumulative modelling scenario (scenario 3) presented in the EIS is more informative with respect to predicting the "worst case scenario" as it models extraction from all coal seam gas proponents irrespective of their financial investment decision (FID) status. Arrow appreciates that the data used to generate the model is now outdated, however, notes that the predicted drawdowns presented by the OGIA for the Surat Cumulative Management Area are less than those predicted by Arrow in the EIS.</p> <p>Arrow has prepared a numerical groundwater model using the OGIA model as a base, and updated it to include to Arrow's current development case. The predicted groundwater drawdowns are presented and discussed in SREIS Chapter 8, Groundwater. The OGIA model provides for the most up to date production information available. In the future, periodic reviews and updates of the UWIR (by OGIA) will consider changes to proponents' production plans.</p>
8g	<p>Issue: Inadequate explanation for the decline in water extraction Chapter 14, pg. 8, Figure 14.2 - Clarification is required on the reasons for the decline in water extraction over time. Is this due to exhausting of the water associated with the seam, significant drawdown, fewer wells extracting over time, or a combination of the above?</p> <p>Recommendation Provide further discussion on Figure 14.2 in the supplementary report to the EIS and explain the reasons for the projected decline in water extraction over time.</p>	<p>EIS Chapter 5 and Chapter 14</p>	<p>The decline in water extraction presented in EIS Chapter 14, Groundwater, Figure 14.2 represents the normal decline in coal seam gas water as the wells mature and gas rates increase. This process is described in EIS Chapter 5, Project Description, Section 5.2.4 (Water Treatment and Storage Facilities) and Figure 5.7.</p>
8h	<p>Issue: No information on full groundwater recovery Projection to full recovery date is not included. Outline the long term impacts on groundwater beyond the life of the industry and when is full recovery expected, if at all.</p>	<p>EIS Chapter 14 SREIS Chapter 8</p>	<p>The numerical groundwater model produced for the EIS predicted groundwater drawdown levels to 2071, which is approximately 20 years post-coal seam gas production within the Surat Basin (based on publically available production data from all coal seam gas proponents).</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
8h (cont'd)	<p>Recommendation: In the Supplementary EIS, address the long term impacts on groundwater beyond the life of the industry, whether full recovery is expected, and by what date this is projected to occur.</p>		<p>The model was designed to predict maximum drawdowns in various aquifer units prior to the implementation of mitigation measures. The temporal scale of the model is designed to predict when these peaks are likely to occur in the future. In some cases, this timeframe captures some of the recovery phase, but in others it does not. Arrow is aware that management and mitigation measures will need to be in place well before the recovery phase, and it intends to work to mitigate the effects before they are realised. A longer temporal scale limits the accuracy of the model, and also does not reflect the more likely recovery profiles associated with the implementation of mitigation measures.</p> <p>SREIS Chapter 8, Groundwater presents and discusses the revised groundwater drawdown predictions based on Arrow's current development plan.</p>
8i	<p>Issue: Inadequate information on groundwater / surface water connectivity Table 14.7 (pg. 31) in the first row states that "the Condamine Alluvium aquifer discharges to the Condamine River in some reaches, indirectly supporting biological values". However, there is no information on which reaches this applies to and whether these reaches are within the influence of the project development area. This dependency is not picked up in the surface water assessment and connectivity is not discussed in the surface water chapter (Chapter 15). Moreover, there is no information presented on any assessment or modelling undertaken on the potential connectivity between surface water and groundwater. Information on connectivity needs to be presented consistently throughout the EIS, and should be followed through with impact assessment and identification of mitigation measures.</p> <p>Recommendation: In the Supplementary report to the EIS, state explicitly where surface water-groundwater interactions are believed to occur. Specifically identify the reaches in the Condamine River that are connected to groundwater within the project development area and provide an assessment of connectivity. If the information has been included elsewhere in the EIS, a reference to this section is required.</p>	<p>EIS Chapter 14 SREIS Chapter 8</p>	<p>Section 14.5.3 of the EIS provides a broad discussion on the areas and mechanisms of groundwater and surface water interconnectivity within the project developments area.</p> <p>Following the release of the EIS, and the additional information available on the types and distribution of groundwater dependent ecosystems with the broader Surat Cumulative Management Area, a more detailed discussion on the location and mechanisms of groundwater and surface water connectivity in SREIS Chapter 8.</p> <p>The groundwater modelling results presented in EIS Chapter 14, Groundwater, indicate that the groundwater drawdown in areas where groundwater/surface water interactions may occur, specifically in the Condamine Alluvium, is low. Under the cumulative scenario, the predicted maximum drawdown in the Condamine Alluvium is 2.5 m. The results of the SREIS model, presented in Chapter 8, Groundwater, confirm that the results presented in the EIS were conservative.</p>
8j	<p>Issue: Inadequate consideration of the potential for impacts on the Great Artesian Basin (GAB) The GAB is discussed in connection with the deeper formations only. The intermediate and coal seam groundwater systems should also be considered. All these systems contain water resources used for at least stock purposes and are managed as part of the Water Resource (Great Artesian Basin) Plan 2006.</p>	<p>EIS Chapter 14 SREIS Chapter 8</p>	<p>EIS Chapter 14, Section 14.3.2, Regional Hydrology details the formations classified as part of the Great Artesian Basin. The aquifers that make up the intermediate and coal seam gas groundwater systems are identified as part of the Great Artesian Basin.</p> <p>Potential impacts to the groundwater values (including the Great Artesian Basin) are assessed in Section 14.4, Issues and Potential Impacts. A framework for the management of impacts to the groundwater systems, which include Great Artesian Basin resources, is included in the EIS. The results of the SREIS model, presented in Chapter 8, Groundwater, confirm that the results presented in the EIS were conservative.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
8j (cont'd)	<p>Recommendation: In the EIS, recognise that the intermediate and coal seam groundwater systems are also considered part of the GAB, not just the deeper groundwater systems, and include in assessment of environmental values and impacts.</p>		
8k	<p>Issue: Inadequate consideration of potential impacts of intermixing of aquifers The potential impacts of intermixing / interflow of aquifers are not well considered throughout the EIS. This should be included as a specific impact in the groundwater dependent ecosystem assessment, as well as in the assessment of environmental values.</p> <p>Recommendation: In the EIS, include an assessment of the potential for intermixing / interflow between aquifers and the impacts of this on groundwater dependent ecosystems and environmental values, including mitigation measures for these impacts.</p>	<p>EIS Chapter 14, sections 14.4.2, 14.3.3, Figure 14.6 and Table 14.9</p> <p>SREIS Chapter 8</p>	<p>Section 14.4.2 in the EIS acknowledges the potential for diminished groundwater quality in aquifers above and below the Walloon Coal Measures as a result of coal seam gas extraction and resultant inter-aquifer groundwater flow.</p> <p>EIS Chapter 14, Groundwater, Figure 14.6 presents the location of known springs within the model extent, and Section 14.3.3 presents the available information on the aquifers likely to supply groundwater to these groundwater dependent ecosystems. The information available in relation to likely source aquifers at the time of the EIS was not definitive, but the likely source aquifers were identified as forming part of the intermediate and coal seam gas groundwater systems. The potential impacts of diminished groundwater quality as a function of inter aquifer flow were assessed, and results presented in Table 14.9.</p> <p>Since the release of the EIS, a number of ecological, hydrogeological and botanical studies and surveys of groundwater dependent ecosystems (predominately springs) within the Surat Cumulative Management Area (CMA) have been conducted. The majority of these investigations were commissioned by the Office of Groundwater Impact Assessment (OGIA) to inform the Surat CMA Underground Water Impact Report (UWIR).</p> <p>The findings of these studies are presented in Chapter 8 of the SREIS, and indicate that no groundwater dependent ecosystems are currently identified in the project development area. Under the UWIR, Arrow is not identified as the tenure holder responsible for the management or monitoring of any groundwater dependent ecosystem within the Surat CMA.</p> <p>SREIS Chapter 8, Groundwater presents Arrow's framework for the management of potential impacts on groundwater dependent ecosystems that may be identified in the future. Arrow will continue to participate in the early warning industry-wide programs and investigations on the location of springs, the type and extent of groundwater dependent ecosystems, and the affected environmental values. This work is being conducted within the framework of the UWIR and required Spring Monitoring Program and Spring Impact Mitigation Strategy.</p>
8l	<p>Issue: Inadequate information has been provided on land subsidence study and related impacts "Research into the potential for regional land subsidence across the project development area was based on a review of relevant projects internationally." (Chapter 14, Section 14.6.3, pg. 46) It is unclear why no local or national examples were cited. If is preferable that if available, more local examples are used.</p>	<p>SREIS Chapter 8 and Chapter 9</p>	<p>EIS Appendix G, Groundwater Impact Assessment, Section 8.4 presents a literature review of available publications relevant to subsidence as a result of coal seam gas extraction. No local examples were available.</p> <p>As part of the SREIS, a desktop assessment of additional information available since the EIS has been undertaken and included in SREIS Chapter 8, Groundwater and Chapter 9, Surface Water.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
8l (cont'd)	<p>Recommendation:</p> <p>Arrow Energy to provide information on any local or national examples on subsidence associated with CSG extraction. Discuss possible impacts from subsidence and proposed mitigation measures.</p>		<p>The desktop study includes examples of potential subsidence associated with coal seam gas extraction, and presents the results of a collaborative baseline surface deformation study conducted by coal seam gas proponents within the Surat Cumulative Management Area (Altamira Information. 2012a). The information has been used to expand on the description provided in the EIS that subsidence as a result of coal seam gas extraction is unlikely to occur in the region.</p> <p>SREIS Chapter 9, Surface Water provides and assessment of potential impacts associated with subsidence.</p> <p>If available, Arrow will review information available from the Australian Government's Office of Water Science (a group within SEWPaC) in relation to subsidence to further enhance its understanding of potential impacts of subsidence.</p>
8m	<p>Issue: Inadequate assessment of the potential impact of the proposed project on springs</p> <p>The EIS does not provide an adequate assessment of whether springs outside the project area will be affected by the project.</p> <p>Ch 14, Section 14.3.6, pg.33 indicates that more information needs to be collected on connectivity before the impact assessment can be completed: "The specific aquifers that serve as a groundwater source for the identified discharge springs are unclear, and the impact assessment below is based on known information."</p> <p>Monitoring and assessment of springs should be implemented before rather during the operations phase. There is also incomplete identification of potential options to prevent or mitigate impacts on springs (Appendix G, Section 9.4.1.3, pg. 93).</p> <p>Recommendation:</p> <p>That Arrow Energy:</p> <ul style="list-style-type: none"> • clarify the source aquifers for the springs as much as possible. Obtain from the Queensland Water Commission a copy of Environmental Hydrology Associates Ltd (2009a) Identification of source aquifers to significant springs dependent on groundwater flow from the Great Artesian Basin - Stage 1B Report – Volume 1 Overview Report. This report details a methodology to identify source aquifers and reports on application of the methodology to 12 spring groups; • include consideration of the source aquifer attribution for springs in the QWC's Draft Underground Water Impact Report – Surat Cumulative Area released on the 17th May 2012 and add this to its modelling and impact assessment; 	<p>SREIS Chapter 8</p>	<p>SREIS Chapter 8 summarises the new information on springs that has become available since the release of the EIS, including potential source aquifers.</p> <p>No springs have been identified within the Arrow project development area. Under the now finalised and EHP-approved Underground Water Impact Report (UWIR) for the Surat Cumulative Management Area (CMA), Arrow is not the responsible tenure holder for springs located outside the project development area.</p> <p>However, Arrow is undertaking and participating in a number of research and study projects associated with the groundwater systems of the Surat Basin. These include Arrow's Condamine-Walloon Coal Measures Connectivity Study, and participation in the Joint Industry Plan for an Early Warning System for the Monitoring and Protection of EPBC Springs.</p> <p>The supplementary groundwater assessment prepared for the SREIS presents the results of a numerical groundwater model based on the framework of the OGIA model, and updated with Arrow's current development plan. Specific outputs comparing drawdown in potential source aquifers for groundwater dependent springs were not prepared for the SREIS, as potentially affected springs are identified in the UWIR, none of which are assigned to Arrow as the responsible tenure holder.</p> <p>In the event that groundwater-dependent springs are identified in the future and assigned to Arrow for monitoring or management, Arrow will comply with the requirements of the Spring Impact Management Strategy (SIMS) framework, as detailed in SREIS Chapter 8, Groundwater.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
8m (cont'd)	<ul style="list-style-type: none"> discuss actions to be taken to prevent impacts on springs, not only actions to mitigate any detrimental impacts. Mitigation strategies need to be listed for each impact. <p>It is recommended that before the environmental authority is granted, that through monitoring designed to confirm or otherwise the connectivity of discharge springs to aquifers potentially influenced by the project be undertaken. This is necessary to ensure impacts have been established with an appropriate level of certainty and mitigation measures have been developed as required.</p>		
8n	<p>Issue: Lack of detail on mitigation measures for indirect depressurisation of adjacent aquifers</p> <p>Chapter 14, Table 14.9, pg. 52 states that “Subsequent indirect depressurisation of adjacent aquifers causing reduced groundwater flow to groundwater dependent ecosystems or areas of cultural and spiritual importance fed by the adjacent aquifers” has a “low to high” magnitude and “moderate to high” significance (premitigated). After mitigation, this is “very low – low” and “low – moderate”, respectively. The EIS does not clearly indicate how the impacts can be reduced so much from the mitigation measures proposed, which are mostly focussed on springs. One of the mitigation measures are to “minimise impacts of groundwater depressurisation on sensitive areas (e.g., groundwater-dependent ecosystems)”, but no information is provided on how this will be achieved.</p> <p>Recommendation:</p> <p>Arrow Energy to provide more detail on the specific mitigation measures that will be applied to minimise impacts of depressurisation of adjacent aquifers on groundwater dependent ecosystems.</p>	<p>EIS</p> <p>Chapter 14, Table 14.9</p>	<p>Arrow's groundwater management framework targets potential impacts to groundwater users and ecological receptors such as springs and groundwater dependent ecosystems.</p> <p>Arrow will implement the framework required under the Water Act to management these potential impacts. This framework requires Arrow to comply with make good obligations and to work within the Underground Water Impact Report (UWIR), specifically the Spring Impact Management Strategy (SIMS).</p> <p>SREIS Chapter 8, Groundwater provides further updates to Arrow's procedures to comply with the Office of Groundwater Impact Assessment (OGIA) Spring Impact Management Strategy (SIMS) framework. Arrow is involved in a number of current and future research programs that will improve the capacity for OGIA to predict groundwater level impacts, and provide additional detail in future UWIRs. The future research directions include:</p> <ul style="list-style-type: none"> Interconnectivity between the Condamine Alluvium and Walloon Coal Measures. Influence of geological structure on groundwater flow in the Surat CMA. Hydrogeology of the Walloon Coal Measures. Re-conceptualisation of the groundwater systems in the Surat and Bowen Basins in the Surat Cumulative Management Area (CMA). Second generation regional flow modelling for the Surat CMA. Improving knowledge about springs.
8o	<p>Issue: No identification of groundwater dependent ecosystems and impacts No groundwater dependent ecosystems (GDEs) have been specifically identified in the groundwater chapter (e.g. Ch 14, Section 14.3.3, pg. 18). The EIS states that in order to avoid groundwater impacts, development planning will avoid natural springs (Ch 5, pg. 33, Table 5.10). However, GDEs should also be considered. While potential connectivity between the Condamine River and Condamine Alluvium is mentioned in several places in the report, there is no evidence or mapping of potential areas of connectivity presented.</p>	<p>EIS</p> <p>Chapter 14</p> <p>SREIS</p> <p>Chapter 8</p>	<p>Since the release of the EIS, a number of ecological, hydrogeological and botanical studies and surveys of groundwater dependent ecosystems (predominately springs) within the Surat Cumulative Management Area (CMA) have been conducted. The majority of these investigations were commissioned by the Office of Groundwater Impact Assessment (OGIA) to inform the Surat Cumulative Management Area (CMA) Underground Water Impact Report (UWIR). The findings of these studies are presented in SREIS Chapter 8, Groundwater.</p> <p>In addition, information on other forms of groundwater-dependent ecosystems available since the release of the EIS is presented in SREIS Chapter 8, Groundwater.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
80 (cont'd)	<p>Where are these areas? Inadequate detail is presented regarding minimisation of impacts of depressurisation on GDEs</p> <p>Recommendation: That the supplementary report to the EIS address:</p> <ul style="list-style-type: none"> the potential presence in the project area of the full suite of GDE types including aquifer and cave ecosystems, all ecosystems dependent of the surface expression of water (e.g. base-flow rivers and streams, wetlands, floodplains and springs) and all ecosystems dependent on the subsurface presence of groundwater (e.g. river red gum). <p>This should be based on a conceptualisation of the aquifers, groundwater flow paths, and recharge and discharge points. See Eamus et al. 2006 for further description of GDE types. The National Water Commission's GDE Toolbox also provides a comprehensive set of methods for identification of potential GDEs (http://nwc.gov.au/publications/waterlines/69-70).</p> <ul style="list-style-type: none"> Overlay / intersect the groundwater conceptualisation with surface features such as regional ecosystems, wetlands and the stream network to identify potential areas of dependency. Identify all GDEs in the groundwater area affected by the project, both inside and outside the project area. If any GDEs are to be excluded from further consideration, provide a rationale for this. Map locations where the Condamine Alluvium discharges to the Condamine River, and provide mapping for the location of all potential GDEs. Provide an assessment of the potential impacts on all GDEs identified through this process, and mitigation and monitoring activities proposed. Finally, include all relevant GDEs in constraints mapping where required <p>Note: The National Water Commission is currently funding the completion of a national Atlas of Groundwater Dependent Ecosystems. This will provide a mapping layer at a coarse scale of potential GDEs that may be helpful in identification of potential areas of dependency in the project area. It is expected to be released on the Bureau of Meteorology website on the 31st May 2012. See link below: http://www.bom.gov.au/water/newEvents/index.php?id=201202231345</p>		<p>These information sources include the National Atlas of Groundwater Dependent Ecosystems (BOM, 2013) and the Australian groundwater-dependent ecosystems toolbox (Richardson et al, 2011a and 2011b).</p> <p>Following the release of the EIS, and the additional information available on the types and distribution of groundwater dependent ecosystems with the broader Surat CMA, a more detailed discussion on the location and mechanisms of groundwater and surface water connectivity is provided in SREIS Chapter 8, Groundwater.</p> <p>The groundwater modelling results presented in EIS Chapter 14, Groundwater, indicated that the groundwater drawdown in areas where groundwater/surface water interactions may occur, specifically in the Condamine Alluvium, is low. Under the cumulative scenario, the predicted maximum drawdown in the Condamine Alluvium is 2.5 m.</p> <p>Arrow has prepared a numerical groundwater model using the OGIA model as a base, and updated it to include to Arrow's current development case. The results of the SREIS numerical groundwater model verify that the drawdown in the Condamine Alluvium predicted by the EIS model was conservative.</p> <p>Specific outputs comparing drawdown in potential source aquifers for groundwater dependent springs were not prepared for the SREIS, as potentially affected springs are identified in the UWIR, none of which are assigned to Arrow as the responsible tenure holder.</p> <p>In the event that groundwater-dependent springs are identified in the future and assigned to Arrow for monitoring or management, Arrow will comply with the requirements of the Spring Impact Management Strategy (SIMS) framework, as detailed in SREIS Chapter 8, Groundwater.</p> <p>Irrespective of this, Arrow is undertaking and participating in a number of research and study projects associated with the groundwater systems of the Surat Basin. These include Arrow's Condamine-Walloon Coal Measures Connectivity Study, and participation in the Joint Industry Plan for an Early Warning System for the Monitoring and Protection of EPBC Springs.</p> <p>OGIA has also identified areas of future research. These research programs will improve the capacity for OGIA to predict groundwater level impacts, and provide additional detail in future UWIRs. The future research directions include:</p> <ul style="list-style-type: none"> Interconnectivity between the Condamine Alluvium and Walloon Coal Measures. Influence of geological structure on groundwater flow in the Surat CMA. Hydrogeology of the Walloon Coal Measures.

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
8o (cont'd)			<ul style="list-style-type: none"> • Re-conceptualisation of the groundwater systems in the Surat and Bowen Basins in the Surat CMA. • Second generation regional flow modelling for the Surat CMA. • Improving knowledge about springs.
8p	<p>Issue: No identification of cultural values</p> <p>No cultural or spiritual values have been identified for any of the groundwater systems, with the exception of historical use of GAB water and some GAB springs. It is unclear what assessment and investigation was undertaken.</p> <p>Further clarification is required on the following statements:</p> <ul style="list-style-type: none"> • Chapter 14, Section 14.2.5, pg. 27 – “Groundwater from the deep system can also support spiritually important values, especially in more regional GAB discharge areas outside the project development area.” To which springs does this apply? • Chapter 14, pg. Section 14.3.6, pg 33 – “Groundwater baseflow to the Condamine River has been considered to support cultural values of the river”. This is a very ambiguous statement, what does this mean? Are there identified cultural values? What are they? • Chapter 14, Section 14.7.1, pg. 49 – “Reduced flows to groundwater-dependent ecosystems and areas of cultural and spiritual importance are related to direct coal seam gas water extraction from the Walloon Coal Measures and subsequent induced groundwater drawdown in adjacent aquifers”. Map where these reduced flows are likely to occur. <p>Recommendation:</p> <p>In the supplementary report to the EIS, detail the analysis and investigation undertaken to determine that no cultural and spiritual values apply to the area, to address the questions above. After additional identification of groundwater dependent ecosystems has been completed (see previous comment above), re-evaluate if any spiritual and cultural values apply.</p>	<p>SREIS Attachment 4</p>	<p>Arrow will prepare CHMPs or equivalent agreements in accordance with the provisions of the Aboriginal Cultural Heritage Act (Commitment C396). To meet this commitment and its legislative requirements, Arrow is negotiating two Indigenous Land Use Agreements (ILUAs) that overlap the Surat Gas Project development area. Negotiations for the Western Downs Unclaimed Area agreement are complete. Arrow has lodged this agreement with the National Native Title Tribunal for registration. The remaining area of the Surat Gas Project is overlapped by the proposed Bigambul ILUA. Arrow is currently negotiating an agreement with the Bigambul People.</p> <p>As such, no update on the issues raised has been included for the SREIS.</p>
8q	<p>Issue: Inadequate assessment of groundwater environmental values</p> <p>Chapter 14, pg. 29, Table 14.6 - Rather than grouping environmental values, the correct terminology needs to be used and each environmental value assessed and presented separately.</p> <p>Chapter 14, pg. 31, Table 14.7 – This table needs to consider the sensitivity of each individual environmental value to impacts.</p>	<p>EIS Chapter 14 SREIS Chapter 8</p>	<p>All groundwater quality-based environmental values assigned to the groundwater systems identified in the EIS are based on available DERM bore search results, and have been identified in accordance with the EPP (Water). This groundwater quality aspect of the environmental values is incorporated in to the conservation status aspect of the sensitivity rankings.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
8q (cont'd)	<p>In the EIS some environmental values are not considered relevant in the project area, however where no environmental values have been scheduled, the EPP (Water) requires that all environmental values are considered. Therefore the following environmental values for groundwater need to be considered:</p> <ul style="list-style-type: none"> • Aquaculture • Aquatic ecosystems • Cultural and spiritual values • Drinking water • Farm supply and agricultural purposes • Industrial use • Irrigation • Stock watering <p>See also: http://www.derm.qld.gov.au/environmental_management/water/environmental_values_environmental_protection_water_policy/what_are_env_wqos.html</p> <p>However, the department is satisfied that the following environmental values are not relevant to groundwater and do not need to be considered:</p> <ul style="list-style-type: none"> • Water used for producing aquatic foods for human consumption • Primary recreation • Secondary recreation • Visual appreciation <p>Having established that all the environmental values in the first list above apply, the assessment of groundwater values in the EIS needs to focus on the potential impacts of the project development on the water quality guidelines that support each environmental value. In the case of a range of values, the most stringent value should be applied. As stated in section 10 (1b) of the EPP (Water) "If water quality objectives for the water are not stated in the document— the set of water quality guidelines that will protect all environmental values stated in the document" apply.</p> <p>An indirect impact of coal seam gas water extraction identified is "Diminished groundwater quality in aquifers above and below the Walloon Coal Measures. This relates to groundwater mixing as drawdown in the Walloon Coal Measures aquifers induces flow across deeper and shallower aquifers, especially the Springbok and Hutton sandstones." (Chapter 14, Section 14.4.2 pg. 36). The impact of this should also be considered on each of the environmental values above.</p>		<p>An overall sensitivity ranking is determined for each groundwater system identified in the EIS. The overall ranking considers a range of aspects, including rarity and rehabilitation potential along with conservation status (which is determined by the EPP Water environmental values). SREIS Chapter 8, Groundwater provides additional clarity on the process of inter-aquifer flow and how the groundwater systems interact.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
8q (cont'd)	<p>Recommendation:</p> <p>In the supplementary report to the EIS, include an assessment of the potential water quality impacts on the water quality objectives associated with each of the environmental values for groundwater listed in the EPP (Water) and summarised above. Update the sensitivity table to consider the sensitivity of each environmental value to potential impacts. Where a potential impact is identified, explain the proposed mitigation measures to be put in place.</p> <p>In the Supplementary EIS, revise the impact assessment (sections 14.4 -14.7) based on this assessment of environmental values.</p>		
8r	<p>Issue: Consideration of other shallow aquifers influenced by the project</p> <ul style="list-style-type: none"> • The EIS omits discussion about impacts to the Main Range Volcanics (MRV) aquifer. • Information on connectivity with shallow productive aquifers other than the Condamine Alluvium is not presented. <p>Recommendation:</p> <ul style="list-style-type: none"> • The supplementary report to the EIS should contain mapping showing where Walloons Coal Measures (WCM) drawdowns and depressurisation may impact all shallow aquifers, not just the Condamine Alluvium. Where the base of the MRV directly overlies the WCM and the Mesozoic aquifers that underlie the WCM, this should be displayed in a drawdown/depressurisation map overlain with geological aquifer extents. • Include in the supplementary report to the EIS a commitment to further investigate connectivity with other important aquifers 	<p>EIS Chapter 14 SREIS Chapter 8</p>	<p>As described in EIS Chapter 14, Groundwater, Section 14.3.5, the shallow groundwater system is contained within unconfined aquifers, also known as watertable aquifers, where groundwater levels rise when recharge occurs (e.g., via rainfall infiltration or irrigation seepage) and fall when discharge occurs (e.g., via natural springs or pumping). Groundwater is found extensively across the project development area in these unconfined aquifers, with the Condamine Alluvium forming the main unconfined resource aquifer. The Condamine Alluvium is not the only groundwater bearing unit within the Shallow Groundwater System.</p> <p>Since the release of the EIS, the Underground Water Impact Report (UWIR) for the Surat Cumulative Management Area (CMA) was finalised and endorsed by EHP. The UWIR prepared by the Office of Groundwater Impact Assessment (OGIA) does not include the Main Range Volcanics in the groundwater drawdown predictions (however, it is identified as a formation requiring monitoring). Therefore, going forward, Arrow will be regulated in accordance with its responsible tenure holder obligations defined in the UWIR, and these may include requirements associated with other important aquifers units within the shallow groundwater system.</p> <p>SREIS Chapter 8 describes the process by which Arrow will continually update their geological model with more information as field development progresses over the life of the project, thereby capturing any additional important aquifer units.</p>
8s	<p>Issue: Lack of detail in Adaptive Management FrameworkThe description of the adaptive management framework is very brief (Chapter 14, Section 14.6.1, pg.42-43). More detail is required on how the framework will be implemented, the frequency of review and improvement etc. Specific environmental values and water quality objectives are currently being developed for the Murray Darling Basin catchments and the adaptive management framework will need to include these when they become available.</p>	<p>EIS Chapter 14 SREIS Chapter 8</p>	<p>The information presented in the EIS in relation to the adaptive management framework is a summary of the Queensland Government's publication: Adaptive environmental management regime for the coal seam gas industry (DERM, 2011h). The process is described as a framework to be adopted throughout the project to allow proponents and regulators to change direction if monitoring indicates that potential impacts may be greater than modelled, or if the management options are no longer appropriate.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
8s (cont'd)	<p>Recommendation: Arrow Energy to provide sufficient detail on the proposed implementation of the adaptive management framework to show how it will meet requirements for MDB catchments environmental values and water quality objectives.</p>		<p>Since the production of the EIS, Arrow's coal seam gas water extraction and associated groundwater and spring monitoring requirements have been regulated by the OGIA, as documented in the UWIR produced for the Surat Cumulative Management Area, which forms part of the Murray Darling Basin.</p>
8t	<p>Issue: Insufficient mapping of constraints for construction Section 14.4.4 identifies shallow groundwater as most susceptible to seepage or leaks from water storage facilities. High risk areas need to be mapped as constraints and avoided as potential locations for water storage facilities.</p> <p>Recommendation: Arrow Energy to identify shallow groundwater areas across the project development area and other high risk areas. Map these areas as constraints and avoid construction of water storage dams in these areas.</p>	<p>EIS Chapter 14 SREIS Chapter 8</p>	<p>The shallow groundwater system within the project development area is dominated by the Condamine Alluvium, which is strongly associated with the distribution of good quality agricultural land, potential strategic cropping and intensively farmed land (IFL) in the area. Dams will not be located on IFL, therefore avoiding the potential for these structures to impact on shallow groundwater resources.</p> <p>Arrow has committed to develop the construction, design and monitoring requirements for new dams (either raw water, treated water or brine dams) and determine the hazard category of the dam in accordance with the requirements of the most recent version of Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (EHP, 2012)(Commitment C141).</p> <p>The recommended mapping is not presented in the SREIS, as site specific conditions including geological and geotechnical investigations will be conducted during the detailed design phase.</p>
8u	<p>Issue: Trigger levels for groundwater not associated with environmental values Section 14.8.1 pg. 62 – “Project Infrastructure” discusses the identification of trigger values and the process for developing trigger values for groundwater. Reference needs to be made here to water quality objectives that will protect all environmental values and also the requirements set out in the proposed Murray Darling Basin Plan.</p> <p>Recommendation: In the supplementary report to the EIS, develop trigger levels relevant to water quality objectives that will protect environmental values and provide for requirements of the proposed Murray Darling Basin Plan.</p>	<p>–</p>	<p>The Murray Darling Basin Plan is not relevant to setting trigger levels to protect aquifer water quality from dam leakage.</p> <p>Groundwater monitoring programs will be required as a condition of the environmental authority. As such, the details of the monitoring plan associated with water storage dams, including the approximate locations of monitoring wells, the frequency of monitoring and identification of trigger values will be provided to support the application for an environmental authority or an environmental authority amendment, in accordance with EHP Guideline “Application requirements for petroleum activities”.</p>
9a	<p>General There is insufficient information in the EIS overall to enable a full assessment of the environmental impacts to be completed. Assessment of impacts cannot be completed without the following information:</p> <ul style="list-style-type: none"> • Submission of a coal seam gas water management plan • Estimates of water production for each development region • More detailed analysis of water management options and their feasibility • Identification of potential development locations, discharge points and watercourse crossings 	<p>EIS Chapter 5, Section 5.2.4, Figure 5.8 and Chapter 8 SREIS Chapter 3, Chapter 9, Section 9.6,</p>	<p>Arrow will provide its coal seam gas water management plan as well as statutory information requirements with a detailed monitoring plan, to support an application for an environmental authority (EA) or EA amendment. The SREIS provides further details on Arrow's water management options in Chapter 3, Project Description and Attachment 5, Coal Seam Gas Water and Salt Management Strategy.</p> <p>Estimates of water production for each development region are provided in Chapter 5, Figure 5.8 of the EIS. The SREIS provides an update on the estimates of water production in Attachment 5, Coal Seam Gas Water and Salt Management Strategy. The work recently released by the QWC in relation to groundwater dependent ecosystems has been incorporated.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
9a (cont'd)	<ul style="list-style-type: none"> • Identification of groundwater dependent ecosystems potentially affected by the project, and potential impacts on these ecosystems • Assessment of the potential impacts of development, watercourse crossings and discharges on environmental values as defined in the Environmental Protection (Water) Policy 2009, hereafter referred to as the EPP (Water). • Integration of the assessment of impacts on water quality and aquatic ecosystems in the main report. <p>The EIS is conceptual in describing the water management plans and how the wastewater will be disposed of and / or reused. Arrow have highlighted in the EIS that disposal of untreated or treated CSG water to waterways is one of the "less favoured options" (Executive Summary.pdf; pdf page 24) for water disposal and stated in an information session (11th May; 9 -12; 400 George Street) that there will be no discharge to waterways – apart from in an "emergency". An emergency release, as defined by Arrow, will include releases necessary as a consequence of heavy rainfall events, or occasions where other management strategies are not available (11th May; 9 -12; 400 George Street).</p> <p>Arrow Energy has estimated that approximately 0.5 GL per annum will be discharged to watercourses "during high rainfall events, or during times where beneficial users are unable to receive coal seam water as part of Arrow's substitution strategy" (Appendix I - Surface Water Part B Water Quality Impact Asses+EH.pdf; pdf page 34). At the volumes estimated by Arrow, discharge to streams at the Surat Gas Project could pose a significant risk to aquatic organisms, but it is impossible to estimate this risk without more than incidental information.</p> <p>The absence of a demand for beneficial use water under Arrow's substitution strategy or a lack of options in water management generally should not be considered an emergency nor are emergency discharges usually conditioned under an Environmental Approval. These are usually managed through alternative approvals such as transitional environmental programs (TEP) or under General Environmental Duty (GED).</p> <p>Many other aspects of the projects are also still at the planning (conceptual) stage including the placement of production facilities and related infrastructure. Although the framework for the placement of Surat Gas Project activities appears sound it is still highly theoretical (a desktop approach) and considers limited field studies/ecological surveys.</p>	<p>SREIS (cont'd)</p> <p>Chapter 10 and Attachment 5</p>	<p>At the time of publication of the EIS, the specific location of project infrastructure was unknown. As such, Arrow conducted the impact assessment under the structure of the environmental framework which is presented in Chapter 8 of the EIS.</p> <p>Since publication of the EIS, Arrow has identified four potential sites to locate central gas processing facilities (CGPFs), two of which may be co-located with water treatment facilities that contain discharge points. Another site has also been identified to locate a temporary workers accommodation facility (TWAF). The exact locations of infrastructure within those sites are not known at this time and will be informed using constraints identified through technical studies. SREIS Chapter 9, Surface Water, Section 9.6 identifies potential impacts and mitigation measures for the five sites, including impacts from coal seam gas water discharge on geomorphology, hydrology, water quality and ecological function. Recommendations have also been made for a water quality monitoring program in accordance with Queensland Water Quality Guidelines (QWQG)(DERM, 2009b) to develop water quality guidelines for the watercourses proposed to receive discharge. Site specific details will be elaborated on in an application for an EA or EA amendment.</p> <p>The SREIS provides further explanation regarding the interpretation of water quality values in line with the EPP (Water).</p> <p>Chapter 9, Section 9.6.2, outlines the environmental values that have been considered for watercourses associated with the five sites, particularly those proposed to receive discharge. Water quality for these watercourses was found to be generally comparable to interim site-specific guideline values developed for sub-basins within which the watercourses lie. Impacts to water quality from the discharge of coal seam gas water will be managed by only discharging coal seam gas water that meets interim water quality guidelines outlined in the SREIS or developed through the completion of a water quality monitoring program. Water quality is considered within both the Surface Water (Chapter 9) and Aquatic Ecology (Chapter 10) chapters in the SREIS.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
9a (cont'd)	<p>For example, only 35 water quality samples have been used to represent the entire Surat Gas Project area, which given the size of the project area and number of different river basins incorporated is considered inadequate. There are some issues related to how Arrow has incorporated Department of Environment and Heritage Protection (DEHP) (formerly Department of Environment and Resource Management (DERM)) data and how all reference (baseline) data has been analysed and compared to national and state guidelines.</p> <p>Experimental results to confirm desktop findings on the suitability of sites (detailed terrestrial and aquatic surveys of proposed construction/ operational sites) are only to be conducted immediately prior to activities taking place. Therefore at this stage it is not considered possible to determine the potential risk to environmental values (EVs) from the construction, operation or decommissioning of production facilities and or pipeline (gas and water) without more detailed information on where these activities will occur. However, it is expected that risk to aquatic organisms will be low where suitable management and mitigation strategies are in place.</p> <p>Limited information is available to show what type of water quality monitoring will occur throughout the operational process (from untreated water to water treated for different end use or disposal purposes), which is particularly important where discharge to waterways may occur but will be important to ensure that water is fit for purpose for use in, for example, irrigation.</p> <p>At this stage there is no information on how background surface water quality will be monitored at each site prior to construction, although it may be too early considering the placement of production facilities or pipelines have not yet been decided. Field surveys of background water quality should be conducted (and assessed by DEHP) once the placement of facilities are decided and once Arrow know where any stream disturbance will occur due to laying of pipelines or construction activities.</p> <p>There is also no information on what receiving environment monitoring will occur during construction, operation and at the decommissioning stage. Receiving environment monitoring should provide a near-field condition assessment of water quality likely to be impacted by activities within the Arrow Surat Project Area and is particularly relevant for sites where discharge to waterways will occur but also where there is potential for stream disturbance during all stages (construction, operation and decommissioning) of the project.</p>		

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
9a (cont'd)	<p>It is acknowledged that Arrow Energy already have an approval (PEN100449509) for a discharge to water (event based – contaminant release during flow events) in the Surat Gas Project Area, namely Dalby Expansion Project (Daandine) with a discharge point into an unnamed tributary of Wilkie Creek, a tributary of the Condamine River downstream of the Chinchilla Weir.</p> <p>The exact placement of production wells and facilities and associated infrastructure has not been decided but the primary area of development for the Surat Gas Project will be in the Condamine basin and exploration (wells, etc) is underway under current approvals.</p> <p>Recommendation</p> <p>That the supplementary report to the EIS should address the matters raised above while taking into account the details comments on these matters which follow.</p>		
9b	<p>Issue: Inadequate detail on the locations of proposed activities and impacts</p> <p>The EIS does not adequately describe the proposed locations for development and areas of potential impact. A circle of 12km radius is a very large area that covers a wide range of land and water habitats. As it is currently presented, there is insufficient information in the EIS to identify and assess the potential impacts of the project on ecosystems and environmental values.</p> <p>Recommendation:</p> <p>The supplementary report to the EIS should include details on the specific locations proposed and investigations to date so that a more detailed assessment of potential impacts can be made. Based on the layout of CSG bore field activities in the existing development area, initial planning conducted for the first two development areas (Dalby and Wandoan), and on known constraints, map out a likely layout of wells, production facilities, storage ponds, discharge points etc. in the Dalby and Wandoan development areas. Where a specific location cannot be provided, provide a list of possible locations and assess the potential impacts of each option.</p> <p>If possible locations cannot be provided, then a more detailed analysis of constraints will be required, including identification of all groundwater dependent ecosystems, high ecological value and minimally disturbed surface water ecosystems in the project area.</p> <p>Similarly, initial investigations undertaken into the feasibility of aquifer injection need to be included, as well as an analysis of water allocations in each area, the likely demand and feasibility of substitution of allocations.</p>	<p>SREIS</p> <p>Chapter 3 and Chapter 9, Section 9.6</p>	<p>At the time of publication of the EIS, specific locations of project infrastructure were unknown. Since publication of the EIS, Arrow has identified four potential sites to locate central gas processing facilities, two of which may be co-located with water treatment facilities that contain discharge points. A fifth site has been identified by Arrow to accommodate workers. The exact locations of infrastructure within those sites are not known at this time and will be informed using constraints identified through technical studies.</p> <p>The EIS identified potential impacts and mitigation measures associated with the infrastructure components identified for the Surat Gas Project. SREIS Chapter 9, Surface Water, Section 9.6 identifies potential impacts and mitigation measures for the five sites, including impacts from coal seam gas water discharge on geomorphology, hydrology, water quality and ecological function.</p> <p>Site specific details including coal seam water management strategies will be provided with statutory information requirements to be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to support an application for an EA or EA amendment.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
9b (cont'd)	To cover uncertainties, a range of best and worst case scenarios would need to be presented to represent the range of possible impacts.		
9c	<p>Issue: No assessment of impacts associated with buried pipelines, bores and watercourse crossings. The proposed locations of buried pipelines and potential watercourse crossings are not provided. An analysis of the potential impacts of buried pipelines and watercourse crossings has not been presented. Local impacts to groundwater and groundwater dependent ecosystems from horizontal directional drilling and borehole drilling and how these will be mitigated are not discussed.</p> <p>Recommendation:</p> <p>In the supplementary report to the EIS, provide detailed information on the proposed locations of buried pipelines and watercourse crossings. Provide an assessment of the potential impacts of buried pipelines and watercourse crossings on environmental values. Where a specific location for a watercourse crossing cannot be provided, narrow down to a list of possible locations and assess the potential impacts of each option, with particular focus on the water quality impacts.</p> <p>In accordance with section 6 of EPP (Water), all environmental values must be enhanced or protected for an area unless specific environmental values have been scheduled for that area in Schedule 1 of EPP (Water). All the environmental values listed as follows must be assessed for potential impacts on water:</p> <ul style="list-style-type: none"> • Aquaculture • Aquatic ecosystems • Cultural and spiritual values • Drinking water • Farm supply and agricultural purposes • Industrial use • Irrigation • Stock watering • Water used for producing aquatic foods for human consumption • Primary recreation • Secondary recreation • Visual appreciation <p>Locally relevant environmental values have been scheduled for the Fitzroy Basin since September 2011.</p>	<p>SREIS</p> <p>Chapter 3 Chapter 9 and Appendix 6</p>	<p>Since publication of the EIS, Arrow has identified four properties to potentially locate central gas processing facilities, two of which will have water treatment facilities located adjacent to them. A fifth property has been identified by Arrow to accommodate workers. The exact locations of infrastructure within those sites are not known at this time and will be informed using constraints identified through technical studies, including a surface water assessment.</p> <p>The water quality assessment (SREIS Appendix 6, Supplementary Surface Water Assessment Part B – Water Quality), considers the environmental values listed and provides reference to the relevant water quality guidelines as part of the investigation of coal seam gas water discharges which is presented in SREIS Chapter 9, Surface Water. In regards to the impacts of watercourse crossings, the commitments made in the EIS are consistent with Australian Pipeline Industry Association (APIA) guidelines and as such any watercourse crossings that result in temporary watercourse diversions will be conducted in accordance with relevant legislation. Impacts on pipelines and watercourse crossings were identified in the EIS. Mitigation measures will be addressed for groundwater and groundwater dependent ecosystems to be protected when encountered during horizontal directional drilling and borehole drilling. The EIS has the commitment to manage potential impacts on identified spring complexes by:</p> <ul style="list-style-type: none"> • Supporting the identification of specific aquifers that serve as a groundwater source for discharge springs. • Assessing springs that are predicted to be subject to unacceptable impacts through the source aquifer. • Developing monitoring and mitigation strategies to avoid or minimise unacceptable impacts. <p>Arrow acknowledges that the water quality guidelines for the Fitzroy Basin will need to be taken into account once buried pipelines or watercourse crossings are identified within that basin. The SREIS Chapter 3, Project Description presents that Arrow is not proposing to discharge coal seam gas water to watercourses within the Fitzroy Basin.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
9c (cont'd)	<p>Therefore, the local water quality guideline must be used to assess water quality impacts and protect local environmental values for the Fitzroy Basin:</p> <p>http://www.derm.qld.gov.au/environmental_management/water/environmental_values_environmental_protection_water_policy/schedule_1_of_epp_water_including_plans/fitzroy_scheduled_evs_wqos.html</p> <p>In accordance with section 10 of the EPP (Water), where water quality objectives have not been scheduled, the water quality guidelines that will protect all the environmental values listed above are to be used. This means that for areas other than the Fitzroy Basin, use the Queensland Water Quality Guidelines 2009:</p> <p>http://www.derm.qld.gov.au/environmental_management/water/queensland_water_quality_guidelines/queensland_water_quality_guidelines_2009.html.</p> <p>Where this guideline does not cover an environmental value, use other relevant guidelines for that environmental value such as Australian Drinking Water Guideline or ANZECC guidelines. If two different guideline values for the same parameter apply in an area apply, then the stricter value is to be used.</p> <p>In assessing aquatic ecosystem environmental values, identify each watercourse crossing site as one of the following for water quality protection purposes:</p> <ul style="list-style-type: none"> • High ecological value systems: Protect and maintain current water quality • Slightly disturbed systems: Restore to high ecological value water quality • Moderately disturbed systems: Maintain current condition and improve towards water quality objectives <p>Use the map provided for the Fitzroy Basin to identify areas of high ecological value systems (referred to as “high ecological value fresh waters (maintain)” on map) and slightly disturbed systems (referred to as “high ecological value fresh waters (achieve)” on map) at:</p> <p>http://www.derm.qld.gov.au/environmental_management/water/environmental_values_environmental_protection_water_policy/pdf/ev_plans/upper_dawson_plan_300_811.pdf</p> <p>Also state how groundwater and groundwater dependent ecosystems will be protected when encountered during horizontal directional drilling and borehole drilling.</p>		

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
9d	<p>Issue: Limited referencing between the main EIS report and the appendices. There is limited referencing between sections in the main report and sections in the appendices, where more information is available. In some cases information appeared for the first time in an appendix, for example the list of impacts and beneficial uses considered in Section 4.2 in Appendix I are not all considered in the main report. Similarly on pg. 30 of Section 4.2 in Appendix I, an allowance for a 0.5 GL discharge per annum of treated coal seam gas water is mentioned; however this figure does not appear to be discussed elsewhere in the report. The TOR specifically states (pg. 6) that “the main text of the EIS addresses all relevant matters concerning environmental values, impacts on those values and proposed mitigation measures. No relevant matter will be raised for the first time in an appendix or the draft environmental management plan”.</p> <p>Recommendation: Arrow Energy to ensure that the main report contains all required information or specifically refers to the location of the information if presented elsewhere. Resubmit the appropriate section of the main report as part of the Supplementary EIS will all information presented together on water management (for example in Chapter 5 or Chapter 26).</p>	<p>SREIS Chapter 9, Section 9.6 and Chapter 10, Section 10.4.4</p>	<p>Due to the volume of information contained within specialist technical study reports, the chapters presented in the EIS constituted a summary of information. The main chapters of the SREIS contain all relevant information or specifically refer to the location of the information if presented in an appendix. The value of 0.5 GL/annum of discharge to watercourses was selected in the EIS to allow potential impacts to be assessed of releases of coal seam gas water during emergency conditions only. Since publication of the EIS, the discharge of coal seam gas water is proposed to occur during normal operating conditions, and the results of the assessment of discharge at identified potential discharge points are included in the Surface Water chapter (SREIS Chapter 9, Surface Water, Section 9.6) and Aquatic Ecology Chapter (SREIS Chapter 10, Aquatic Ecology, Section 10.4.4).</p>
9e	<p>Issue: Inadequate information on hydrostatic pressure testing water (s.15.6.4 Mitigations for Surface Water Quality Degradations) While preparation of a hydrostatic testing procedure is proposed as a mitigation measure, there is no indication in the EIS of where hydrostatic pressure testing water will be supplied from, or how it will be stored or disposed of.</p> <p>Recommendation: The supplementary report to the EIS, should include an assessment of how much water will be required for hydrostatic pressure testing, how water will be sourced, and how and where this water will be stored and how it will be disposed of.</p>	<p>SREIS Chapter 3, Section 3.6.2</p>	<p>Arrow has made the commitment in the EIS to develop and implement a hydrostatic testing procedure prior to commencement of hydrostatic testing activities. Consultation with landholders and relevant regulatory authorities will occur prior to sourcing and disposing of hydrostatic test water. Hydrostatic test water that is discharged or recycled for secondary uses will meet relevant statutory water quality guidelines. Specific details on pipeline lengths that inform quantities of hydrostatic test water will be provided in relevant statutory documents prepared as part of an EA or amendment EA application. Further discussion regarding the hydrostatic testing activities is also presented in SREIS Chapter 3, Project Description, Section 3.6.2.</p>
9f	<p>Issue: Inadequate information on the supply of potable water for the project. It is not clear if the project, during construction or operation, will be sourcing potable water from existing urban supplies. There is no mention of whether any town will be approached to supply potable water during construction and operation activities in the EIS, and there is no mention of discussions having been undertaken with local government regarding potable water supply options.</p>	<p>–</p>	<p>Potable water is required during construction and operational activities. Water will be sourced from existing town water supplies, groundwater bores or from a reticulated water supply, depending on the location of the activities and production facilities. Coal seam gas water is no longer one of the potable water supply options being considered. Arrow will commence commercial discussions with the relevant local councils and water supply regulators during the detailed design phase of the project to explore its options further.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
9f (cont'd)	<p>Recommendation:</p> <p>In the supplementary report to the EIS, provide clarification on the supply of potable water during construction and operation. If necessary, discuss possible alternative supply options. Demonstrate that contingency options are available in the case of water not being available from town water supplies, if they are to be used.</p>		
9g	<p>Issue: The assessment of cumulative impacts on surface water lacks detail. The assessment of cumulative impacts for the project lacks sufficient detail to determine at a project development scale, the nature, extent and intensity of potential impacts. Detail is required on the specific cumulative impacts expected in each development area and the mitigation strategies that will be put in place to address the range of impacts.</p> <p>Recommendation:</p> <p>In the supplementary report to the EIS, include detail on the specific cumulative impacts expected in each development area and the mitigation strategies that will be put in place to address such impacts.</p>	<p>EIS</p> <p>Chapter 28</p> <p>SREIS</p> <p>Chapter 9, section 9.6 and 9.6.4</p>	<p>EIS Chapter 28, Cumulative Impacts, discusses the potential cumulative impacts of future developments on the environmental values of the project development area. The cumulative impact assessment for the EIS found that the project is not expected to significantly contribute to cumulative impacts on the local surface water environment.</p> <p>Since the publication of the EIS, Arrow has identified four properties where central gas processing facilities will potentially be located, two of which will have water treatment facilities located adjacent to them, which are proposed to discharge coal seam gas water to nearby watercourses. The surface water technical study undertaken for the SREIS assessed surface water impacts of discharge at the two sites, including a discussion of cumulative impacts (SREIS Chapter 9, Surface Water, Section 9.6). As details of other proponents' discharge strategies were not available, a detailed assessment could not be included of the contribution that proposed discharges will make to existing discharges and/or diversions in those watercourses. However, the closest point known to receive discharge from another proponent, that could be included in a cumulative assessment of discharge, is Chinchilla Weir. The weir is 194.5 km north of the site identified by Arrow as a potential water treatment facility location. It is therefore expected that discharge by Arrow at this site will have negligible cumulative impacts.</p> <p>Arrow has an Environmental Authority (EA) PEN100449509 to discharge treated coal seam gas water to an unnamed tributary of Wilkie Creek during natural flow events only. However, the reaches of the Condamine River affected by discharges to the unnamed tributary of Wilkie Creek are likely to be beyond the extent of predicted geomorphic change and potential mixing zones for coal seam gas water discharged from the proposed water treatment facility locations, (Section 9.6.4). Further investigation will be conducted as required, as part of the development of a discharge strategy, should an application be made for a new environmental authority (EA) or an EA amendment.</p>
9h	<p>Issue: Inadequate identification of cultural and other environmental values</p> <p>The water uses identified in Section 15.3.4 (pg. 17) are environmental values for water and should be redefined under the environmental value headings. There is also a statement that "the Condamine River is likely to have cultural and spiritual values associated with it." The cultural values should have been identified in the EIS and any risk of impacts addressed.</p>	<p>EIS</p> <p>Chapter 15, Appendix H and Appendix I</p>	<p>Arrow will prepare CHMPs or equivalent agreements in accordance with the provisions of the Aboriginal Cultural Heritage Act (Commitment C396). To meet this commitment and its legislative requirements, Arrow is negotiating two Indigenous Land Use Agreements (ILUAs) that overlap the Surat Gas Project development area. Negotiations for the Western Downs Unclaimed Area agreement are complete. Arrow has lodged this agreement with the National Native Title Tribunal for registration.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
9h (cont'd)	<p>Recommendation:</p> <p>The supplementary report to the EIS should include a detailed analysis and investigation of cultural and spiritual values that apply to the area. The report should clarify those cultural and spiritual values applying to the Condamine River. It should also identify all surface water environmental values as outlined in the following comment.</p>		<p>The remaining area of the Surat Gas Project is overlapped by the proposed Bigambul ILUA. Arrow is currently negotiating an agreement with the Bigambul People.</p> <p>The mitigation measures presented in the EIS in relation to water quality will maintain and protect the water quality and quantity of the Condamine River.</p>
9i	<p>Issue: Incomplete assessment of surface water environmental values</p> <p>There has been inconsistent consideration of environmental values for water as described in the EPP (Water) throughout the chapters and appendices. Overall, the identification and assessment of environmental values has not met the requirements under legislation. Under Section 6(1)(b) of the EPP (Water), where no environmental values have been scheduled, all environmental values for surface water and groundwater apply.</p> <p>Appendix I, Section 3.3, pg. 27 - "Specific environmental values for watercourses in the project development area are not defined in the EPP Water". This is incorrect. Specific environmental values have not been scheduled for the Condamine and Balonne, Moonie and Border Rivers catchments yet, however the standard set of environmental values to be applied are defined in the EPP (Water) under section 6(2). Environmental values and water quality objectives have been scheduled for the Fitzroy Basin, which covers part of the Wandoan development region, which the EIS should recognise.</p> <p>Appendix I, Section A2.2, pg. 55 - This section recognises environmental values, but only a subset of these is considered further. However the EPP (Water) requires that where no environmental values are scheduled, all environmental values apply with the most stringent water quality guideline to be applied in each case.</p> <p>Recommendation:</p> <p>At a minimum, the supplementary report to the EIS should include a specific assessment of the potential impacts of the project on all the environmental values listed below for surface waters needs to be completed as part of the Supplementary EIS. This should be based on an assessment of the potential water quality impacts of the project on the applicable water quality guidelines, using the most stringent water quality guidelines that apply across all the environmental values below.</p> <ul style="list-style-type: none"> • Aquatic ecosystems • Irrigation of crops • Farm use 	<p>EIS</p> <p>Appendix I, Section 3</p> <p>SREIS</p> <p>Chapter 9, sections 9.3, 9.6.3 and 9.6</p>	<p>An assessment of EPP (Water) is included in Appendix I, Surface Water Part B: Water Quality Impact Assessment, Section 3 of the EIS. This has been reviewed to incorporate information from the relevant plans associated with the policy in SREIS Chapter 9, Surface Water, Section 9.3. The Surat Gas Project does not involve the taking or diversion of surface water other than for construction of production facilities, gathering systems and wells. The potential impacts on surface water will occur at watercourse crossings and at the facilities where treated coal seam gas water is proposed to be discharged to the adjacent watercourse.</p> <p>A detailed assessment of surface water resources at the proposed water treatment facility sites (and proposed discharge locations) has been undertaken as part of the SREIS Chapter 9, Section 9.6. This assessment addresses the environmental values set out in EPP (Water) and relevant water quality guidelines including ANZECC/ARMCANZ 2009 and QWQG. Section 9.6.3 includes a recommendation for a water quality monitoring program in accordance with QWQG to establish water quality guidelines for the watercourses proposed to receive discharge from the two water treatment facilities.</p> <p>Consideration of constraints mapping and ground-truthing of sites in the Fitzroy River Basin will be undertaken to inform site and route selection following the identification of potential locations for project infrastructure.</p> <p>Similarly, Arrow acknowledges that the water quality guidelines for the Fitzroy Basin will need to be taken into account once the locations of project infrastructure is known.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
9i (cont'd)	<ul style="list-style-type: none"> • Stock watering • Aquaculture • Production of aquatic food for human consumption • Primary recreation • Secondary recreation • Visual appreciation • Raw drinking water • Industrial use • Cultural and spiritual values <p>In accordance with section 6 of EPP (Water), all environmental values must be enhanced or protected for an area unless specific environmental values have been scheduled for that area in Schedule 1 of EPP (Water).</p> <p>Locally relevant environmental values have been scheduled for the Fitzroy Basin since September 2011. Therefore, the local water quality guideline must be used to assess water quality impacts and protect local environmental values for the Fitzroy Basin:</p> <p>http://www.derm.qld.gov.au/environmental_management/water/environmental_values_environmental_protection_water_policy/schedule_1_of_epp_water_including_plans/fitzroy_scheduled_env_wqos.html</p> <p>In accordance with section 10 of the EPP (Water), where water quality objectives have not been scheduled, the water quality guidelines that will protect all the environmental values listed above are to be used. This means that for areas other than the Fitzroy Basin, use the Queensland Water Quality Guidelines 2009: http://www.derm.qld.gov.au/environmental_management/water/queensland_water_quality_guidelines/queensland_water_quality_guidelines_2009.html. Where this guideline does not cover an environmental value, use other relevant guidelines for that environmental value such as Australian Drinking Water Guideline or ANZECC guidelines. If two different guideline values for the same parameter apply in an area apply, then the stricter value is to be used.</p> <p>In assessing aquatic ecosystem environmental values, identify each watercourse crossing site as one of the following for water quality protection purposes:</p> <ul style="list-style-type: none"> • High ecological value systems: Protect and maintain current water quality • Slightly disturbed systems: Restore to high ecological value water quality • Moderately disturbed systems: Maintain current condition and improve towards water quality objectives 		

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
9i (cont'd)	<p>Use the map for the Fitzroy Basin to identify areas of high ecological value systems (referred to as “high ecological value fresh waters (maintain)” on map) and slightly disturbed systems (referred to as “high ecological value fresh waters (achieve)” on map) at: http://www.derm.qld.gov.au/environmental_management/water/environmental_values_environmental_protection_water_policy/pdf/ev_plans/upper_dawson_plan_300811.pdf</p> <p>Finally, the information in Appendix I needs to be reconciled with the main aquatic ecology section of the EIS report, which does not recognise environmental values at all. In the Supplementary EIS, ensure the most stringent guideline is selected in each case.</p>		
9j	<p>Issue: Inadequate assessment of potential impacts of CSG water discharges on water quality in surface waters.</p> <p>A number of average water quality parameters are provided for CSG water from wells which show that it is highly variable. However, no analysis is provided on how controlled or uncontrolled discharges of treated or untreated CSG water may or may not meet Queensland Water Quality Guidelines (or impact on environmental values for water). Additionally, no analysis is provided against local or regional targets, or state commitments such as the Basin Salinity Management Strategy 2011-2015 (Murray—Darling Basin Commission).</p> <p>Recommendation:</p> <p>The supplementary report to the EIS should include an assessment of treated and untreated CSG water quality against relevant environmental values and water quality guidelines applicable to the project area. This assessment is required to demonstrate the possible impacts from controlled or uncontrolled releases to streams throughout the project area. In the Supplementary EIS, explain the circumstances that would lead to either a controlled or uncontrolled discharge and provide modelling of potential cumulative salinity loads from best and worst case scenario discharge to streams to enable assessment of potential impacts of the project on state commitments to regional and national water quality plans.</p>	<p>SREIS Chapter 9, sections 9.6, 9.6.3, 9.6.4 and 9.5, Chapter 10 and Attachment 4</p>	<p>Any coal seam gas water discharged to any watercourse must meet regulatory requirements and approved release limits. Arrow has committed to develop a strategy for the discharge of coal seam gas water to watercourses in accordance with relevant legislation (Commitment C498). Since the publication of the EIS, Arrow has identified four properties to potentially locate central gas processing facilities, two of which will have water treatment facilities located adjacent to them and are proposed to contain coal seam gas water discharge points. A technical surface water study was undertaken for the SREIS to investigate impacts of coal seam gas water discharge on water quality and other surface water aspects including geomorphology, hydrology and ecological function (SREIS Chapter 9, Surface Water, Section 9.6). Section 9.6.3 provides recommendations for preliminary guidelines for initial discharge within which impacts to erosion are likely to be negligible. Section 9.6 provides guidance on developing a discharge strategy that considers the natural flow regimes of the watercourses, to also reduce impacts on aquatic ecology and overall ecological function. Recommendations have also been made for a water quality monitoring program in accordance with QWQG to develop water quality guidelines for the watercourses proposed to receive discharge. Arrow will use the information from this study, together with information from the Aquatic Ecology chapter (SREIS Chapter 10, Aquatic Ecology) to inform its discharge strategy.</p> <p>As details of other proponents' discharge strategies were not available, a detailed assessment could not be included of the contribution that proposed discharges will make to existing discharges and/or diversions in those watercourses. However, as described in SREIS Chapter 9, Surface Water, Section 9.6.5, the closest point known to receive discharge from another proponent, that could be included in a cumulative assessment of discharge, is Chinchilla Weir. The weir is 194.5 km north of the site identified by Arrow as a potential water treatment facility location. It is therefore expected that discharge by Arrow at this site will have negligible cumulative impacts.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
9j (cont'd)			<p>Arrow has an Environmental Authority (EA) PEN100449509 to discharge treated coal seam gas water to an unnamed tributary of Wilkie Creek during natural flow events only. However, the reaches of the Condamine River affected by discharges to the unnamed tributary of Wilkie Creek are likely to be beyond the extent of predicted geomorphic change and potential mixing zones for coal seam gas water discharged from the proposed water treatment facility locations. Further investigation will be conducted as required, as part of the development of a discharge strategy, should an application be made for a new environmental authority (EA) or an EA amendment.</p> <p>In any case, it is assumed that all other projects discharging to watercourses will use discharge strategies that have the same water quality objectives as the Surat Gas Project. Provided all proponents discharge coal seam gas water that meets standard or developed water quality guideline values for the receiving watercourse, potential impacts on water quality from releases of coal seam gas water are expected to be minimal.</p> <p>Uncontrolled releases of coal seam gas water may occur during catastrophic scale flood emergencies, and in this case the released coal seam gas water would be diluted to be within the prescribed limits due to the large flows the watercourse is experiencing.</p>
9k	<p>Issue: Lack of rationale for selection of general mitigation measures</p> <p>Chapter 15, Section 15.6.1, pg.30 - No rationale is provided for implementing a 100m buffer zone from the high bank of all watercourses. There is also no presentation of any evidence, if available, to support that this is a suitable distance to achieve environmental protection.</p> <p>Section 15.6.1 pg 31 – “Develop a protocol for the discharge of coal seam gas water to watercourses in a controlled manner under emergency situations”. The EIS does not provide any information on what would define or trigger an ‘emergency situation.’”</p> <p>Recommendation:</p> <p>Arrow Energy should provide justification and supporting evidence, where available, to support the proposed buffer zone width of 100m.</p> <p>Provide more detail on when and where a discharge to stream may occur and provide more information on what a protocol might contain in the water management plan.</p>	<p>EIS</p> <p>Chapter 15, Section 15.6.1</p> <p>SREIS</p> <p>Chapter 10, Chapter 9, Section 9.6 and Attachment 4</p>	<p>Queensland legislation prescribes buffers to environmentally sensitive areas and watercourses. The buffers are set out in conditions on environmental authorities for petroleum activities. The buffers have been included as constraints as part of the ‘environmental framework’ and delineated as ‘no go’ or highly constrained areas depending on the type of activities precluded by Queensland regulations. Aquatic ecosystems associated with environmentally sensitive areas such as Lake Broadwater are protected, as well as sensitive reaches of watercourses in the project development area. The environmental framework does not preclude pipeline crossings of watercourses but does preclude the development of wells and production facilities in buffers included as conditions on environmental authorities.</p> <p>To reduce potential impacts on watercourses, Arrow has committed to implement a buffer zone, of a distance determined in accordance with legislative requirements at the time of development or through preconstruction clearance surveys, from the high bank of all watercourses to prevent development or clearance occurring within the buffer (other than construction of watercourse crossings for roads and pipelines, discharge infrastructure and associated stream monitoring equipment) (Commitment C157). The 100-m buffer that was specified in the EIS, Chapter 15, Surface Water, Section 15.6.1, aligns with the EA condition that exists for the Dalby Expansion Project. Given that almost 75% of the watercourses in the Surat Gas Project area were classified as stream order one, for which a 50-m buffer is standard for an EA condition, a distance of 100 m is considered conservative for the majority of the project area. However, as previously specified, buffer widths will now be in accordance with the relevant legislative requirements and therefore may be more or less than 100 m.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
9k (cont'd)			<p>Coal seam gas water is proposed to be discharged during normal operating conditions. Since the publication of the EIS, Arrow has identified four properties to potentially locate central gas processing facilities, two of which will have water treatment facilities located adjacent to them and are proposed to contain coal seam gas water discharge points. A technical surface water study was undertaken for the SREIS to investigate impacts of coal seam gas water discharge on water quality and other surface water aspects including geomorphology, hydrology and ecological function (SREIS Chapter 9, Surface Water, Section 9.6). This investigation provides recommendations for preliminary guidelines for initial discharge within which impacts to erosion are likely to be negligible. Guidance is also provided on developing a discharge strategy that considers the natural flow regimes of the watercourses, to reduce impacts to aquatic ecology and ecological function. Recommendations have also been made for a water quality monitoring program in accordance with QWQG to develop water quality guidelines for the watercourses proposed to receive discharge. Arrow will use the information from this study, together with information from the Aquatic Ecology chapter (SREIS Chapter 10, Aquatic Ecology) to inform its discharge strategy.</p> <p>Uncontrolled releases may occur during catastrophic scale flood emergencies, and in this case the released coal seam gas water would be diluted to be within the prescribed limits due to the large flows the watercourse is experiencing.</p>
9l	<p>Issue: Clarification required for mitigations for changes to physical form</p> <p>Two of the commitments made in Chapter 15, Section 15.6.2, pg. 31 raise concern and appear to contradict each other:</p> <p>C165 - The stockpile of watercourse bed material in the watercourse channel seems like a large risk for sedimentation in the event of sudden rainfall. Due to the extent of construction works the removal of this stockpiled material before heavy rain does not seem feasible.</p> <p>C170 – “Locate soil stockpiles away from watercourses and wetlands to minimise potential for sediment runoff to enter the watercourse or wetland”. This appears to be opposite to C165.</p> <p>Clarification is required on when and where each commitment will be applied.</p> <p>Recommendation:</p> <p>That Arrow Energy provide a more detailed assessment of alternative options for location of stockpile materials. Provide further information on the course of action to be taken when heavy rainfall is predicted. Clarify the course of action to be taken if the composition of watercourse bed material contains fine particles that would cause sedimentation. Clarify the circumstances in which each commitment above would be applied.</p>	<p>EIS</p> <p>Chapter 15, Section 15.6.2</p>	<p>Commitment C165 states that watercourse bed material will be stockpiled in the watercourse channel adjacent to the construction ROW, only when the watercourse is dry. However, if construction works are extensive, i.e., will take a significant amount of time, and/or heavy rainfall is predicted, this option will not be considered. In this case, soil stockpiles will be located away from watercourses and wetlands to reduce potential for sediment runoff to enter the watercourse or wetland, as stated in Commitment C170.</p> <p>Detailed information on the mitigation measures to reduce the impacts of changes to physical form will be provided in relevant statutory information requirements to support an application for an EA or an EA amendment in accordance with EHP Guideline “Application requirements for petroleum activities”.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
9m	<p>Issue: Incomplete assessment of hydrology impacts and inadequate mitigation measures</p> <p>Chapter 15, Section 15.6.3, pg 32:</p> <p>Where practicable, indicate the location of facilities and equipment above the 1-in-100-year ARI may not occur. If site facilities shouldn't be exposed to flood events, then all site facilities must be located outside the area susceptible to flooding.</p> <p>This section makes no reference to changes in hydrology due to potential discharge of water to streams, and mitigation of impacts on the ephemeral nature of streams.</p> <p>Recommendation:</p> <p>That the supplementary report to the EIS clarify which processing facilities and equipment must be located above the 1-in-100-year ARI.</p> <p>Detail the mitigation strategies that will be put in place to minimise the potential impacts on the hydrology of ephemeral streams from possible discharges.</p>	<p>EIS</p> <p>Chapter 15, Section 15.6.3</p> <p>SREIS</p> <p>Chapter 9, sections 9.5 and 9.6 and Chapter 10</p>	<p>In the EIS, Arrow stated that will site facilities above the 1-in-100-year average flood recurrence interval, where practicable and design infrastructure taking into consideration overland flow and flooding regimes to reduce impacts on immediate and surrounding areas (Commitment C155).</p> <p>Since publication of the EIS, Arrow has identified four properties to potentially locate central gas processing facilities, two of which will have water treatment facilities located adjacent to them and will potentially contain coal seam gas water discharge points. A fifth property has been identified by Arrow to accommodate workers. The exact locations of infrastructure within those sites are not known at this time and will be informed using flood extent constraints identified through technical studies As part of a surface water technical study, flood modelling of these locations was undertaken showing the predicted extents for the 1-in-100-year average recurrence interval flood event in relation to potential facility locations (SREIS Chapter 9, Surface Water, Section 9.5).</p> <p>Additionally, the study investigates impacts of coal seam gas water discharge, which is proposed to occur under normal operating conditions, on the water quality and other surface water values, including geomorphology, hydrology and ecological function, of watercourses proposed to receive discharge (Section 9.6). This investigation provides recommendations for preliminary guidelines for initial discharge within which impacts to erosion are likely to be negligible. Guidance is also provided on developing a discharge strategy that considers the natural flow regimes of the watercourses, to reduce impacts to aquatic ecology and ecological function. Recommendations have also been made for a water quality monitoring program in accordance with QWQG to develop water quality guidelines for the watercourses proposed to receive discharge. Arrow will use the information from this study, together with information from SREIS Chapter 10, Aquatic Ecology, to inform the development of a discharge strategy that will minimise potential impacts to the hydrology of ephemeral watercourses.</p>
9n	<p>Issue: Proposed monitoring not based on guidelines</p> <p>Chapter 15, Section 15.8, pg. 34 - This section lists a range of water quality parameters to be monitored, but does not relate them back to the relevant water quality objectives and guidelines.</p> <p>Recommendation:</p> <p>That the supplementary report to the EIS detail which parameters need to be monitored in accordance with the relevant guidelines to ensure environmental values are protected.</p>	<p>EIS</p> <p>Appendix I, Section 3</p> <p>SREIS</p> <p>Chapter 9, sections 9.6, 9.6.3 and Appendix 6</p>	<p>The EIS Appendix I, Surface Water Part B Water Quality Impact Assessment, Section 3 includes a review of the Queensland Water Quality Guidelines (DERM, 2009b), the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ, 2000) and the EHP (formerly DERM) Guidelines for Monitoring and Sampling (DERM, 2010f). A surface water technical study was undertaken for the SREIS which investigated impacts of coal seam gas water discharge on the water quality of watercourses proposed to receive discharge (SREIS Chapter 9, Surface Water, Section 9.6). Upon review of the above guidelines, this study retained the interim water quality guidelines developed in the EIS and compared these to results from the water quality sampling undertaken for the SREIS. Recommendations have also been made in Section 9.6.3 for a water quality monitoring program in accordance with QWQG to develop water quality guidelines for the watercourses proposed to receive discharge which will inform Arrow's discharge strategy.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
9o	<p>Issue: Inadequate assessment of beneficial use water supply mechanisms Section 15.6.1 Beneficial use pg. 31. It is unclear how treated CSG water will be supplied as substitute water allocations to users (e.g. by pipe, using the stream as a conduit) and what environmental harm might be caused by this delivery mechanism. Nor are mitigation measures for impacts described.</p> <p>Recommendation:</p> <p>That the supplementary report to the EIS provide an assessment of the potential environmental harm associated with the supply of water to substitute water allocations, including an identification of impacts and details of mitigation strategies and actions that would be applied.</p>	<p>SREIS Chapter 3, Chapter 8 and Attachment 5</p>	<p>The EIS considers impacts related to the construction, operation and decommissioning of underground water gathering lines, which is consistent with the potential impacts associated with the substitution network.</p> <p>Chapter 3, Project Description and Attachment 5, Coal Seam Gas Water and Salt Management Strategy of the SREIS provides additional information on the substitution strategy and outlines that Arrow will enter into commercial water off-take agreements with third parties to facilitate the provision of a specified volume of coal seam gas water, at a specific quality and over a given time period in lieu of the third party's access to groundwater allocations from the Condamine Alluvium. These sections of the SREIS also provide additional context on the proportions of coal seam gas water management options within the vicinity of the two water treatment facilities, based on land use, seasonal water supply and demand patterns and the potential for new uses to emerge during the life of the project.</p> <p>For the SREIS, Arrow has prepared a numerical groundwater model using the Office of Groundwater Impact Assessment (OGIA) Surat Cumulative Management Area (CMA) groundwater model as a base. The model has been updated to include to Arrow's current development case. The model has been used to predict groundwater drawdown under a cumulative scenario, with the results presented in SREIS Chapter 8, Groundwater. The groundwater model prepared for the SREIS includes a scenario which will predict the response in the Condamine Alluvium when Arrow's component of the flux from that unit to underlying aquifers is offset by 'virtual injection' of treated coal seam gas water via substitution. Arrow is committed to offsetting its component of modelled likely flux of groundwater from the Condamine Alluvium as a result of coal seam gas water extraction from the Walloon Coal Measures through a process of 'virtual injection' in the area of greatest predicted drawdown (Commitment 565).</p> <p>The results of this groundwater modelling scenario have been presented in Chapter 8 to demonstrate the effectiveness of 'virtual injection' in offsetting drawdown in the Condamine Alluvium.</p>
9p	<p>Issue: Environmental protection objective for the Great Barrier Reef Appendix I, section 3.3, pg. 28 – There is no reason given for the inclusion of the environmental protection objective: "Protection of the integrity of the downstream marine environment, specifically the Great Barrier Reef Marine Park and World Heritage property" would appear to be outside the area of influence of the project.</p> <p>Recommendation:</p> <p>Arrow Energy should clarify whether this objective should be included.</p>	<p>SREIS Chapter 9, Section 9.6 and Appendix 6, Section 5.1</p>	<p>Since publication of the EIS, Arrow has identified four properties to potentially locate central gas processing facilities, two of which will have water treatment facilities located adjacent to them and will potentially contain coal seam gas water discharge points. A surface water technical study was undertaken for the SREIS which investigated impacts of coal seam gas water discharge on water quality and other surface water environmental values, including geomorphology, hydrology and ecological function, of watercourses proposed to receive discharge (SREIS Chapter 9, Surface Water, Section 9.6).</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
9p (cont'd)			The environmental protection objective to protect the Great Barrier Reef has been retained however it has been noted in SREIS Appendix 6, Supplementary Surface Water Assessment Part B – Water Quality, Section 5.1 that minimal disturbance is expected within the catchment of the Great Barrier Reef Marine Park, i.e. the Fitzroy basin. Watercourses within the project development area in this basin contribute less than 1% of the total area of the Dawson River sub-basin and flow approximately 700 km from the project development area before discharging to the sea.
9q	<p>Issue: Use of the most current information to determine EVs and WQOs</p> <p>In the surface water quality chapter (Chapter 15 - Surface Water.pdf) the section on legislative context, policies and standards (15.1, pdf pages 1 and 2) refers to two important documents that have been superseded including:</p> <p>A) the Environmental Protection (Water) policy 1997 now updated to Environmental Protection (Water) policy 2009 now including EVs and WQOs for the Fitzroy Basin (http://www.derm.qld.gov.au/environmental_management/water/environmental_values_environmental_protection_water_policy/schedule_1_of_epp_water_including_plans/index.html) and</p> <p>B) the Water Resource (Fitzroy Basin) Plan 1999, now updated to Water Resource (Fitzroy Basin) Plan 2011, where e.g. environmental flow objectives have been updated.</p> <p>Recommendation:</p> <p>Arrow Energy should ensure that the most recent legislation, policies and guidelines are used to identify EVs and WQOs to protect these; and provide guidance on managing or mitigating impacts to surface water (water quality and flow characteristics). The supplementary report to the EIS should detail any changes in the project and its impacts that would be needed for the project to meet these more recent policies for water.</p>	<p>SREIS</p> <p>Chapter 9, Section 9.3</p>	<p>Since publication of the EIS, Arrow has identified four properties to potentially locate central gas processing facilities, two of which will have water treatment facilities located adjacent to them and will potentially contain coal seam gas water discharge points. A surface water technical study was undertaken for the SREIS which investigated impacts of coal seam gas water discharge, that are proposed to occur under normal operating conditions, on water quality and other surface water environmental values, including geomorphology, hydrology and ecological function, of watercourses proposed to receive discharge. This study includes a review of the relevant water quality guidelines, including the two documents referred to in this issue (SREIS Chapter 9, Surface Water, Section 9.3).</p> <p>This study considers water quality guidelines, legislation and policies including these two documents relating to the Fitzroy Basin.</p>
9r	<p>Issue: Insufficient characterisation of field survey sites for comparison with national (ANZECC/ARMCANZ (2000)) or regional (QWQGs, 2010) water quality guidelines and deriving sub-regional guidelines.</p> <p>Thirty five sites were selected to represent “different creek and river system conditions within the project development area, together with different land uses in the project development area (agriculture use, residential, forest parks, mining).” (pdf page 68 of Appendix I - Surface Water Part B Water Quality Impact Asses.pdf). These samples seem to have been collected as part of a water quality field survey by NRA for Arrow.</p>	<p>SREIS</p> <p>Chapter 9, Section 9.6.3 and Appendix 6, Section 8.2</p>	<p>All available water quality data, whether from flowing or non-flowing conditions, was included in the calculation of the interim water quality guideline values for the purpose of the EIS, the intent of which was to provide a representative assessment of water quality within the Surat Gas Project area. This was considered appropriate as these conditions are likely to be experienced for several months of the year throughout the Surat Gas Project area. It is known that flowing and non-flowing water quality conditions may differ. The intent was to develop a representative comparison dataset for the purpose of describing site conditions of the Surat Gas Project area, acknowledging that site-specific guideline values should ideally be developed for each specific impact area and for each type of flow condition prior to potential impact.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
9r (cont'd)	<p>Flow condition has not been recorded/described for every site and/or for every date where water quality sampling occurred. From the information provided in Table 3-1; pdf pages 22-34 (Appendix I - Surface Water Part B Water Quality Impact Asses.pdf) it appears that water quality samples were taken primarily during no flow periods (in 2009) and low flow periods (2010). Added to this it is suspected that the NRA field study sites are not true reference sites as defined in the Queensland Water Quality Guidelines ((QWQGs), 2010) given the representation in land use categories of Table 3-1 (Appendix I - Surface Water Part B Water Quality Impact Asses.pdf). This is not unusual as it is difficult find sites that fulfil true reference criteria but it still needs to be clearly presented why they do not fit those criteria and how the data will then be used.</p> <p>The NRA collected field data that appears to have been pooled with DERM data (see excerpt in italics below), however no metadata has been presented for the data used from DERM sites (e.g. are they reference sites? what was the adjacent landuse; what were the flow conditions at the time of sampling, etc). There is also no information flow conditions of DERM data used in the baseline assessment of water quality in the Surat Project area.</p> <p>“DERM maintains water quality data which includes the major rivers and associated sub-catchments of the project development area. This data, and that collected during the field surveys conducted in October 2009, November 2009 and March 2010, was assessed for the purpose of nominating environmental values.” (Appendix I - Surface Water Part B Water Quality Impact Asses.pdf; Pdf page 36) and</p> <p>“Site specific guideline values were calculated using data provided by the State of Queensland (Department of Environment and Resource Management) [2009 and 2011]) and baseline data collected during baseline surveys undertaken in October 2009, November 2009 and March 2010.”. (Appendix I - Surface Water Part B Water Quality Impact Asses.pdf; pdf pages 91-92)</p> <p>The above information (flow; site characteristics, etc.) is integral to determining whether data collected in field studies (NRA sites) from the Arrow Surat Gas Project can be pooled with data collected from DERM and/or compared to reference based guidelines (QWQGs, 2010) or used in place of national (ANZECC/ARMCANZ, 2000) guidelines where no (more relevant) regional guidelines exist. It appears that water quality collected during no flow conditions has already been included in statistical analyses with water quality data collected during flow conditions.</p>		<p>The interim water quality guideline values calculated for the Surat Gas Project EIS are considered suitable for the purpose of a broad comparison of water quality conditions in the project area. Site-specific guideline values representing different flow conditions and relevant to each facility location will be derived prior to project development. Site-specific information has been collected for the SREIS and will be used to support approvals post EIS for activities that may impact watercourses.</p> <p>The SREIS includes a site-specific assessment of the impacts of discharge on watercourses at two sites identified by Arrow as potential locations for water treatment facilities and discharge points. As part of this assessment, water quality samples were taken from each of the watercourses proposed to receive discharge and streamflow condition was noted. Results, which have been presented according to whether the sample was taken from the watercourse in a 'flow' or 'no-flow' condition, are included in detail in SREIS Appendix 6, Supplementary Surface Water Assessment Part B – Water Quality. A discussion has been included in Section 8.2 regarding whether the sampling sites constitute true reference sites. It has been recognised that watercourses proposed to receive discharge are already affected by disturbance and that using 'true reference sites' may not provide an appropriate comparison for receiving waters proposed to receive discharge.</p> <p>Recommendations have also been made in SREIS Chapter 9, Surface Water, Section 9.6.3 for the collection of further site-specific background/reference data (as part of a water quality monitoring program) for the calculation of water quality guideline values prior to any potential impacts resulting from the development of Surat Gas Project facilities. Interim guidelines were used for the EIS and SREIS to formulate the analyte suite for the water quality monitoring program and ongoing monitoring. Site-specific information collected for the SREIS will be used to support approvals post EIS for activities that may impact watercourses.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
9r (cont'd)	<p>Combining data from no flow and flow conditions is usually inappropriate, particularly for physico-chemical stressors such as electrical conductivity (EC); dissolved oxygen (DO) and pH. It may also be inappropriate from comparison with national water quality guidelines (2000) and regional water quality guidelines (QWQGs, 2010). In this instance Arrow should refer to 5.2.2 Application of guidelines to ephemeral waters in the QWQGs (2010).</p> <p>Recommendation:</p> <p>Arrow Energy, in the supplementary report to the EIS, should include appropriate characterisation and a description of the flow conditions at the time where water quality samples were collected as part of their (NRA) field surveys in October and November of 2009 and March, 2010. Appropriate site characterisation and a description of flow conditions for any DERM data used in the background water quality assessment in the Surat Gas Project area should be included. Monitoring data collected during times of no flow should be removed from the assessment.</p> <p>The supplementary report to the EIS should also clarify whether the NRA and DERM sites used to assess background water quality in the Surat Gas Project area are true reference sites (fulfil the criteria in 4.4.2 of the QWQGs, 2010) and if not describe the condition of the sites (do they divert much from the reference sites). Sites that fail the reference site criteria but are not heavily impacted can still be used to derive sub-regional guidelines. Alternatively, that can still be used to inform licensing decisions as background or control site information.</p>		
9s	<p>Issue: Confirmation of site locations; appropriate referencing of information from other sources.</p> <p>It appears that the site locations for those surveyed by NRA (on behalf of Arrow Energy) are in Table A1T-3 to A1T-5 but it is unclear whether the "watershed sites" in Table A1T-6 represent the locations of DERM sites used for baseline water quality assessment in the Surat Gas Project area (Appendix I - Surface Water Part B Water Quality Impact Asses.pdf).</p> <p>Recommendation:</p> <p>Arrow Energy should confirm whether the monitoring site locations in Table A1T-6 are those surveyed by DERM i.e. "watershed sites" represents the locations of DERM sites used for baseline water quality assessment in the Surat Gas Project area (Appendix I - Surface Water Part B Water Quality Impact Asses.pdf). In general, all information used from other sources, e.g. DERM data, should be comprehensively identified and referenced.</p>	<p>EIS</p> <p>Appendix I, Attachment A, Table A1T-6</p> <p>SREIS</p> <p>Appendix 6, tables A1T-1, A1T-2 and A1T-3</p>	<p>The sites listed in Table A1T-6 represent those used to develop the nominated guideline values, with data for those sites presented in Attachment A of EIS Appendix I, Surface Water Part B Water Quality Impact Assessment. The following reference clarifies the source of the information: Source: © The State of Queensland (DERM, 2009e).</p> <p>In SREIS Appendix 6, Supplementary Surface Water Assessment Part B – Water Quality, Tables A1T-1, A1T-2 and A1T-3, reference has been made to data from 2009 (ERM, 2009e) and updated in 2011 (DERM, 2011i).</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
9t	<p>Issue: Data requirements for comparison of background-reference data with guideline values.</p> <p>The minimum data requirements for comparison of local background-reference data with national guidelines may not have been fulfilled (it is unclear what “n” is in Table A1T-2 of Appendix I - Surface Water Part B Water Quality Impact Asses.pdf) nor is it clear whether the data quantity requirements have been achieved for comparison with QWQGs (2010) i.e. it is not clear if there are 3 or more reference (as defined in QWQGs, 2010) or background-reference sites (similar to reference sites but do not fully meet reference site criteria) for each water quality type.</p> <p>Recommendation:</p> <p>Arrow Energy should ensure that the minimum data requirements are fulfilled, in order to compare background-reference data with guideline values, according to reference data quantity of QWQGs (DERM, 2010) - Table 4.4.2: Reference data requirements for estimating 20/25th, 50th and 80/75th percentiles – for comparison with regional water quality guidelines.</p>	<p>EIS</p> <p>Appendix I, Table A1T-2</p> <p>SREIS</p> <p>Chapter 9, sections 9.6, 9.6.3 and Appendix 6, Tables A1T-2 and A1T-3</p>	<p>Clarification: “n” in Table A1T-2 of Appendix I, Surface Water Part B Water Quality Impact Assessment represents the number of individual data points used to calculate the 80th (and 20th) percentile.</p> <p>The intent of the interim water quality guideline values calculated for the EIS was to provide a representative assessment of water quality within the Surat Gas Project area.</p> <p>As described in the EIS and SREIS, when selecting data to use for the derivation of guideline values, there is a preference for the use of local reference data (i.e., from reference sites in very similar condition/setting but that are free of the impact being measured. For example, reference data may be gathered from upstream of a potential impact). This ensures that guideline values reflect local site conditions. As the location of specific Surat Gas Project facility sites was not available for the assessment of potential future impacts during preparation of the EIS, collection of sufficient data representative of potential impact areas was not possible.</p> <p>Although the QWQG recommends the use of reference sites with no intensive industry within 20 km upstream, for the purpose of the EIS this was not considered to provide a representative assessment of background water quality conditions for the Surat Gas Project, particularly as many watercourses within the project area did not meet the criteria outlined in Table 4.4.1 of the QWQG. Therefore, a range of sites from throughout the project area were selected for the calculation of guideline values, including sites sampled during specific EIS field surveys and by the State (e.g., DERM).</p> <p>The interim water quality guideline values calculated for the Surat Gas Project EIS are considered suitable for the purpose of a broad comparison of water quality conditions in the project area. Site-specific guideline values relevant to each facility location will be derived prior to project development.</p> <p>The SREIS includes a site-specific assessment of the impacts of discharge on watercourses at two sites identified by Arrow as potential locations for water treatment facilities and discharge points (SREIS Chapter 9, Surface Water, Section 9.6). As part of this assessment, water quality samples were taken from each of the watercourses proposed to receive discharge. Results are included in detail in SREIS Appendix 6, Supplementary Surface Water Assessment Part B – Water Quality, Tables A1T-2 and A1T-3. In SREIS Chapter 9, Surface Water, Section 9.6.3, recommendations have been made for the collection of further site-specific background/reference data (as part of a water quality monitoring program) for the calculation of water quality guideline values prior to any potential impacts resulting from the development of Surat Gas Project facilities. This includes the collection of water quality samples from a minimum of 18 data points collected from one to two reference sites (or 12 data points from three or more reference sites) over a minimum period of 12 months.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
9u	<p>Issue: Comparing background-reference data from the Surat Gas Project area with water quality guidelines</p> <p>It appears that 80th percentile values of “site-specific” or background-reference data (DERM, 2009 & 2011 and NRA survey data collected October 2009, November 2009 and March 2010) have been compared to both physico-chemical stressors and toxicant ANZECC/ARMCANZ (2000) guideline values. However, it is not clear for parameters where there are ranges for “site-specific” data (e.g. pH, dissolved oxygen) whether the lower site values are 20th percentile.</p> <p>There appears to be no comparison with QWQG (2010), apart from salinity, because there are limited regional guideline values for most of the regions encompassed by the Surat Gas Project. For salinity the proponent has used the correct (75th percentile) value for comparison with salinity guidelines within each zone in the QWQG (2010). However, as highlighted in issue 3 there are more up to date regional water quality objectives for the Dawson River, which should be included in Table A1T-2, including ammonia, oxidised nitrogen, organic nitrogen, total nitrogen, dissolved oxygen, etc.</p> <p>Recommendation:</p> <p>In order to ensure correct use of approaches for comparing baseline or background-reference data from the Surat Gas Project area with water quality guidelines Arrow Energy, in the supplementary report to the EIS, should:</p> <p>A) Specify in Table A1T-2 (pdf pages 83-92; Appendix I) what the lower values of the data ranges for “site-specific” data are and</p> <p>B) Use of most current regional guideline values from the Environmental Protection (Water) policy 2009 now including EVs and WQOs for the Fitzroy Basin (http://www.derm.qld.gov.au/environmental_management/water/environmental_values_environmental_protection_water_policy/schedule_1_of_epp_water_including_plans/index.html)</p> <p>This should only be done once it has been determined whether the data requirements for reference site criteria (for QWQGs, 2010; section 4.4.2), have been fulfilled.</p>	<p>SREIS</p> <p>Appendix 6, Tables A1T-2 and A1T-3</p>	<p>The SREIS includes a site-specific assessment of the impacts of discharge on watercourses at two sites identified by Arrow as potential locations for water treatment facilities and discharge points. As part of this assessment, water quality samples were taken from each of the watercourses proposed to receive discharge. Results are included in detail in SREIS Appendix 6, Supplementary Surface Water Assessment Part B – Water Quality, Tables A1T-2 and A1T-3. Tables from the EIS have not been updated however the tables presenting water quality results in Appendix 6 include the following:</p> <ul style="list-style-type: none"> • Reference to the 20th percentile, used to calculate the lower range for pH and dissolved oxygen; and • The most current regional guideline values from the EPP (Water) 2009 for the Fitzroy Basin, where relevant. As neither of the watercourses proposed to receive discharge lie within the Fitzroy Basin, these guidelines are therefore not included in the table.

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
9v	<p>Issue: Expected water quality of CSG associated water during different stages of operational process has not been adequately described. Comments on relevant sections on characterisation of CSG water quality (including documents - Executive Summary.pdf; Chapter 5 - Project Description.pdf and Appendix I - Surface Water Part B Water Quality Impact Asses.pdf).</p> <p>Arrow have very briefly characterised the CSG water from the Surat Basin in the Executive Summary and Chapter 5. The CSG water is described as typically brackish with suspended solids, trace levels of metals and low levels of nutrients. Water quality varies between wells and can vary over the wells' lifetime. There is no characterisation of organic contaminants such as hydrocarbons (polycyclic aromatics hydrocarbons (PAHs), benzene, toluene, xylene (BTEX), etc) that could potentially be mobilised from coal seams during gas extraction. There is also no indication of what "trace metals" (Chapter 5 - Project Description.pdf; pdf page 14) are present. More detailed data presented in Table A1T-1 (Appendix I; pdf pages 74-82) characterises water quality for Arrow wells and dams including some individual metals and levels of BTEX. However, there is no metadata to accompany these results, for example, how many samples were taken?; from what wells and/or dams?; what was the origin of the water?; how long had the water been stored?, etc. The only information given is that the wells and dams water quality was from a determination of dam content for dam characterisation for PEN200055107, i.e. if the content of dam is hazardous waste. It is important to note that some organic compounds and metals are potentially toxic to aquatic organisms even at trace levels, for example, benzo[a]pyrene (a PAH) has an ANZECC/ARMCANZ (2000) trigger value for the protection of aquatic ecosystem health of 0.1 µg/L.</p> <p>Understanding the quality of the CSG production water prior to treatment (feed water) can be used to inform risk assessment process, particularly where there is potential for discharge of this untreated water to waterways (e.g. during heavy rainfall events) and if there is potential for leaks; spills or infiltration of this water to surface waters.</p> <p>There is also no information provided to characterise the expected quality of water for each potential end disposal or end use. The only information provided is that water produced during CSG extraction will be treated so that it is fit for purpose and this could involve reverse osmosis (RO) and water balancing (although it is not clear what this is and we assume it is addition of calcium and/or magnesium) at integrated processing facilities.</p>	<p>EIS Chapter 5, Section 5.2.4 and Appendix I, Table A1T-1</p> <p>SREIS Chapter 9, Section 9.6, Chapter 10, Appendix 6, Tables A1T-1, A1T-2 and A1T-3 and Attachment 5</p>	<p>As described in the EIS Chapter 5, Project Description, Section 5.2.4, the coal seam gas water quality from the Walloon Coal Measures can vary from freshwater to saline water.</p> <p>Coal seam gas water can contain high concentrations of suspended solids, and typically has a pH that ranges between 7 and 11. Ions (including calcium, magnesium, potassium, fluoride, bromine, silicon and sulphate) and trace metals can also be present.</p> <p>Arrow is currently undertaking a water quality monitoring program to gather additional information on the quality of coal seam gas water and the potential receiving watercourses. The SREIS includes a site-specific assessment of the impacts of discharge on watercourses at two sites identified by Arrow as potential locations for water treatment facilities and discharge points (SREIS Chapter 9, Surface Water, Section 9.6). As part of this assessment, water quality samples were taken from each of the watercourses proposed to receive discharge. Results are included in detail in SREIS Appendix 6, Supplementary Surface Water Assessment Part B – Water Quality, Tables A1T-2 and A1T-3.</p> <p>Table A1T-1 in the SREIS is the equivalent of Table A1T-1 in the EIS Appendix I, Surface Water Part B Water Quality Impact Assessment, and has been updated to include metadata where available (sample location, dates and number of samples). Aromatic hydrocarbons (BTEX) and Polycyclic Aromatic Hydrocarbons (PAHs) have been included in this table. Arrow has committed to develop a strategy for the discharge of coal seam gas water to watercourses in accordance with relevant legislation (Commitment C498). Any coal seam gas water discharged to any watercourse must meet regulatory requirements and approved release limits, which will be conditioned in the relevant Environmental Authority.</p> <p>Water quality for end uses is defined in recognised standards such as the ANZECC guidelines and use and supply as part of a beneficial use scheme will be authorised based on water meeting those specifications. The water will be amended or treated to meet the necessary specifications prior to supply or use.</p> <p>Since the publication of the EIS, Arrow has identified four properties to potentially locate central gas processing facilities, two of which will have water treatment facilities located adjacent to them and will potentially contain coal seam gas water discharge points which may discharge under normal operating conditions.</p> <p>A technical surface water study was undertaken for the SREIS to investigate impacts of the coal seam gas water discharge on the relevant environmental values and water quality (SREIS Chapter 9, Surface Water, Section 9.6). This investigation provides recommendations for preliminary guidelines for initial discharge within which impacts to erosion are likely to be negligible. Guidance is also provided on developing a discharge strategy that considers the natural flow regimes of the watercourses, to reduce impacts to aquatic ecology and overall ecological function.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
9v (cont'd)	<p>End uses of CSG water could include very different water quality needs i.e. agricultural (stock watering or irrigation) use; industrial (coal washing, dust suppression, etc); reinjection (shallow or deep aquifers); supplementing civil water supplies, etc. There is also a potential that there will be discharge to waterways of both untreated and treated water. Otherwise there will be reinjection of water to deep or shallow aquifers.</p> <p>If discharge to watercourses was to occur it would be difficult to assess the risk to aquatic organisms without further detail on the expected water quality to for different purposes. Given the potential for interconnectivity to groundwater systems surface waterways also have the potential to be contaminated by compounds reinjected into particularly shallow aquifers. Agricultural uses such as irrigation have the potential to impact surface waters if not properly managed - via subsurface layer contamination and runoff/infiltration into streams.</p> <p>Recommendation:</p> <p>The supplementary report to the EIS should address the following matters, particularly if discharges to water courses are to occur:</p> <p>a. Provide estimated/expected water quality for different end uses (minimum and maximum values at least) based on proposed treatments for water quality indicators expected for the activity (e.g. salts; metals; hydrocarbons). This can include similar treatment at Arrow sites Dalby Expansion Project (PEN100449509); Moranbah Gas Project (PEN100015907) and / or East Theten Irrigation Area (ENBU01696710));</p> <p>b. Provide more information on the estimated/expected levels of PAHs in untreated water (minimum and maximum values at least) to supplement data already included in Table 5.3 Groundwater quality in the Walloon Coal Measures (pdf page 14; Chapter 5 - Project Description) and Table A1T-1 of Appendix I (pdf pages 74-82). Ensure that any metadata relevant to the sampling (see point C below), and</p> <p>c. Any data provided should include:</p> <p>a. number of samples collected;</p> <p>b. sampling point (where samples collected), and</p> <p>c. when were samples collected.</p>		<p>Recommendations have also been made for a water quality monitoring program in accordance with QWQG to develop water quality guidelines for the watercourses proposed to receive discharge. Arrow will use the information from this study, together with information from SREIS Chapter 10, Aquatic Ecology, to inform the development of a discharge strategy that will reduce potential impacts to watercourses. This will include the treatment of coal seam gas water, if necessary, to meet water quality guidelines developed through the water quality monitoring program.</p> <p>Uncontrolled releases may occur during catastrophic scale flood emergencies, and in this case the released coal seam gas water would be diluted to a level within the prescribed limits.</p> <p>Further detail is provided on Arrow's water management options, including discharge and injection, within the updated SREIS Attachment 5, Coal Seam Gas Water and Salt Management Strategy.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
9w	<p>Issue: Limited consideration of potential for cumulative impacts to water quality</p> <p>The EIS has focused on potential cumulative impacts to water quantity (water supply) and surface water flow in the assessment of cumulative impacts. However, it also important to consider cumulative impacts to water quality where there may be discharge to waterways of brackish water. It is not enough for Arrow to state that “The Surat Gas Project is not expected to significantly contribute to this cumulative impact as discharges are expected to be minimal.” (Chapter 28 - Cumulative Impacts.pdf; pdf page 20) when there may be a significant release to streams (up to 0.5 GL per annum) from the Arrow Surat Gas Project during an emergency</p> <p>Recommendation:</p> <p>Arrow Energy, in the supplementary report to the EIS, should include consideration of potential cumulative impacts of Surat Gas Project and similar activities within the region (e.g. coal mines, other CSG operators) on water quality. This should be included or referred (if outlined in other Chapters of the EIS) to in the cumulative impacts chapter (Chapter 28). If controlled discharge to waterways are to occur cumulative impacts to salinity are of particular importance.</p>	<p>EIS Chapter 28</p> <p>SREIS Chapter 9, sections 9.6, 9.6.5</p>	<p>EIS Chapter 28, Cumulative Impacts, discusses the potential cumulative impacts of future developments on the environmental values of the project development area. The cumulative impact assessment for the EIS found that the project is not expected to significantly contribute to cumulative impacts on the local surface water environment.</p> <p>Since the publication of the EIS, Arrow has identified four properties where central gas processing facilities will potentially be located, two of which will have water treatment facilities located adjacent to them which are proposed to discharge coal seam gas water to nearby watercourses. The surface water technical study undertaken for the SREIS assessed surface water impacts at the two sites (SREIS Chapter 9, Surface Water, Section 9.6). As details of other proponents’ discharge strategies were not available, an assessment could not be included of the contribution that proposed discharges will make to existing discharges in those watercourses. However, as described in SREIS Chapter 9, Surface Water, Section 9.6.5, the closest point known to receive discharge, from another proponent, that could be included in a cumulative assessment of discharge is Chinchilla Weir. The weir is 194.5 km north of the site identified by Arrow as a potential water treatment facility location. It is therefore expected that discharge by Arrow at this site will have negligible cumulative impacts. Arrow has an Environmental Authority (EA) PEN100449509 to discharge treated coal seam gas water to an unnamed tributary of Wilkie Creek during natural flow events only. However, the reaches of the Condamine River affected by discharges to the unnamed tributary of Wilkie Creek are likely to be beyond the extent of predicted geomorphic change and potential mixing zones for coal seam gas water discharged from the proposed water treatment facility locations. Further investigation will be conducted as required, as part of the development of a discharge strategy, should an application be made for a new environmental authority (EA) or an EA amendment.</p> <p>In any case, it is assumed that all other projects discharging to watercourses will use discharge strategies that have the same water quality objectives as the Surat Gas Project. Provided all proponents discharge coal seam gas water that meets standard or developed water quality guideline values for the receiving watercourse, potential impacts on water quality from releases of coal seam gas water are expected to be minimal.</p> <p>Regulatory requirements and approved release limits will be conditioned in the relevant Environmental Authority. Arrow recognises that uncontrolled releases of coal seam gas water may occur during catastrophic scale flood emergencies, though in this case the released coal seam gas water would be diluted to be within the prescribed limits due to the large flows the watercourse is experiencing.</p> <p>Arrow recognises that specific assessment is required for approval under the <i>EP Act</i> and <i>Water Supply (Safety and Reliability) Act</i>, which will typically involve an assessment of existing watercourse hydrology and water quality.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
	<p>The following comments are based on a review of the EIS, including a thorough review of the specialist report (Appendix J; hereafter specialist report) and the EMP (Appendix 005, Volume 2, relating to aquatic ecology; hereafter EMP).</p>		<p>Noted.</p>
<p>10a</p>	<p>Key issues</p> <p>The description of the aquatic ecology section of Chapter 16, (Volume 1; hereafter EIS chapter), lacks in a thorough description of the aquatic ecology present in the project development area and that any descriptions provided in the EIS/EMP do not relate directly to project specific issues and project descriptions.</p> <p>Generally, the EIS chapter does not represent the field survey effort, data compilation, and discussion on possible impacts and mitigation strategies, including monitoring and inspection carried out for the original aquatic ecology report in Appendix J. Furthermore, mitigation measures outlined in the specialist report, the EIS chapter and the EMP used a different approach, which makes a direct comparison and cross-checking impossible.</p> <p>Important findings and outcomes discussed in the specialist report are missing from the EIS main report, including summaries of each study area, the overall summary outlined in heading 4.5 and the inclusion of No Go Zones in the mitigation strategies.</p> <p>The specialist report mentioned the environmental significance of Oakey Creek in numerous places. Despite this the EIS chapter only very briefly addresses Oakey Creek despite its presence and potential impacts in the project development area.</p> <p>Recommendation</p> <p>The supplementary report to the EIS should include relevant information on mitigation measures outlined in the specialist report, the EIS chapter and the EMP to allow for a direct comparison and cross-checking.</p> <p>It should also include information on the environmental significance, avoidance, mitigation and management measures of Oakey Creek in both the supplementary report to the EIS and EMP.</p> <p>Important findings and outcomes discussed in the specialist report, including summaries of each study area, the overall summary outlined in heading 4.5 and the inclusion of No Go Zones in the mitigation strategies should be included.</p> <p>Include information on potential cumulative impacts on environmental values for the aquatic ecology in the project study area.</p>	<p>EIS</p> <p>Chapter 16, tables 16.5, 16.7 and Chapter 28</p> <p>SREIS</p> <p>Chapter 10, Section 10.4, and Attachment 2</p>	<p>The aquatic ecology chapter of the EIS was a summary of the technical findings of the aquatic ecology specialist report.</p> <p>Oakey Creek (upstream of site C) was considered to have environmental values of a high sensitivity. This was described in EIS Chapter 16, Aquatic Ecology, Table 16.5, where the attributes of the environmental values were discussed and Table 16.7 identifies the potential impacts and mitigation measures.</p> <p>The SREIS Chapter 10, Aquatic Ecology, Section 10.4, provides site specific details of the aquatic environment at the two potential discharge locations, and describes the additional aquatic environment information collected in the field.</p> <p>As more information with regards to project infrastructure locations become known, Arrow will identify if site specific aquatic areas with high sensitivities exist and will accordingly update its constraints maps.</p> <p>EIS Chapter 28, Cumulative Impacts provides a summary of the cumulative impact assessment conducted for aquatic ecology.</p> <p>The SREIS provides an updated strategic EMP (SREIS Attachment 2, Strategic Environmental Management Plan) which will inform the statutory information requirements to support the application for an environmental authority or an environmental authority amendment, in accordance with EHP Guideline "Application requirements for petroleum activities".</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
10b	<p>Issue: Page 16-3 to 16-5, 16.2.2 Field survey</p> <p>The process of site selection is unclear:</p> <ul style="list-style-type: none"> Explain why 11 sites were considered a comprehensive sample size to extrapolate results. It is unclear if these sites are connected to proposed infrastructure or impacts (e.g. near areas where potential discharge to waterways may occur (as per Fig 5.17). Specify which or if all 11 sites have been surveyed twice (November 2009 and May 2010). Table 1.6. does not give any information on the survey site locations. Please refer to AquaBAMM/ANZECC DNRM, (2001; Australia-Wide Assessment of River Health: Queensland AUsRivAS Sampling and Processing Manual. 53. Commonwealth of Australia and Queensland Department of Natural Resources and Mines (Ed.). Environment Australia, Canberra and Rocklea for appropriate description. Only two ephemeral streams were surveyed, despite that this type of hydrology is the 'normal' status of inland river systems. Inadequate information is provided on the aquatic ecology in the Dawson and Weir rivers drainage basins to determine the aquatic values present. <p>Recommendation:</p> <p>The supplement report to the EIS should address the matters raised. Additional surveys may be needed to ensure there is adequate data for the entire project development area, including Dawson and Weir rivers drainage basins.</p>	<p>EIS</p> <p>Appendix J, Section 3.3</p> <p>SREIS</p> <p>Chapter 10, sections 10.3.2, 10.4 and 10.2.2</p>	<p>A comprehensive desktop assessment indicated 73 sites that were potentially suitable for ground truthing the aquatic ecology desktop findings. Many of these sites were relatively homogeneous in terms of key biophysical attributes such as habitat type, altitude, land use and climate, indicating that a representative subset of sites could be sampled without significant loss of information.</p> <p>A field reconnaissance trip was undertaken to assess all 73 sites and ground truthing identified 11 of those 73 sites as being representative of the entire study area.</p> <p>The methodology for the EIS field work is explained in further detail in EIS Appendix J, Aquatic Ecology Impact Assessment, Section 3.3.</p> <p>Ephemeral watercourses were targeted for surveys undertaken to inform the SREIS, including Bottle Tree Creek, Dogwood Creek and Crawlers Creek. This allowed for further characterisation of ephemeral watercourses within the project development area to be presented, supplementing the findings of the EIS.</p> <p>Since publication of the EIS, two proposed discharge locations have been identified, within drainage area 2 and drainage area 9, and extensive site specific aquatic ecology surveys were undertaken at both sites, as described in SREIS Chapter 10, Aquatic Ecology, Section 10.3.2 with the results presented in Section 10.4.</p> <p>As described in SREIS Chapter 10, Aquatic Ecology, Section 10.2.2, additional surveys to characterise the existing environment of the Dawson River and Macintyre and Weir rivers sub-basins were undertaken to supplement the findings of the EIS.</p>
10c	<p>Issue: Page 16-4, 16.2.2 Field Survey, forth paragraph</p> <p>The paragraph mentions that many of the 73 sites were "relatively similar" in terms of key attributes. Furthermore, the EIS chapter states: "A field reconnaissance trip was undertaken to assess all 73 sites on the basis of the above criteria. Ground truthing identified 11 of the 73 sites as being representative of the ecological conditions of the study area with regard to human, climatic and physical influences on aquatic ecology. Further details of the site selection process are provided in Section 3.3, Field Surveys, of Appendix J, Aquatic Ecology Impact Assessment."</p> <p>These statements can not be verified in the specialist report, where it states in Appendix J, page 13, 3.3 Selection of field sites: "Aquatic ecosystems within the study area are relatively diverse with permanent, semi-permanent and highly seasonal lotic and lentic environments represented in four river basins [...]."</p>	<p>EIS</p> <p>Appendix J, Section 3.3 and figures 3-3 and 3-4</p> <p>SREIS</p> <p>Chapter 10, sections 10.3.2 and 10.4.4</p>	<p>The methodology for the EIS field work is explained in greater detail in EIS Appendix J, Aquatic Ecology Impact Assessment, Section 3.3. Figures 3-3 and 3-4 highlight the representativeness of the selected sampling sites.</p> <p>Ephemeral watercourses were underrepresented given the dry conditions under which the sampling was undertaken. The permanent/ semi-permanent watercourses were considered more likely to contain dry season refugia for aquatic biota and more likely to contain less resilient species, communities and habitats than the low order ephemeral watercourses typical of much of the project development area.</p> <p>SREIS Chapter 10, Aquatic Ecology, Section 10.3.2 describes the additional field work undertaken to inform the SREIS, including extensive site-specific fieldwork undertaken at the two proposed discharge locations.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
10c (cont'd)	<p>Furthermore on page ii, Study Methods, the specialist report states: "Through field reconnaissance and careful consideration of physical and ecological factors the number of sites to be physically sampled was reduced to a final 11 sites that were sampled during November 2009 and May 2010. The 11 sites selected are considered representative of ecological conditions across the study area."</p> <p>Recommendation:</p> <p>The supplementary report to the EIS should clarify the specialist methodology used to describe the aquatic ecology of the project area and explain in more detail the findings and implications for the project.</p>		<p>Section 10.4.4 identifies the potential impacts of the coal seam gas water receiving system, and describes the proposed mitigation and management measures to reduce project impacts.</p>
10d	<p>Issue: Page 16-7, 16.2.2, second paragraph</p> <p>In the EIS it is unclear, which of the 11 sites were selected to sample for the 7 sites to analyse sediments. No further information is given in the EIS chapter on full testing and results of the sediments.</p> <p>Recommendation</p> <p>The supplementary report to the EIS should state the locations of the sediment sampling and describe the methods and findings of the specialist report. The results and findings can be presented in an overall summary where the results from the sediment, water quality, PET, macrophytes and aquatic fauna sampling are discussed in combination.</p>	<p>EIS</p> <p>Appendix J, Section 3.5</p> <p>SREIS</p> <p>Chapter 10, Section 10.4</p>	<p>The sediment sampling undertaken for the EIS is explained in greater detail in EIS Appendix J, Aquatic Ecology Impact Assessment, Section 3.5.</p> <p>Sediment samples were collected at all 11 survey sites in accordance with the Monitoring and Sampling Manual (DERM, 2010f).</p> <p>Only eight samples were analysed for the parameters described in EIS Appendix J, Aquatic Ecology Impact Assessment, Section 3.5, as those sites were considered representative of the different sediment conditions within the study area.</p> <p>The remaining three samples were taken as back up samples and were frozen and stored, allowing further analyses if required.</p> <p>SREIS Chapter 10, Aquatic Ecology, Section 10.4, presents the findings of the field surveys conducted for the SREIS.</p>
10e	<p>Issue:</p> <p>Page 16-11, 16.3.4 Aquatic flora species</p> <p>This section describes high turbidity but there is no evidence that water quality assessment (turbidity, EC, N, etc) and physical form assessments (sediments, bank habitats, water flow, etc) have been carried out during the aquatic ecology surveys.</p> <p>Recommendation</p> <p>Arrow Energy should clarify whether water quality assessments were carried out in conjunction with the aquatic ecology surveys. If so, the results should be discussed in relation to the aquatic flora and fauna found on site.</p>	<p>EIS</p> <p>Appendix J, Section 4.3 and tables 4-2, 4-3, 4-4, 4-5 and 4-6</p> <p>SREIS</p> <p>Chapter 10, Section 10.4.4</p>	<p>The water quality assessments undertaken during the aquatic ecology surveys are explained in greater detail in EIS Appendix J, Aquatic Ecology Impact Assessment, Section 4.3.</p> <p>These assessments were undertaken in both the November and May sampling periods, with the results at each site provided in EIS Appendix J, tables 4-2, 4-3, 4-4, 4-5 and 4-6.</p> <p>Arrow acknowledges that the survival of any fish species is dependent on the quality of habitat and the overall health of the ecosystem, and this is taken into consideration when discussing possible habitat presence. The mitigation measures recommended are intended to maintain or improve the status of aquatic ecosystems, which in turn will assist in protecting or enhancing the status of species present.</p> <p>SREIS Chapter 10, Section 10.4.4 presents water quality results that were taken to describe water quality at the time of sampling and to use to interpret results. The water quality is discussed in relation to aquatic flora and fauna where relevant. Further discussion is provided in SREIS Appendix 8, Supplementary Aquatic Ecology Assessment.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
10f	<p>Issue: Pages 16-11 and 16-13, 16.3.5 Aquatic fauna species (fish and reptiles)</p> <p>The second paragraph discusses listed threatened species of conservation interest but no information was given where this information was derived from.</p> <p>The purple-spotted gudgeon and river blackfish were mentioned as potentially threatened and scarce but no information was given where this information was derived from.</p> <p>Recommendation</p> <p>The supplementary report to the EIS should state the source of the conservation status of the species listed in the EIS.</p>	<p>EIS</p> <p>Appendix J, Section 14</p> <p>SREIS</p> <p>Appendix 7, Attachment 2</p>	<p>The ecological characteristics of fish species recorded during the EIS field surveys are discussed in greater detail in EIS Appendix J, Aquatic Ecology Impact Assessment, Section 14.</p> <p>The source for the stated conservation status of both species is provided, as well as further details regarding the individual species.</p> <p>Species dossiers for all species of conservation significance identified within the project development area, including the purple-spotted gudgeon and river blackfish, were prepared to inform the SREIS, and are presented in SREIS Appendix 7, Attachment 2.</p>
10g	<p>Issue:</p> <p>Page 16-13, 16.3.6 Aquatic fauna species</p> <p>The third paragraph states: "Oakey Creek (site C) provides habitat for the purple-spotted gudgeon and river blackfish (potentially threatened, locally significant species now very scarce within the region). These species were recorded approximately 48 km upstream of the project development area in a tributary of Oakey Creek (Gowrie Creek)."</p> <p>According to Figure 16.1, site C is located within the project development area.</p> <p>Also, if the location is situated 48 km upstream of the project development area, it is unclear why this site was selected as it is located upstream and a substantial distance away from any impact area. This will lead to the question asked earlier why these 11 sites were selected and how they can be representative of such a large development area.</p> <p>Recommendation</p> <p>The supplementary report to the EIS should clarify where Site C is located and if it is located outside the project development area, explain why it was selected and its relevance to the project and its impacts.</p>	<p>EIS</p> <p>Chapter 16, Figure 16.1</p> <p>SREIS</p> <p>Chapter 10, Section 10.3.2</p>	<p>This particular paragraph is referring to the habitat provided in Oakey Creek upstream of site C, with the recorded species being identified at site 62, as described in EIS Chapter 16, Aquatic Ecology, Figure 16.1, which identifies where each of the 11 survey sites are located.</p> <p>The study area includes the project development area as well as some surrounding catchment areas to enable comparison of aquatic habitat within and adjacent to the project development area. This comparative analysis is to quantify and understand changes over time, if any, on aquatic habitats associated with project activities.</p> <p>SREIS Chapter 10, Aquatic Ecology, Section 10.3.2 further discusses the inclusion of aquatic habitat situated outside of the project development area being required to adequately characterise aquatic ecosystems potentially impacted by project activities. This is because impacts can be transmitted downstream through modified water quality or quantity, the extent of which depends upon the nature and severity of impact, as well as the prevailing hydrologic conditions (e.g., flow rate of the receiving watercourse) or by overland flow.</p>
10h	<p>Issue: Page 16-17, 16.4.1 Construction</p> <p>Impacts on migration and movements of fauna (fish, turtle) have not been described in this section, especially in context to the pipeline construction through waterways (open-cut waterway crossings (including the construction of cofferdams)).</p>	<p>EIS</p> <p>Attachment 8</p>	<p>Impacts on migration and movements of fauna (fish, turtle), especially in context to the pipeline construction through watercourses (open-cut watercourse crossings (cofferdams)) were addressed generally in the EIS, and will be specifically addressed in watercourse barrier permits at a later date, when actual locations are known.</p> <p>Specific information regarding management and mitigation measures will be developed and set out in the statutory information requirements to support the application for an environmental authority (EA) or an EA amendment, in accordance with EHP Guideline "Application requirements for petroleum activities".</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
10h (cont'd)	<p>Recommendation</p> <p>While the specialist report provided some information on these matters more detail should be provided in the supplementary report to the EIS and the EMP on impacts and mitigation measures associated with pipeline and other infrastructure that would need to be constructed across watercourses.</p>		<p>Arrow notes that the EMP as part of the EIS aims to identify the high level controls that need to be implemented in subsequent plans.</p> <p>Commitments have been presented in the EIS and updated where appropriate in the SREIS regarding the mitigation of impacts following watercourse crossings, an example of these are:</p> <p>Commitment C158 - Develop site-specific management plans for permanent and semi-permanent watercourse crossings detailing construction and environmental management requirements, including consideration of the scour potential of the watercourse.</p> <p>Commitment C192 - Obtain all relevant permits required under the Fisheries Act 1994 (Qld), including permits for construction of waterway barriers or disturbance of fish habitat.</p> <p>Commitment C196 – Design flumes used to construct watercourse crossings to a suitable size to maintain flows and enable fish passage. Protect the bed of the watercourse from scouring at the site of the downstream discharge of any flumes or pipes.</p> <p>Commitment C198 - If diversion of watercourse flows using pumps is required, screen the pump intakes with mesh to protect aquatic life.</p> <p>Commitment C507 - Visually inspect physical form and monitor hydrology, turbidity and pH upstream and downstream of crossings immediately prior to, during and after construction of watercourse crossings.</p>
10i	<p>Issue: Page 16-17, 16.4.2 Operation</p> <p>This section refers to “emergency discharge of CSG water”; however, it lacks additional information on possible impacts on downstream aquatic flora and fauna.</p> <p>Recommendation</p> <p>Emergency discharge of CSG water is a real possibility as part of the operation and hence must be addressed in the supplementary report to the EIS and in the EMP.</p>	<p>SREIS</p> <p>Chapter 10, sections 10.3.2 and 10.4.4</p>	<p>Since the publication of the EIS, Arrow has identified two potential coal seam gas water locations, with discharge under normal operating conditions now proposed.</p> <p>Extensive site-specific surveys were undertaken at both locations, described in SREIS Chapter 10, Aquatic Ecology, Section 10.3.2, and the potential impacts assessed in Section 10.4.4 along with the proposed mitigation and management measures to minimise these potential impacts. Regulatory requirements and approved release limits will be conditioned in relevant environmental authorities.</p> <p>Arrow recognises that uncontrolled releases of coal seam gas water may occur during catastrophic scale flood emergencies, though in this case the released coal seam gas water would be diluted to within the prescribed limits due to the large flows the watercourse is experiencing.</p>
10j	<p>Issue: Inappropriate assessment of sensitivity of ephemeral and permanent watercourses</p> <p>Sensitivity should be a location specific assessment rather than a rating applied to all ephemeral streams. It is not possible to generalise that all permanent waterways have a moderate sensitivity and that all ephemeral waterways have a low sensitivity. An assessment of sensitivity needs to be made on a case by case basis.</p>	<p>SREIS</p> <p>Chapter 10, sections 10.4, 10.3.2, 10.4.3, 10.5.2 and Table 10.8</p>	<p>Arrow acknowledges the requirement for watercourse by watercourse analysis to be undertaken when project infrastructure locations are known, and will perform this work prior to relevant environmental authority applications.</p> <p>SREIS Chapter 10, Aquatic Ecology, Section 10.4, describes the additional surveys undertaken to further characterise the existing environment, with extensive surveys undertaken at the two proposed discharge locations in drainage areas 2 and 9.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
10j (cont'd)	<p>A number of comments throughout the EIS indicate that a generalised assessment was undertaken:</p> <ul style="list-style-type: none"> Chapter 8, Section 8.4.2, pg. 5 - The EIS states that the aquatic ecology assets in the project development area are variable because of the ephemeral nature of the watercourses, and identifies "the more intact streams, water bodies and wetlands" as assets posing a constraint on development." This implies that ephemeral watercourses are not 'intact'. Appendix J pg. 60-61. Permanent watercourses are ranked as having a moderate sensitivity to impacts. However the definition of moderate in Table 3.5 includes 'limited spawning / nursery opportunities'. But clearly the deep pools contain important habitat, and in times of flood the whole channel may become a nursery habitat. Appendix J pg. 61. Ephemeral watercourses are ranked as low sensitivity to impacts. The definition (Table 3.5) explains that communities in these watercourses are capable of rapidly recovering after disturbance events and that impacts are short term (<3months). However, no evidence is provided to support these definitions. It could be argued that without continuous flushing flows an ephemeral stream may be impacted for longer periods than permanent streams and not easily recover after a disturbance event. <p>Appendix J Fig. 6.1 - Based on the 'low sensitivity' assessment of ephemeral streams, much of the project area is mapped as low sensitivity and therefore has limited constraints. Water quality is an important part of aquatic ecosystem health, and while the impacts can be considered separately in the Appendices, they should be drawn together in the main report.</p> <p>Recommendation:</p> <p>The supplementary report to the EIS should recognise that the water regime (ephemerality or permanency) is unrelated to 'intactness' or ecological value.</p> <p>The supplementary report to the EIS should provide evidence on a case by case basis to support the assessment of sensitivity for each ephemeral stream potentially impacted by the project area. Where necessary, the sensitivity analysis and constraints mapping is to be updated to reflect potentially sensitive ephemeral areas.</p> <p>When more detail is available on the locations of infrastructure and potential discharge points, a more detailed assessment on a stream by stream basis will be required to assess the potential risk to affected streams (i.e. preceding the issuing of an environmental authority). This information should be included in the EMP.</p>		<p>Field surveys were also situated within the Dawson River and Macintyre and Weir rivers sub-basins (as per Section 10.3.2 and 10.4.3), to supplement the findings of the EIS.</p> <p>Table 10.8 summarises the sensitivity of the aquatic ecology values of the receiving environment watercourses in CGPF2 and CGPF9 properties to coal seam gas water discharges. The sensitivity ranking is based on conservation status, intactness, uniqueness, resistance to change and recovery potential.</p> <p>Arrow will continue to conduct site-specific surveys at watercourses as additional facility locations become known. Through the life of the project, the constraints maps will be updated to reflect site-specific sensitivities.</p> <p>Arrow recognises that specific assessment is required for approval under the <i>Water Supply (Safety and Reliability) Act</i>, which specifies assessment requirements for recycled water.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
11a	<p>Issue: Environmentally Sensitive Areas (ESAs) not consistently or adequately addressed in the EIS (Ch 17). There is conflicting information within different parts of the EIS as to which ESAs fall within the project development area.</p> <p>The EIS states that only 'limited petroleum activities' are able to be conducted in Environmentally Sensitive Areas.</p> <p>Category C ESAs that may be affected by the project development area are particularly important for QPWS consideration because they include State Forests and Timber Reserves managed by QPWS under the Forestry Act 1959, and Resources Reserves managed under the Nature Conservation Act 1992.</p> <p>The lists below are from different sections within the EIS, all of which state different ESA Category Cs. Category C – ESAs (stated in the Executive summary section 6.5.2 Terrestrial Ecology) include - Barakula State Forest, Bendidee State Forest, Braemar State Forest, Western Creek State Forest, Whetstone State Forest. Category C ESAs listed in Table 17.8 Attributes and sensitivities allocated to values of each existing environment, include Gurulmundi State Forest, Bendidee State Forest, Binkey State Forest and Barakula State Forest.</p> <p>ESAs not identified in the project development area in the EIS, but which fall within the Project Development Area and have a current Arrow ATP over them include:</p> <ul style="list-style-type: none"> • Kumbarilla State Forest • Bulli State Forest <p>Figures 17.7 and 17.8 from Chapter 17 – Terrestrial Ecology, only show a few of the actual ESAs that exist within the project development area.</p> <p>Recommendation</p> <p>The supplementary report to the EIS should describe all of the ESAs which will be potentially affected by the project and also provide comprehensive maps (like 17.7 and 17.8) that illustrate all of the ESAs that fall within the project area.</p>	<p>EIS</p> <p>Chapter 17, Figure 17.2</p> <p>Appendix K, Figure 14 and Table 25</p> <p>SREIS</p> <p>Appendix 9, Section 6.5</p>	<p>Noted. Figure 17.2 of EIS Chapter 17, Terrestrial Ecology and Figure 14 of EIS Appendix K, Terrestrial Ecology Impact Assessment present all Category C Environmentally Sensitive Areas (ESAs) within the project development area, including Kumbarilla and Bulli State Forests.</p> <p>Category C ESAs requiring management by QPWS under the Forestry Act 1959, and Resources Reserves managed under the Nature Conservation Act 1992 are detailed in Table 25 of EIS Appendix K, Terrestrial Ecology Impact. Additional detail on Bulli State Forest and Kumbarilla State Forest is provided in SREIS Appendix 9, Supplementary Terrestrial Ecology Assessment, Section 6.5.</p> <p>The environmental framework, as presented in EIS Chapter 8, Environmental Framework, Section 8.5, is an internal process developed by Arrow for managing impacts in the planning phase and in the construction and operation phases through the application of environmental controls that reflect the sensitivity or vulnerability of environmental values. Constraints mapping, an integral part of the environmental framework, is informed by the environmental impact assessment and guides site and route selection that seeks to avoid and reduce impacts, thereby protecting environmental values.</p> <p>ESA's identified in the project development area were included in the constraints mapping that identified no go areas and areas of high, moderate and low constraint to development.</p> <p>The types of development that were appropriate for each level of constraint were identified as well as the appropriate level of environmental management i.e., standard or procedural, detailed and site specific controls.</p>
11b	<p>Issue: Queensland Biodiversity Offset Policy (QBOP)</p> <p>While noted in the EIS that the QBOP is a requirement for the project (page 17-5) it is noted that there is currently no planned strategy for the implementation of the QBOP. The QBOP will apply to this project and needs specific information contained in an offset strategy.</p> <p>Recommendation</p> <p>In order to meet the requirements of the QBOP, the following information must be provided in the supplementary report to the EIS and EM Plan:</p>	<p>EIS</p> <p>Chapter 8, Section 8.5</p> <p>SREIS</p> <p>Attachment 6, Section 7 and Appendix 9</p>	<p>The environmental framework, as described in EIS Chapter 8, Environmental Framework, Section 8.5. The framework assists in siting of project infrastructure and facilities such that the locations avoid significant environmental values (habitat, vegetation communities, ESAs, etc.). This framework provides incentives for Arrow to avoid significant habitat and vegetation communities.</p> <p>Arrow has already successfully implemented the environmental framework described in the EIS. It has been applied to site selection for facilities associated with approved developments, specifically the Dalby Expansion Project.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
11b (cont'd)	<p>1. details on how Arrow Energy will manage the project activities (planning, design, construction, management and monitoring) to avoid impacts on State significant biodiversity values, and where this is not possible, minimise impacts on State significant biodiversity values.</p> <p>2. conducts an analysis of the potential State significant biodiversity values which will be impacted over the life of the project.</p> <p>3. provides a detailed description of the extent of impact on each State significant biodiversity value.</p> <p>4. details its proposed offset delivery mechanism (i.e. land based offset or offset payment):</p> <ul style="list-style-type: none"> • where offsets will be provided via a land based offset, information should be included detailing whether the values can be offset within the landscape consistent with the Biodiversity Offset Policy. • where an offset payment is proposed, the values to which the offset payment relates. <p>5. provides details of when offsets will be provided in relation to the life of the project, that is, provision of offsets for the project prior to the issuing of the environmental authority, or, at staged intervals over the life of the project:</p> <ul style="list-style-type: none"> • where it is proposed to stage the provision of offsets, identify what those stage intervals may be and the anticipated timeframes. • a more detailed assessment of the impacts on State significant biodiversity values and subsequent offset requirements for the first stage to be impacted should be submitted as part of the Offset Strategy. This should include an on ground assessment/survey of values. <p>6. conducts and provides an assessment of ecological equivalence of the impact area where land based offsets is proposed. The Ecological Equivalence Methodology should be used for assessment of ecological equivalence which is available at: http://www.derm.qld.gov.au/environmental_management/environmental-offsets/pdf/ecological-equivalence-methodology.pdf.</p>		<p>In those instances, ecological surveys comprised an important part of the planning process, confirming the suitability of sites identified using constraints mapping. They also informed the design of the facility layouts to ensure they maximise avoidance.</p> <p>For the Surat Gas Project, the regional environmental constraints identified in the EIS were used to guide field development plans across the project development area. Ultimately, site selection will aim to avoid constrained areas and will ensure that those areas designated as 'no go' e.g., Lake Broadwater Conservation Park, are avoided. Early identification of sensitive areas (including essential habitat which is identified in core habitat mapping for each species) allows Arrow the best opportunity to avoid sensitivities to the greatest extent practicable.</p> <p>Following completion of the EIS and the SREIS, the constraints maps will be updated as needed to inform field development plans. Once a preferred location for project infrastructure is known, ecological and preconstruction clearance surveys will be conducted. At this time, a suitably qualified person(s) will determine whether the site comprises listed species or ecological communities, and if required, further investigation into whether they comprise important populations and require additional control measures.</p> <p>Arrow proposes to develop an offset strategy linked to actual disturbance and not to estimated disturbance areas. SREIS Attachment 6, Draft Environmental Offsets Strategic Management Plan, describes the measures taken to avoid and minimise impacts, the expected requirement for environmental offsets, and evidence that there are opportunities to achieve the required offset. It details Arrow's preferred approach to the provision of environmental offsets.</p> <p>This method would provide incentives to minimise impacts to listed species and their respective habitats rather than the option of clearing to the maximum proposed disturbance limits. SREIS Attachment 6, Draft Environmental Offsets Strategic Management Plan, presents the results of GIS analysis to facilitate identification of potential offset sites. A summary of Arrow's activities against state significant biodiversity values under the Queensland Biodiversity Offset Policy is provided in Section 7.</p> <p>In direct response to the proposed recommendation:</p> <ol style="list-style-type: none"> 1. Further detail regarding management measures and monitoring requirements will be presented in statutory information requirements to support the application for an environmental authority (EA) or an EA amendment, in accordance with EHP Guideline "Application requirements for petroleum activities". 2. A comprehensive analysis of all state significant biodiversity values is provided in Appendix K of the EIS and is further informed by SREIS Appendix 9, Supplementary Terrestrial Ecology Assessment.

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
11b (cont'd)			<p>3. The abovementioned method of 'incentives to minimise impacts to listed species and their respective habitats rather than the option of clearing to the maximum proposed disturbance limits' is further explained in the SREIS.</p> <p>4. The methodology behind the offset equivalence and the way in which this will be implemented into the environmental framework and offset strategy is described in the offset strategy developed in the SREIS.</p> <p>A conceptual field layout will be used to develop maximum clearing footprints as part of the offsets framework.</p>
11c	<p>Issue: Sensitivity Levels for a fragmented landscape</p> <p>The project area covers several subregions within the Brigalow Belt bioregion which have less than 30% of mapped remnant vegetation - Eastern Darling Downs and Moonie R. – Commonon Creek Floodout. A summary of research on landscape thresholds for remnant vegetation is provided by James, C.D. & Saunders, D.A. (2001) in "A Framework for Terrestrial Biodiversity Targets in the Murray Darling Basin" CSIRO Sustainable Ecosystems and Murray-Darling Basin Commission, Canberra page 104. Evidence suggests that once remnant vegetation falls below 30%, there are significant declines in biodiversity. The EIS does not adequately address how the project impacts these remaining areas of vegetation within these subregions, nor does it assign appropriate values to them, based on the sensitivity analysis.</p> <p>Recommendation</p> <p>In the supplementary report to the EIS, the sensitivity value of all regional ecosystems in fragmented subregions should be elevated to at least "High", based on the regional context of a fragmented subregion with less than 30% remaining vegetation, to ensure biodiversity values are protected. The value of "High" corresponds to Table 17.1's criteria as:</p> <p>'The environmental value is unique to the environment in which it occurs (remaining vegetation within a highly cleared subregion). It is isolated to the affected system or area, which is poorly represented in the region, territory, country or world'.</p>	<p>SREIS</p> <p>Appendix 9, Section A4</p>	<p>Noted. SREIS Appendix 9, Supplementary Terrestrial Ecology Assessment, Section A4 provides further validation of the significance assessment presented in the EIS. The assessment undertaken draws from both extensive desktop investigations and targeted field assessment to define the sensitivity of habitats, local flora populations and fauna populations. This is in respect to ecological attributes including life span and life cycle, resilience to disturbance and the capacity of the population for rehabilitation. Local, regional and global impacts are considered.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
11d	<p>Issue: Magnitude of Impact (p.17-11)</p> <p>The EIS uses a measure of sensitivity of terrestrial environmental values and assessments of magnitudes of impacts to determine the significance of potential impacts. It is probable that <i>clearing of remnant vegetation could have significant impacts and result in substantial and possibly irreversible change, thus it is a 'major' impact</i> on terrestrial ecology environmental values (Table 17.2). However the sensitivity criterion analysis appears to place many vegetation communities in the 'not sensitive' criterion due to them not being listed as threatened under State or national legislation (Table 17.1). Subsequently the significance assessment matrix (Table 17.3) could compute an 'insignificant' value. <i>Any clearing of remnant or regrowth vegetation should not be considered as 'insignificant' impact in the significance assessment process.</i> In addition, cumulatively, the impact of the gas industry on vegetation communities in the Surat basin is very significant.</p> <p>Recommendation</p> <p>Arrow Energy in the supplementary report to the EIS should reassess the significance of vegetation clearing impacts on terrestrial ecology.</p>	<p>EIS</p> <p>Chapter 17, Section 17.2.4</p> <p>Chapter 28, Section 28.3.6</p> <p>Appendix K, Section 10</p> <p>SREIS</p> <p>Attachment 1, Appendix C</p> <p>Appendix 9, Section 6.5</p>	<p>The basis for the rankings takes into consideration that 'substantial and possibly irreversible change' to a community is determined with a review of the broader environment and landscape, rather than the community at the site level. Therefore, clearing of remnant vegetation is only determined to be a major impact when there is potential for 'widespread harm' and/or due to the 'uniqueness or restricted occurrence' of the community, as described in EIS Chapter 17, Section 17.2.4. In line with this assessment, an insignificant ranking for the significance of the potential impact is a possible outcome.</p> <p>SREIS Appendix 9, Supplementary Terrestrial Ecology Assessment, Section A4 provides further validation of the sensitivity of communities, flora and fauna species and the assessment of significance. The revised criteria has been applied to all species assessed in the EIS and additional species identified from the SREIS desktop database searches. SREIS Appendix 9, Supplementary Terrestrial Ecology Assessment, Section 6.5 presents the findings of the updated assessment.</p> <p>Arrow acknowledges that cumulative impact poses a risk to vegetation communities in the Surat basin. EIS Chapter 28, Cumulative Impacts, Section 28.3.6 describes the cumulative impacts with respect to terrestrial ecology. Further detail is provided in EIS Appendix K, Section 10. SREIS Attachment 1, MNES, Appendix C provides further clarification on cumulative impacts on terrestrial flora and fauna communities and species listed under the Environment Protection and Biodiversity Conservation Act 1999 (Cwlth).</p>
11e	<p>Issue: Vegetation Corridors (p.17-26)</p> <p>This paragraph reads: 'State wildlife corridors are identified under the Vegetation Management Act and are used by fauna to move between existing vegetation stands. These have been identified as large vegetation tracts (under Criterion C, tract size) and vegetation intersecting rivers (under Criterion J, corridors). Prime examples include vegetation along the Condamine River, Charleys Creek and Wilkie Creek'.</p> <p>There are no such corridors identified under the Vegetation Management Act (VMA). The paragraphs reference Biodiversity Planning Assessment criteria (C and J). References to corridors are unclear as to which corridors have been utilised, however, examination of the constraints mapping indicates that terrestrial corridors have not be included.</p> <p>Recommendation:</p> <p>In the supplementary report to the EIS, corridors (Terrestrial and Riparian) as identified within the Biodiversity Planning Assessment (BPA) should be considered as "High" value sensitive environmental values and included in the constraints mapping.</p>	<p>EIS</p> <p>Appendix K, sections 5.4.5 and 5.6</p> <p>SREIS</p> <p>Chapter 11, Figure 11.8</p> <p>Attachment 1, Section 5.6.2</p> <p>Attachment 8</p>	<p>Noted. Wildlife corridors were identified in the EIS, and further desktop assessment and mapping of vegetation corridors were undertaken for the SREIS in terms of riparian corridors, corridors for conservation listed species and updated RE mapping which includes use of the new mature regrowth database.</p> <p>EIS Appendix K, Terrestrial Ecology Impact Assessment, sections 5.4.5 and 5.6 identify riparian corridors and essential habitat areas which provide important movement corridors.</p> <p>SREIS Attachment 1, MNES, Section 5.6.2 provides further clarification on areas of known or potential corridor use by species listed under the Environment Protection and Biodiversity Conservation Act 1999 (Cwlth). Bioregional corridors are shown in SREIS Chapter 11, Figure 11.8.</p> <p>Desktop assessment of narrow vegetation tracts of (potential corridors) connecting vegetation stands were identified as highly constrained (to inform constraints mapping for areas of importance to MNES species).</p> <p>Updated constraints maps are presented in SREIS Attachment 8, Constraints Mapping Update. The constraints maps will continue to be updated as further site specific information is gathered (e.g., high resolution imagery; field surveys; preconstruction surveys).</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
11e (cont'd)	Due to the fragmented landscape any regrowth vegetation in adjoining areas should be afforded the same values as the corridors vegetation (as identified through Criteria J in the Brigalow Belt BPA).		
11f	<p>Issue: Terrestrial Flora (Section 17.3.3) Vegetation Communities</p> <p>Several vegetation communities have been identified as 'Nationally Classified Vegetation Communities or State Classified Vegetation Communities' in Table 17.4. The constraints mapping is limited to remnant vegetation; remnant regrowth vegetation should be included. Regrowth vegetation is of value in protecting regional biodiversity, it provides ecosystem functions similar to remnant vegetation, such as connectivity and refuge. The precautionary principle should be applied unless it is proved that regrowth does not offer biodiversity and ecosystem services through on-ground assessment, these areas should be given the same value as their remnant counterparts.</p> <p>Recommendation</p> <p>The supplementary report to the EIS should include any regrowth mapping vegetation in the constraints mapping based on its "High Value Regrowth" (HVR) field status.</p>	<p>SREIS</p> <p>Chapter 11, Section 11.2.2</p>	<p>Since the EIS was finalised, EHP has released the following database updates (SREIS Chapter 11, Section 11.2.2):</p> <ul style="list-style-type: none"> • Version 7.0 Regional Ecosystem digital data (EHP, 2012d). • EHP's Mature Regrowth digital data (EHP, 2012a). <p>The release of Version 7.0 Regional Ecosystem digital data mapping is specifically for use in projects regulated under the Environmental Protection Act 1994 (Qld) (EP Act) where 'biodiversity status' should be applied rather than 'vegetation management status' (under the Vegetation Management Act 1999 (Qld)).</p> <p>Prior to the release of EHP's Mature Regrowth digital data, regional ecosystem types were not attributed to regrowth vegetation, formerly recognised as 'high value regrowth'. The revised dataset now attributes regional ecosystem types and associated biodiversity status using mapping of regrowth vegetation. The precautionary principal is therefore applied for the SREIS as regrowth vegetation is assigned the same level of protection as its remnant counterpart.</p>
11g	<p>Issue: Wetlands (p.17-26)</p> <p>The EIS has not utilised available datasets such as the Queensland Wetland Mapping and DERM's QMDB Aquatic Conservation Assessment (ACA) version 1.4 mapping. The EIS has only listed two wetlands as important near Lake Broadwater, due to the presence of migratory species. The QMDB ACA also provides information regarding the presence of migratory species accessed from WildNet records. The availability of Qld Wetland data throughout the project area should be included within the EIS, including areas identified as having value through the DERM Qld Murray Darling Basin Aquatic Conservation Assessments.</p> <p>Recommendation</p> <p>The supplementary report to the EIS should reassess the constraints mapping utilising the Qld Wetland Mapping Data and ACA data.</p>	<p>SREIS</p> <p>Attachment 8 Appendix 9, sections 4.1.1 and 5.5</p>	<p>A review of the Queensland Wetland Mapping and DERM's QMDB Aquatic Conservation Assessment (ACA) was undertaken as part of the desktop assessment for the SREIS (SREIS Appendix 9, Section 4.1.1). The WildNet database was used for the EIS and was not updated for the SREIS as no new records were present.</p> <p>Wetland management areas, informed by the databases reviewed for the SREIS, are described in SREIS Appendix 9, Supplementary Terrestrial Ecology Assessment, Section 5.5. The SREIS presents an update to constraints identified in the EIS (SREIS Attachment 8, Constraints Mapping Update) and will be periodically updated to include updates to Australian and Queensland government GIS data, the results of ecological and preconstruction clearance surveys, and any subsequent environmental impact assessment processes.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
11h	<p>Issue: Additional Areas of Environmental Value (p.17-28)</p> <p>While four additional areas are identified as special value in the EIS, these areas are to be considered of special value, other areas warrant consideration based on a rigorous assessment of environmental values.</p> <p>Recommendation</p> <p>The supplementary report to the EIS should re-evaluate areas of environmental value throughout the project area using the following criteria:</p> <ul style="list-style-type: none"> • Areas that have a range of significant ecosystems, which are connected to regrowth and are able to facilitate faunal movement within a fragmented landscape. • Established areas where there are mapped endangered RE types within the project area • Areas of floodplain vegetation that are connected to riparian ecosystems • Ecosystems that support threatened and 'near threatened' species • Areas of "good-quality" and "best-quality" grassland under the EPBC threshold criteria. <p>Specific areas should also be investigated and included as Additional Areas of Environmental Value including:</p> <ul style="list-style-type: none"> • Habitat for the Bulloak jewel butterfly as identified within the Brigalow Belt Biodiversity Planning Assessment • Quoll habitat • Declared areas for offset <p>These areas, once identified, should be added to the constraints mapping.</p>	<p>EIS</p> <p>Chapter 17 and Appendix K</p> <p>SREIS</p> <p>Chapter 11, Attachment 1, Section 5.5 and Appendix C, Attachment 6 and Appendix 9</p>	<p>The recommended areas described were considered and have been assessed as part of the EIS and SREIS. EIS Chapter 17, Terrestrial Ecology and SREIS Chapter 11 Terrestrial Ecology consolidate and highlight areas of key importance while further detail is provided in EIS Appendix K Terrestrial Ecology Impact Assessment and SREIS Appendix 9, Supplementary Terrestrial Ecology Assessment . The following has been assessed:</p> <ul style="list-style-type: none"> • Regrowth vegetation has been identified in EHP's Mature Regrowth digital data and has been considered in conjunction with vegetation corridors and existing vegetation to facilitate landscape connectivity for faunal movement. • Mapping has been provided for all RE types within the project area. All RE's present have been assessed in terms of value. This information is presented in both EIS Chapter 17 and updates presented in SREIS Chapter 11. Detailed descriptions of REs are provided throughout EIS Appendix K and SREIS Appendix 9. • Floodplain and riparian vegetation has been identified, mapped and assessed in EIS Appendix K with further information provided in SREIS, Appendix 9, , Section 5.5. This information is also presented in SREIS Chapter 11 for targeted survey areas. <p>Ecosystems were assessed on their regional ecosystem status, biodiversity status, the fauna and flora compositions and the likely presence of listed species. This included 'threatened' and 'near threatened' species.</p> <p>All EPBC Act listed grasslands have been assessed using the "good-quality" and "best-quality" threshold criteria. This information is presented in EIS Chapter 17 and detailed information provided in community profiles in SREIS Attachment 1, Matters of National Environmental Significance, Appendix C.</p> <p>Habitat of the bulloak jewel butterfly has been assessed in both EIS Chapter 17 and EIS Appendix K and has been updated for the SREIS following the exclusion of Bendidee National Park and State Forest and identification of potential habitat in survey area 9.</p> <p>Quoll habitat has been assessed in EIS Appendix K and has been downgraded in the SREIS to 'unlikely to occur' based on further desktop review (SREIS Attachment 1, Section 5.5).</p> <p>SREIS Attachment 6, Draft Environmental Offsets Strategic Management Plan, presents the results of GIS analysis to facilitate identification of potential offset sites. The identification of sites for particular activities is informed by the potential environmental values (constraints) of the sites, providing buffers around these sites if required, and the potential offset requirements. Terrestrial ecology values that were not confirmed, but considered likely to be present, will inform design of preconstruction clearance survey to identify any additional sensitive areas that may need to be avoided. Constraints mapping will be periodically updated to include updates to Australian and Queensland government GIS data, the results of ecological and preconstruction clearance surveys.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
11i	<p>Issue: Capturing core habitat</p> <p>The Brigalow Belt South expert panel process has mapped core habitat for a range of listed species which should be included in the core habitat mapping (Figure 17.4).</p> <p>Recommendation</p> <p>The supplementary report to the EIS should use the Brigalow Belt Biodiversity Planning Assessment core habitat values and any essential habitat mapping to revise the constraints mapping.</p>	<p>EIS</p> <p>Chapter 17, Section 17.2.2 and Appendix K</p> <p>SREIS</p> <p>Attachment 1, Appendix C, Attachment 8 and Appendix 9, sections 4.1.1 and Appendix A2</p>	<p>Among other sources, the Biodiversity Planning Assessment for the Brigalow Belt (DERM 2008) was used to inform biodiversity significance, essential habitat and regional wildlife corridors (SREIS Appendix 9, Supplementary Terrestrial Ecology Assessment, Section 4.1.1).</p> <p>Essential habitat mapping and the Brigalow Belt Biodiversity Planning Assessment core habitat values were considered in the development of core habitat mapping for conservation listed species.</p> <p>Habitat descriptors for core habitat mapping are adapted from the Biodiversity Assessment Mapping Methodology and are described in SREIS, Appendix 9, , Section A2. Updated constraints mapping is presneted in SREIS Attachment 8, Constraints Mapping Update.</p> <p>SREIS Attachment 1, Matters of National Environmental Significance, Appendix C presents a dossier for each EPBC listed community and species potentially occurring within the project development area.</p> <p>Individual maps are contained within each dossier with habitat displayed as per the updated mapping criteria (also found within each dossier) refined from the species dossiers found in EIS Appendix K, Terrestrial Ecology Impact Assessment.</p> <p>The updated maps and mapping criteria are informed by the SREIS desktop assessment as described in SREIS Appendix 9, Terrestrial Ecology, Appendix A2, as well as updated regional ecosystem mapping (Version 7 regrowth mapping (EHP, 2012d)) and targeted surveys of individual properties identified as potential facility locations. Where mapping wasn't available for a species, the potential habitat preference for the individual species was analysed against known ecological niches as described in EIS Chapter 17, Terrestrial Ecology, Section 17.2.2.</p>
12a	<p>Issue: s.20.1 legislative context</p> <p>Consideration should be given to the use of the WHO 2009 standard which outdates the 1999 publication with new noise levels for night time.</p> <p>Recommendation:</p> <p>The supplementary report to the EIS should reference the night noise level to the stand in WHO 2009 Night Noise Guidelines for Europe.</p>	–	<p>The WHO 2009 guidelines apply specifically to European conditions and do not include Australia. Noise criteria prescribed in the SREIS are based on the Coal Seam Gas Industry Procedural Guide – Control of Noise from Gasfield Activities (DERM, 2011a) and the EHP Noise Assessment Guideline – Prescribing noise conditions for environmental authorities for petroleum activities (EHP, 2013a), which provides recommended noise criteria which are based on the Procedural Guide. The Procedural Guide is a statutory noise guideline that sets appropriate noise criteria (developed by the governing authority using best practice limits) for noise emissions produced during gasfield activities.</p>
12b	<p>Issue: Noise Measurement</p> <p>The ToR required the background measurements to take account of seasonal variation. This does not appear to have been done according to the EIS. Also, additional measurements made for the ML4 site have a different date and different trend than the other sites ML1, ML2 and ML3.</p>	–	<p>Site specific locations of project facilities were not known for the EIS. Background noise measurements were undertaken in relevant locations in order to establish worst case noise impacts on the receiving environment. This involved considering worst-case (CONCAWE Category 6) meteorological conditions and accounting for seasonal variation.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
12b (cont'd)	<p>Recommendation:</p> <p>Arrow Energy should report on background noise levels made during a number of seasons to determine the variation in background noise.</p> <p>In the supplementary report to the EIS, explain why ML4 was measured on different dates, and why the sites ML1, ML2 and ML3 were not measured again for checking variability of data. Implications for suitability of this data to determine background variability should be reassessed.</p>		<p>Once facility locations are known, the noise abatement measures required at each facility to meet the statutory noise compliance limits will be determined with consideration for the nearest sensitive receptor, local meteorological and topographical conditions and background noise levels. Such information will be used to meet the statutory information requirements for the application for an environmental authority (EA) or EA amendment, in accordance with the EHP Guideline "Application requirements for petroleum activities".</p>
13a	<p>While chapter provides adequate information on the waste avoidance, mitigation, and management measures proposed to achieve the identified environmental protection objectives it lacks sufficient detail in relation to the potential effects of the generated waste on the environment and likelihood of this causing environmental harm.</p>	<p>EIS Chapters 9 to 25</p>	<p>The potential impacts resulting from waste-generating activities are described in further detail in the relevant sections of the EIS impact assessment (Chapters 9 to 25).</p>
13b	<p>Issue: Legislative context (26.1)</p> <p>Section 26.1 of this chapter identifies the legislation, policy, and guidelines relevant to waste management through all the phases and activities of the proposed project. However, the chapter has failed to include a reference to the recently passed legislation on Waste Reduction and Recycling Act 2011, and no reference is made to Public Health Act 2005. Both pieces of legislation are relevant to this chapter.</p> <p>Recommendation</p> <p>Arrow Energy should review the following legislation and where relevant, include reference to this legislation in the supplementary report to the EIS. Legislation to be considered includes: Waste Reduction and Recycling Act 2011; Waste Reduction and Recycling Regulation 2011; Public Health Act 2005; Public Health Regulation 2005</p> <p>Of particular relevance to this project is the Public Health Act 2005, the waste to be generated in this project has the potential to pose human health risk and the health of project workers.</p>	<p>SREIS Attachment 7</p>	<p>A review of the recommended legislation has been conducted and references to updated legislation (including the Public Health Act and Regulation 2005, and the Waste Reduction and Recycling Act and Regulation 2011) are included in SREIS Attachment 7, Legislation and Policy.</p>
13c	<p>Issue: Sewage treatment (Table 26.2)</p> <p>The EIS does not specify how treated effluent will be disposed of, if treated onsite.</p> <p>Recommendation</p> <p>The supplementary report to the EIS should clearly state where and how the treated effluent will be disposed of. If the treated effluent is disposed at the site, the potential impacts on water quality should be fully assessed and provide details of environmental protection measures associated with water quality.</p>	<p>EIS Chapter 26, Section 26.6.4</p>	<p>EIS Chapter 26, Waste Management, Section 26.6.4 details Arrow's commitment to use onsite waste treatment for such purposes as sewage, coal seam gas water and other specified wastes. Sewage will be treated in packaged sewage treatment plants. Sewage treatment plants will be located at production facilities and include settlement, digestion, aeration, clarification and disinfection equipment (Commitment C469).</p> <p>The produced sewage sludge following the onsite waste treatment will be disposed of in an offsite regulated waste facility.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
13c (cont'd)			Statutory information requirements will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to support the application for an environmental authority (EA) or EA amendment.
13d	<p>Issue: Potential Environmental Risk</p> <p>The chapter has identified type, characteristics and quantities of the waste generated in the proposed project; however, there is no assessment of the potential risks these wastes pose to the environment and the likelihood of wastes not being contained and causing a serious environmental harm. Also, it is proposed to transport significant volumes of these wastes off-site for disposal at regulated disposal sites. Presently there are either not such facilities located in the Surat Basin (e.g. salt requiring storage for an average of 110,670 t/year if other options do not eventuate) or the present facilities do not have the capacity and are not constructed to the required standards to permanently contain the wastes.</p> <p>Recommendation</p> <p>Arrow Energy should undertake a detailed assessment on the potential of environmental risk caused by the wastes being generated and disposed of. It should also identify remedial measures that are put in place to mitigate these impacts. The project should identify high risk wastes (e.g. regulated waste) and what procedures are in place to manage these wastes in case of emergencies. Risk assessed should be in the production phase, temporary onsite storage, in transport and at the disposal stage. The chapter should also identify wastes that are relatively inert and easy to contain and henceforth, pose low environmental risk.</p>	<p>EIS</p> <p>Chapter 19 and Chapters 9 to 25</p> <p>SREIS</p> <p>Chapter 12</p>	<p>The potential impacts and relevant avoid, minimise and mitigation measures that are applicable to waste management are described in further detail in the relevant sections of EIS Chapters 9 to 25. For example, the potential impacts resulting from the estimated traffic generated by disposal of brine to landfill (currently Arrow's least preferred option) was included in EIS Chapter 19, Roads and Transport, and has been updated in SREIS Chapter 12, Roads and Transport.</p> <p>Although disposal to a suitably-licensed landfill remains the base case for brine and/or salt management, this option would only be pursued if beneficial use options were proven infeasible or uneconomic. Arrow expects other suitably licensed landfill sites to be developed in response to the demand created by the coal seam gas industry and to be available to accept brine (as a salt concentrate) produced in its operations.</p>
13e	<p>Issue: Uncontrolled release of waste</p> <p>The chapter states that failure to properly manage waste storage and containment systems could potentially result in soil and water contamination and impacts on visual amenity. However, the EIS fails to identify what is the appropriate management of waste or what are the strategies in place to minimise environmental impacts from the uncontrolled release of waste.</p> <p>Recommendation</p> <p>The supplementary report to the EIS and the EMP should clearly identify the strategies/management practices in place to prevent/minimise any environmental harm caused by the uncontrolled release of waste.</p>	<p>EIS</p> <p>Chapter 12 and Chapters 9 to 25</p>	<p>The potential impacts and relevant avoid, minimise and mitigation measures that are applicable to waste management are described in further detail in the relevant sections of EIS Chapters 9 to 25.</p> <p>For example, EIS Chapter 12, Geology, Landform and Soils presents Arrow's commitment to develop and implement emergency response and spill response procedures to minimise any impacts that could occur as a result of releases of hazardous materials or any loss of containment of storage equipment (Commitment C036).</p> <p>Statutory information requirements will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to support the application for an environmental authority (EA) or EA amendment.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
13f	<p>Issue: Controlled release of waste or emissions</p> <p>The EIS states that discharge of waste water and air emissions could potentially lead to adverse health and ecological impacts (e.g. discharge of sewage). However, the chapter fails to identify whether any environmental monitoring (e.g. quality of discharged sewage) will be undertaken to describe the impacts of controlled release of wastes or emissions on the receiving environments.</p> <p>Recommendation</p> <p>Any controlled release of waste or emission to the environment must be monitored as required by relevant legislation and Queensland Standard Guidelines. The supplementary report to the EIS should provide information on the estimated quantities of controlled release of waste and air emissions that could potentially be discharged to receiving environment. The report should provide chemical characteristics, the potential environmental impacts, proposed monitoring program and the proposed mitigation measures. The report should fully assess the potential impacts on water quality and provide details of all environmental protection measures associated with water quality. The measures should include a water monitoring program, showing the locations of discharge points and monitoring points, and addressing such matters as the frequency of monitoring and data interpretation.</p>	<p>EIS Chapter 9 SREIS Chapter 9</p>	<p>EIS Chapter 9, Air Quality contains details regarding potential impacts from air emissions, as well as proposed mitigation and management measures, including the inspection and monitoring measures.</p> <p>SREIS Chapter 9, Surface Water provides details of the two proposed surface water discharge locations, and describes the detailed site-specific field surveys undertaken at these locations.</p> <p>Statutory information requirements will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to support the application for an environmental authority (EA) or EA amendment.</p>
13g	<p>Issue: Potential bioaccumulation of chemicals</p> <p>In this chapter of the EIS it is stated that the chemicals that can bioaccumulate within the environment will not be present in any of the project discharges which include hydrotest waste, sewage, coal seam gas water and runoff. However, no information has been provided to support this statement.</p> <p>Recommendation</p> <p>Arrow Energy should provide sufficient information to show that chemicals that can bioaccumulate within the environment will not be present in any of the project discharges.</p>	<p>–</p>	<p>Arrow's statement that 'chemicals that can potentially bioaccumulate within the environment will not be present in any of the project discharges' will be achieved through the careful selection of chemicals used for activities that result in discharges to the environment. Statutory information requirements will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to support the application for an environmental authority (EA) or EA amendment.</p>
13h	<p>Issue; Prolonged storage of brine in brine dams</p> <p>In a presentation (11th May at 400 George Street, Brisbane) Arrow advised that the brine created during the treatment of CSG water in the Surat Gas Project may potentially be sitting in the brine ponds for up to 30 years (to be dealt with at the end of the project during the decommissioning stage).</p>	<p>SREIS Attachment 5</p>	<p>SREIS Attachment 5, Coal Seam Gas Water and Salt Management Strategy presents a further refined coal seam gas water and salt management strategy. This includes an investigation of a collaborative approach for the development of a selective salt recovery plant as well as presenting further research into the feasibility of Arrow's own selective salt recovery plant.</p> <p>The brine management options considered in the SREIS are:</p> <ul style="list-style-type: none"> • Selective salt recovery at a joint industry facility. • Selective salt recovery at an Arrow-only facility.

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
13h (cont'd)	<p>Considering there will be up to 12 x 1,440 ML brine storage dams scheduled for the Surat Gas Project area this is not an adequate means to manage this waste product particularly when prolonged storage of contaminated wastes such as brine will increase the risk of surface water contamination via leaks, spills or overtopping during heavy rainfall events.</p> <p>Recommendation</p> <p>Arrow Energy should present an appropriate and viable means to dispose of brine wastes during the operational period rather than waiting until the decommissioning stage of the project in order to avoid long periods of brine storage.</p>		<ul style="list-style-type: none"> • Injection into a suitable aquifer. • Discharge to the ocean. • Disposal to landfill. <p>The management options for brine/salt will be continually reviewed as planning for field development evolves and opportunities for additional beneficial uses present themselves.</p> <p>Coal seam gas water storage dams are assessed using the Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (EHP, 2012f). If a dam is assessed as being in the significant or high-hazard category, it will be considered a regulated dam and will need to be registered with regulatory authorities.</p>
13i	<p>Issue: Poor characterisation of waste products (other than CSG water)</p> <p>In the EIS there is a general description (list) of solid and liquid wastes that will be generated during construction and operation and maintenance stages of Surat Gas Project area. Arrow Energy has not supplied sufficient detail, particularly on chemical wastes, to properly characterise potential risk to aquatic ecosystems, particularly if waste spills occur and there is potential for consequent contamination of surface waters. It is not considered sufficient to present the estimated quantity of the waste. For example, it not clear what constitutes "cleaning acids" or "pesticides and herbicides" and it is unclear is referring to in Table 26.2 of Chapter 26 – Waste Management.pdf (pdf pages 9-19)?</p> <p>Recommendation:</p> <p>Arrow Energy should expand on the description of waste material in Table 26.2 of Chapter 26 – Waste Management.pdf (pdf pages 9-19) in the same manner as they have for "drilling fluid additives" in column 2; row five of the table, i.e. supply an inventory of chemicals and / or chemical mixture generated on site including:</p> <p>A) acids and caustics; B) used or spent chemicals; C) spent and unused solvents; D) used chemicals and oils; E) domestic cleaners; F) cleaning acids and G) pesticides and herbicides</p>	<p>EIS Chapter 26</p>	<p>The waste management strategy presented in the EIS adopts the waste management hierarchy and sets out management measures for types of waste including chemicals and other hazardous materials. EIS Chapter 26, Waste Management sets out the controls required to safely store, handle, use and dispose of wastes.</p> <p>Statutory information requirements will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to support the application for an environmental authority (EA) or EA amendment.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
13j	<p>Issue: Limited detail to characterise disposal and management of waste materials, particularly reuse waste material</p> <p>In the EIS there is inadequate characterisation of waste reuse, including management measures to ensure surface water; soil and groundwater are not contaminated. Some of the disposal and management methods listed in Table 26.2 (Chapter 26 – Waste Management.pdf; pdf pages 9-19) for waste materials may lead to contamination of surface waters and should be revised to ensure that this does not occur. Of particular concern is the reuse of soils, drill cuttings, hydrostatic test water and waste or washout liquids. It is not possible to ascertain the potential risks to surface waters without knowing where these components will be reused and the quality at which they are reused. In some instances, for example, with waste material of soil, the expected quantity (maximum estimated) of the waste material is not included.</p> <p>In addition, management measures to be implemented around the onsite disposal of concrete and abandoning pipeline infrastructure during the decommissioning stage lack specificity for this project. Degradation of buried cement can result in leaching of calcium carbonate and metals into adjacent soils and potentially ground and / or surface water.</p> <p>Recommendation:</p> <p>The supplementary report to the EIS should provide information on where and the expected quality of waste materials are to be reused including the following matters:</p> <p>A) soils; B) drill cuttings; C) hydrostatic test water, and D) waste or washout liquids.</p>	SREIS Chapter 2	Statutory information requirements will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to support the application for an environmental authority (EA) or EA an amendment.
13k	<p>Recommendation:</p> <p>Arrow Energy should provide detailed information on management measures of wastes to be left on site, such as cement or pipelines, to ensure that they will have measures in place to prevent or reduce potential for surface water contamination (and will also be important to prevent potential contamination of soil and groundwater).</p>	–	The materials that may be left on site, including materials used to decommission pipelines etc., are identified as being inert, and thus will not cause contamination following decommissioning.

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
14a	<p>Issue: Inadequate mitigation actions proposed for cumulative impacts Mitigation actions listed on pg. 19-20 in Section 28.3.3 include providing support to the QWC, compliance with industry standards, monitoring and modelling. However, these are not mitigation activities.</p> <p>Recommendation In the supplementary report to the EIS, Arrow Energy should propose mitigation actions that will result in changes to the projected aquifer impacts described in the EIS.</p>	<p>SREIS Chapter 8</p>	<p>SREIS Chapter 8, Groundwater, provides further information on Arrow's water management strategy including for example, make good requirements. The chapter also outlines the findings of groundwater modelling into the effectiveness of mitigation measures.</p>
14b	<p>Issue: Incomplete assessment of cumulative impacts on environmental values The cumulative impacts chapter does not fulfill the requirement of the TOR to "describe any cumulative impacts on environmental values caused by the project, either in isolation or by combination with other known existing or planned development or sources of contamination", as no consideration of the cumulative impacts on environmental values for water are presented.</p> <p>Water quality is very briefly discussed, but not in terms of the impacts on each of the environmental values for surface waters. The potential for impacts of the project affecting the ability to meet salinity targets under the Murray Darling Basin Plan is not addressed.</p> <p>Recommendation: In the supplementary report on the EIS, for each environmental value for water, describe the cumulative impacts from the project, and from other developments in the area. Consider the water quality impacts of the project in terms of the water quality guidelines and objectives applicable to each environmental value. Quantify the possible impacts in terms of best and worst case scenarios (as presented for groundwater) and discuss potential impacts, including ability to meet salinity targets under the Murray Darling Basin Plan.</p>	<p>SREIS Chapter 10, Section 10.4</p>	<p>Arrow proposes operational discharge of treated coal seam gas water at two potential sites in drainage areas 2 and 9 in the project development area from water treatment facilities to be developed at those sites.</p> <p>Detailed water quality, aquatic and surface water studies have been undertaken at those sites as a part of the SREIS and have informed preliminary guidelines for an initial discharge based on natural flow regimes. SREIS Chapter 10, Aquatic Ecology, Section 10.4, summarises the aquatic ecology study undertaken for discharging coal seam gas water. The studies inform the development of preliminary discharge parameters to meet the relevant water quality standards.</p> <p>Subsequent applications for an environmental authority (EA) or to amend an EA to incorporate the discharges will be supported by further detailed information on the type, volume, rate and duration of planned discharges, and how they meet the relevant standards and guidelines, as required. Based on studies undertaken for the SREIS and recommendations from specialists, Commitment C498 has been updated to develop a strategy for the discharge of coal seam gas water to watercourses in accordance with relevant legislation. The strategy will incorporate a water quality monitoring program with locations upstream and downstream of the discharge point to inform site specific water quality objectives. A detailed environmental flows assessment informed by water quality monitoring data and an aquatic ecology monitoring program will inform the discharge strategy. Periodic inspections of the physical form and hydrology of the watercourse are to be incorporated in the strategy to monitor geomorphic performance.</p> <p>Preparation of those applications will require consideration of existing water quality and any cumulative impacts in those catchments.</p>
15	<p>Issue: Omission of native species dependent on discharge from the GAB Attachment 3, Section 4.2, Table 4.1 pg. 15 - "The community of native species dependent on discharge from the Great Artesian Basin" has not been included in Table 4.1 and is not considered in this section.</p>	<p>EIS Chapter 14, Section 14.3.3</p>	<p>Spring complexes and groundwater dependent ecosystems were discussed in EIS Chapter 14, Groundwater, Section 14.3.3 as well as within EIS technical studies Appendix G, Groundwater Impact Assessment, and Appendix K, Terrestrial Ecology Impact Assessment.</p> <p>EIS Appendix K, Terrestrial Ecology Impact Assessment, Section 6.8.6 states that there are no known groundwater dependant ecosystems in the project development area.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
15 (cont'd)	<p>Recommendation: In the supplementary report to the EIS, include the endangered community in the table and provide an assessment of the potential impacts on these species.</p>	<p>EIS (cont'd) Appendix G and Appendix K, Section 6.8.6</p> <p>SREIS Chapter 8, Section 8.4, Appendix 4 and Appendix 9, Section 5.2.3</p>	<p>There are no potentially impacted springs identified within the project development area. Arrow is not the designated responsible tenure holder for any potentially impacted springs outside the project development area.</p> <p>Since the EIS was finalised, additional information on groundwater dependent ecosystems has become available, as discussed in Chapter 8, Groundwater, Section 8.4. A number of desktop studies and field investigations (hydrogeological, ecological and botanical) have been conducted within the Surat Cumulative Management Area (CMA) by the Office of Groundwater Impact Assessment (OGIA), and used to inform the Underground Water Impact Report (UWIR) prepared by the Queensland Government.</p> <p>One spring complex, identified since the EIS was finalised, was assessed for the potential presence of Groundwater Dependent Communities and Species of interest under the EPBC Act and the VM Act. This complex is located 35 km west of the project development area and may be inter-related to the groundwater systems potentially impacted by the Surat Gas Project.</p> <p>The spring is located outside of the project development area, and is unlikely to be directly impacted by project related activities. This area will not be exposed to Arrow's clearance activities nor any direct disturbance. Terrestrial ecology values associated with the identified spring complex are unlikely to be impacted.</p> <p>The relationship of the spring complex with potentially affected groundwater systems is described in the groundwater assessment, Appendix 4, Supplementary Groundwater Assessment).</p> <p>Should the groundwater level and quality data collected as part of the Spring Impact Management Strategy and the Water Monitoring Strategy show significant changes in spring function or associated source aquifer groundwater levels that could potentially impact vegetation communities and associated species, Arrow will determine the required action through the periodic reporting and review obligations under the UWIR. These requirements will also determine the actions to be taken in the event that a previously unidentified groundwater dependent ecosystem is identified. Arrow is also involved in the preparation of a Joint Industry Plan for an Early Warning System for the Monitoring and Protection of EPBC Springs with other coal seam gas proponents operating within the Surat CMA.</p> <p>These management measures will also be informed by future research directions identified by OGIA, specifically related to improving the knowledge about springs (including watercourse springs). The objective of the research is to improve spring monitoring techniques and existing knowledge about springs in the Surat CMA in relation to their hydrology, ecological and cultural values.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
15 (cont'd)			<p>Groundwater dependent ecosystems are recognised in Queensland in discharge areas of the Great Artesian Basin, and not located in Tertiary aquifers (younger geological units associated with overlying fluvial and alluvial sediments), as part of regional ecosystems 2.3.39, 4.3.22 and 6.3.23 which are listed as Endangered under the VM Act. These regional ecosystems are not present in the project development area and were not found to be present during field investigations (Unpublished Report).</p> <p>Three EPBC Act listed flora species, <i>Eriocaulon carsonii</i>, <i>Arthraxon hispidus</i> and <i>Phaius australis</i>, were identified as being potentially present in association with the spring complex (situated outside of the project development area) (Figure 8-2 of the OGIA report) . The supplementary terrestrial ecology assessment (Appendix 9, Terrestrial Ecology Supplementary EIS Study, Section 5.2.3) excludes these species from being present within the project development area. Field investigations found these species to be absent from the spring complex (Unpublished Report).</p> <p>The Fitzroy River turtle (<i>Rheodytes leukops</i>) is also described within the context of a groundwater dependent ecosystem due to the potential movement between spring-fed watercourses identified in the Surat CMA.</p> <p>The Fitzroy River turtle is only known to occur within the Fitzroy Basin, not the Murray-Darling Basin (within which the vast majority of the project development area is situated). A small portion of the project development area falls within the Dawson River catchment of the Fitzroy Basin.</p> <p>No specimen of Fitzroy River turtle has been recorded within the project development area. Database search results did return the species as 'possibly' occurring within the small portion of the project development area occurring within the Dawson River catchment.</p> <p>No individuals were collected by routine turtle sampling methodologies employed during field surveys in early 2013. The small portion of the project development area occurring within the Dawson River catchment (Fitzroy Basin) is not expected to support suitable habitat for the Fitzroy River turtle.</p>
16a	Arrow Energy should provide a revised EM Plan addressing the following matters concerning the EM Plan submitted as part of the EIS.	EIS Attachment 5 SREIS Attachment 2	<p>The content and structure of EIS Attachment 5, Environmental Management Plan (EMP) was informed by the Guideline for Preparing an Environmental Management Plan for Coal Seam Gas Activities (DERM, 2010c), which has been revoked since publication of the EIS. At the time of writing, alternate guidelines had not been made publicly available.</p> <p>In addition to this change, the Environment Protection Act 1994 (EP Act) no longer stipulates that information once presented in an Environmental Management Plan (EM Plan) (e.g., values, details of emissions/releases, impacts to values, management measures, etc.) be presented in the format of an EM Plan i.e., the process does not provide a preferred format for the presentation of this information, but retains the statutory information requirements needed to</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16a (cont'd)			<p>assess environmental authority (EA) applications or amendment EA applications. The EP Act permits the use of application documents as a means of presenting the information, provided the chosen format meets the requirements outlined in section 125. Arrow will fulfil its statutory information requirements and prepare the necessary documentation with reference to the EHP Guideline 'Application requirements for petroleum activities' (EHP, 2013).</p> <p>In light of the recent legislative changes and absence of a new guideline for structuring a coal seam gas environmental management plan, for the purposes of the SREIS, EIS Attachment 5, Environmental Management Plan (EMP) has simply been updated to capture changes to the project description and supplementary information gained through preparation of the SREIS, which includes any new commitments that Arrow has made (see SREIS Attachment 2, Strategic Environmental Management Plan).</p>
16b	<p>Issue: Environmental Management Plan</p> <p>Section 1.3 states: 'The purpose of this environmental management plan is to detail environmental values; potential impacts to these values from project activities; and environmental protection commitments for the project to implement during planning and design, construction, operation and decommissioning to protect the environmental values identified'.</p> <p>The basis of the EIS indicating no actual impacts was determined in Chapter 8 – 'For this project, the type of development, and construction, operation and maintenance activities are known, as is the duration for installing individual items of project infrastructure e.g., the drilling of a production well or construction of an integrated processing facility. The typical operating life of coal seam gas infrastructure is also known. The potential impacts associated with the project activities are known, as Arrow has been developing coal seam gas resources for over 10 years. What is not known is where future development will occur, and at what time'.</p> <p>Table 4.11 within Attachment 005 outlines the planning and design phase for Terrestrial Ecology Management. The management measures outlined here conflict with the constraints mapping.</p> <p>Recommendation</p> <p>Include the constraints mapping developed in the EIS with recommended changes to inform the placement infrastructure in the design and construction phases to minimise impacts to terrestrial ecology.</p> <p>Use the constraints mapping developed as a part of the EIS process to determine areas to be avoided when planning and designing infrastructure.</p>	<p>EIS Attachment 10 SREIS Chapter 8</p>	<p>As discussed in SREIS Chapter 8, Environmental Framework, constraints that can be defined spatially (e.g., endangered vegetation communities) are maintained in the project geographic information system (GIS) as one of the planning tools that Arrow uses to facilitate avoidance and the establishment of appropriate buffers and management requirements for areas in which project facilities might be located. The constraints maps are indicative and need to be used in conjunction with other information (e.g., mapping of potential SCL and the results of detailed ecological surveys) to provide a meaningful understanding of the type and level of constraint across the project development area. The constraints mapping planning tool is also informed through negotiations with regulatory authorities and ongoing community consultation.</p> <p>The project GIS, a live system, will be periodically updated to include updates to Australian and Queensland government GIS data, the results of ecological and preconstruction clearance surveys, landowner negotiations and any subsequent environmental impact assessment processes.</p> <p>A graphical display of the way in which the environmental constraints are considered as part of Arrow's planning and design process was presented in a series of maps in EIS Attachment 10, Preliminary Constraints Maps. EIS Attachment 10, was prepared using information available prior to completion of the EIS. As an example of how this planning tool is periodically updated, the SREIS presents an update of the maps, incorporating the EIS findings e.g., field survey results and the outcomes of sensitivity analyses performed by technical specialists. The updated maps also include the results from analyses of high resolution aerial photography conducted to improve the accuracy of identification of dwellings within the project development area. Constraints previously shown in relinquished sub-blocks (which no longer form part of the project development area), are not shown.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16b (cont'd)	<p>Where areas of biodiversity values may be impacted by development, use the Qld Biodiversity Offsets Policy to assess the offset requirements.</p> <p>Document the process and methodology used in the constraints mapping, the process should then be applied consistently thorough the life of the project.</p>		
16c	<p>Issue: Implementation strategies specified throughout EM Plan</p> <p>Various 'implementation strategies' specified in the management tables throughout the EM Plan do not provide adequate information on when, how, where each proposal will be used.</p> <p>Terms used such as 'where practical' and 'where alternatives are available' are not suitable for use in the EM Plan.</p> <p>Recommendation:</p> <p>Provide greater detail regarding the proposed implementation strategies listed throughout in the EM Plan. When designing and constructing is required, include detail around the size and standard of the design.</p> <p>Timeframes should also be specified in regards to whether proposed strategies will be implemented before, during or after construction. Frequency of inspections and monitoring must be specified.</p> <p>Remove all terms such as 'where practical', 'as soon as practical', 'regular basis' and 'where alternatives are available' from the EM Plan and replace with objective, quantifiable commitments. If precise timing is unknown, provide indicative timing such as the minimum or maximum timeframes before work will be conducted.</p>	<p>EIS</p> <p>Attachment 5</p> <p>SREIS</p> <p>Attachment 2</p>	<p>EIS Attachment 5, Environmental Management Plan, which has been updated in SREIS Attachment 2, Strategic Environmental Management Plan, is a preliminary document that will be further developed to support the application for an environmental authority (EA) or EA amendment. Some specific details may not be available until after the completion of detailed field development planning. It is likely that the field development planning phase will design out much of the current optionality that is being carried forward. Statutory information requirements will be provided with the application in accordance with the EHP Guideline "Application requirements for petroleum activities". The application process enables an EIS, where it contains sufficient detail, to fulfil the information requirements of an application. The SREIS may not contain sufficient information to support all EA applications e.g., construction of a brine treatment facility. Where necessary, Arrow will prepare more detailed technical information to support applications to amend the Dalby Expansion Project EA or apply for new EAs.</p> <p>Commitments have been made on the basis that in the vast majority of cases, these management measures can be implemented. The use of 'where practicable' or 'to the greatest extent practicable' is included to cover those circumstances where management measures may not be feasible or able to be implemented as stipulated, due to other constraints; for example, weather or seasonality issues, or specific land use on properties that requires a different approach.</p>
16d	<p>Issue: Description of petroleum tenures/petroleum authorities</p> <p>Section 1.8 of the EM Plan does not include a list of all the proposed tenures in the Surat Gas Project. The only tenures listed in this section are the Dalby Expansion Project. Figure 1.1 shows the whole and partial tenures that are proposed to be included in the project.</p> <p>Recommendation:</p> <p>The EM Plan must be revised to include identification of each relevant resource authority and identification of relevant blocks/sub-blocks that form the Surat Gas Project area.</p> <p>Discuss whether the Authority to Prospect tenures that are partially included in the project area (such as ATP747, ATP746 etc in Figure 1.1) will be converted to Petroleum Lease Applications prior to the submission of the environmental authority application.</p>	<p>EIS</p> <p>Chapter 2, Section 2.1.4</p> <p>SREIS</p> <p>Chapter 2, Section 2.3.2 and Attachment 2, Section 1.9</p>	<p>Petroleum tenures and petroleum authorities relevant to the Surat Gas Project were identified in EIS Chapter 2, Project Approvals, Section 2.1.4. The SREIS also includes this detail (i.e., in regards to Arrow's existing petroleum tenures and petroleum authorities) in SREIS Attachment 2, Strategic Environmental Management Plan, Section 1.9.</p> <p>Arrow will lodge applications for petroleum leases in accordance with regulatory processes and recognises that petroleum leases cannot be issued prior to approval of the environmental authority (EA). The petroleum lease applications and EA and EA amendment applications will comprise a staged approach throughout the life of the project as described in SREIS Chapter 2, Project Approvals, Section 2.3.2.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16e	<p>Issue: Level 1 chapter 5A activities and Environmentally Relevant Activities (ERA) The EM Plan does not list of the level 1 chapter 5A activities, listed in Schedule 5 of the Environmental Protection Regulation 2008 (EP Reg) that will be undertaken as part of the Surat Gas Project. Some of the ERA's proposed for the Surat Gas Project have been listed section 1.7 of the EM Plan, however the associated thresholds have not been specified.</p> <p>Recommendation: The EM Plan must include all the level 1 chapter 5A activities to be undertaken as part of the Surat Gas Project. Section 1.7 of the EM Plan must be revised to include all the ERA's proposed for the Surat Gas Project and the associated ERA thresholds as specified in the Environmental Protection Regulation 2008 (EP Reg). For example: ERA 63 (2)(b)(i) Sewage Treatment – Operating sewage treatment works, other than a no-release works, with a total daily peak design capacity of 21 to 100 EP if treated effluent is discharged from the works to an infiltration trench or through an irrigation scheme.</p>	<p>EIS Attachment 5 SREIS Chapter 2 and Attachment 2</p>	<p>SREIS Chapter 2, Project Approvals identifies the relevant ERAs which have been subject to the recent changes to the regulation due to updates that were required to align with the Environmental Protection (Greentape Reduction) and Other Legislation Amendment Act 2012. EIS Attachment 5, Environmental Management Plan, which has been updated in SREIS Attachment 2, Strategic Environmental Management Plan, is a preliminary document that will be further developed to support the application for development approval of all of the project components. Statutory information requirements, including the details of proposed ERAs and their thresholds will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p>
16f	<p>Issue: Notifiable Activities Notifiable Activities as listed under Schedule 3 of the EP Act, have been mentioned briefly in Section 4.2.1 of the EM Plan, however existing or proposed notifiable activities have not been clearly listed in the EM Plan.</p> <p>Recommendation: Revise the EM Plan to list the number and name of all existing and proposed notifiable activities on the project site. Clearly differentiate between the existing notifiable activities and the proposed notifiable activities. Real property descriptions must be provided including the lot on plan of any land that is required to be notified and included on the environmental management register (i.e. contaminated land or land that is being used for a notifiable activity (Schedule 3 of the EP Act)).</p>	<p>EIS Chapter 12, Box 12.1 and Attachment 5 SREIS Chapter 3, Figure 3.6 and Attachment 2, Section 1.8</p>	<p>EIS Attachment 5, Environmental Management Plan, which has been updated in SREIS Attachment 2, Strategic Environmental Management Plan (Strategic EMP), is a preliminary document that will be further developed to support the application for development approval of all of the project components. Arrow recognises that the property on which notifiable activities will take place must be identified and listed on the Environmental Management Register (EMR). EIS Chapter 12, Geology, Landform and Soils, Box 12.1 presents the notifiable activities listed in Schedule 3. Given that the location at which project activities (including the construction of infrastructure and facilities) will occur is not yet known, the lot on plan location for existing or proposed notifiable activities could not be determined for the EIS. The SREIS presents properties acquired by Arrow since the publication of the EIS, on which four central gas processing facilities and one temporary workers accommodation facility (TWAF F) will be sited. The properties are located within drainage areas (DAs) DA2, DA7, DA8, DA9, which are shown on Figure 3.6 of SREIS Chapter 3, Project Description. None of the identified properties are currently listed on the EMR or CLR. Within these properties, the lot on plan location for siting a facility has not been determined. Statutory information requirements, including details on proposed notifiable activities will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16f (cont'd)			Environmentally relevant activities anticipated to be applicable to the project, and providing an indication of notifiable activities are presented in SREIS Attachment 2, Strategic EMP, Section 1.8.
16g	<p>Issue: Total amount of financial assurance</p> <p>The total financial assurance amount has not been specified in Section 1.9 of the EM Plan. The EM Plan states the financial assurance will be calculated for the construction and operation stages as part of the environmental authority application.</p> <p>Recommendation:</p> <p>Section 310D (4) of the EP Act requires the rehabilitation program to state a proposed amount of financial assurance for the environmental authority in the EM Plan. State the total amount of financial assurance required for the project in Section 1.9 of the EM Plan. This calculation should be made in accordance with the latest version of the 'Calculating financial assurance for Level 1, chapter 5A petroleum activities guideline'. Section 1.9 of the EM Plan should also include the assumptions made in calculating this figure. The schedule of disturbance calculation may be provided separately to the department with the environmental authority application.</p>	<p>EIS</p> <p>Attachment 5</p> <p>SREIS</p> <p>Attachment 2</p>	<p>EIS Attachment 5, Environmental Management Plan (EMP), which has been updated in SREIS Attachment 2, Strategic Environmental Management Plan (Strategic EMP), is a preliminary document that will be further developed to support the application for development approval of all of the project components.</p> <p>Statutory information requirements, including details on total financial assurance will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p>
16h	<p>Issue: Existing Petroleum Infrastructure</p> <p>The EM Plan does not list the petroleum infrastructure that is currently located on the tenures that are included in the Surat Gas Project EIS.</p> <p>Recommendation:</p> <p>Provide a map for inclusion in the EM Plan, clearly depicting the location of the existing infrastructure located in the Surat Gas Project area. The EM Plan must be revised to provide a clear description of the existing petroleum infrastructure required as part of the Surat Gas Project area including the number, location and total area of disturbance of the following:</p> <ul style="list-style-type: none"> • Wells; • Field compressor stations; • Central compressor stations; • Gas processing facilities; • Gas turbines; • Gas pipelines; • Brine dams; 	<p>EIS</p> <p>Chapter 5, Section 5.2 and Attachment 5</p> <p>SREIS</p> <p>Attachment 2</p>	<p>The number and footprint of typical infrastructure components are provided in EIS Chapter 5, Project Description, Section 5.2. SREIS Chapter 3, Project Description and SREIS Attachment 2, Strategic Environmental Management Plan (EMP), Section 1.1 presents any changes to the number (reduction) and typical footprint of project components.</p> <p>SREIS Chapter 3, Project Description Figure 3.6 also presents the properties that have been identified since publication of the EIS, on which the first four central gas processing facilities and associated temporary workers accommodation facility will be sited.</p> <p>EIS Attachment 5, Environmental Management Plan, which has been updated in SREIS Attachment 2, Strategic EMP, is a preliminary document that will be further developed to support the application for development approval of all of the project components. Some specific details will not be available until after the completion of detailed field development planning. It is likely that the field development planning phase will design out much of the current optionality that is being carried forward.</p> <p>Statutory information requirements, including details on proposed and existing infrastructure will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16h (cont'd)	<ul style="list-style-type: none"> • Aggregation dams; • Coal seam gas evaporation dams; • Low hazard dams; • Water treatment facilities; • Water pipelines; • Sewage treatment plants (specify volume (KL/day) and equivalent person (EP) of each plant); • Landfill cell(s); • Brine encapsulation facilities; • Discharge points; • Low point drains (provide details on monitoring, water quality, management including storage and disposal); • Other infrastructure such as workshops, office, storage sheds, roads etc. 		
16i	<p>Issue: Proposed Petroleum Infrastructure</p> <p>Section 3.3 of the EM Plan has provided some detail on the major infrastructure proposed for the Surat Gas Project area. However, the details of the maximum disturbance area and the location of the disturbance for each of the major infrastructure components have not been provided.</p> <p>Recommendation:</p> <p>Section 3.3 of the EM Plan must be revised to include the proposed maximum disturbance area and the location for each of the major infrastructure components. Further detail regarding the following major infrastructure components must be provided in Section 3.3 of the EM Plan including, but not limited to:</p> <ul style="list-style-type: none"> • Production wells – maximum well pad size for construction and operation, the associated infrastructure located on well pads including the number and size of sumps, the minimum well pad spacing Arrow is proposing. • Field compression facilities – total number, location and maximum disturbance area • Central gas processing facilities - total number, location and maximum disturbance area • Integrated processing facilities - total number, location and maximum disturbance area 	<p>EIS Attachment 5 SREIS Chapter 3, sections 3.4, 3.5 and Attachment 2</p>	<p>EIS Attachment 5, Environmental Management Plan, which has been updated in SREIS Attachment 2, Strategic Environmental Management Plan (Strategic EMP), is a preliminary document that will be further developed to support the application for development approval of all of the project components. SREIS Chapter 3, Project Description, Section 3.4 presents the revised number and footprint for the Surat Gas Project components. Section 3.5 presents the properties that have been identified since publication of the EIS, on which the first four central gas processing facilities and associated temporary workers accommodation facility will be sited. Environmental authorities issued for petroleum activities require the tenure holder to develop an operational plan that provides detailed information about the activities to be carried out including the location of any facilities and supporting infrastructure. Information prepared to support an application for or to amend an Environmental Authority will include details of the location of the infrastructure for which the approval is sought.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16i (cont'd)	<ul style="list-style-type: none"> Water storage dams – the number, type (i.e. aggregation dam, brine dam, coal seam gas evaporation dam, low hazard dams as per the definitions in the 'structures which are dams or levees constructed as part of environmentally relevant activities guideline') and maximum disturbance area of each water storage dam. Water treatment facilities – total number, location, type and maximum disturbance area 		
16j	<p>Issue: Other infrastructure for the beneficial use of coal seam gas water and brine Section 3.4 of the EM Plan does not adequately detail the infrastructure that is required for the proposed beneficial use of CSG water and brine.</p> <p>Recommendation: The EM Plan must be revised to include specific detail regarding the infrastructure required including but not limited to:</p> <ul style="list-style-type: none"> the location of the proposed infrastructure; whether additional water storage is required and if so, the proposed size, location and quality of water held; the extent of the network of distribution pipelines including proposed number of end users; the capacity of the salt precipitation plant and salt storage area, brine and/or treated water storage area and whether the disturbance required for vehicle access and loading facilities has been included in the expected 150m by 150m area specified. If not, provide the area required for the vehicle access and loading facilities etc. 	<p>EIS Attachment 5 SREIS Chapter 3 and Attachment 2</p>	<p>EIS Attachment 5, Environmental Management Plan (EMP), which has been updated in SREIS Attachment 2, Strategic Environmental Management Plan (Strategic EMP), is a preliminary document that will be further developed to support the application for development approval of all of the project components.</p> <p>Statutory information requirements, including details on proposed and existing infrastructure will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment. Infrastructure will be located using the constraints based approach and also by agreement with landholders/end users. The location of the infrastructure will be determined by the number and locations of end users with whom arrangements are signed. Any beneficial use of coal seam gas water (treated or untreated) and associated infrastructure (e.g., dams) would require a series of licences and approvals prior to the provision or use of water.</p> <p>Arrow is working with other coal seam gas companies towards an industry solution to develop commercial markets for salt products. Details such as vehicle access requirements for a salt precipitation plant are not yet known and this will be assessed through a separate approval process.</p> <p>Further discussion regarding Arrow's beneficial use network and involvement in the investigation of a joint-industry brine management solution is presented in SREIS Chapter 3, Project Description.</p>
16k	<p>Issue: Power generation facilities</p> <p>Section 3.5 of the EM Plan states power generation facilities are assumed to be required as both the production wells and the production facilities.</p> <p>Recommendation: Identify in the EM Plan whether the estimated footprint of 80m by 150m required to accommodate the power generation facility is in addition to the estimated footprint specified for production facilities or is included in the production facility disturbance area. Also, describe in the EM Plan whether noise mitigation is required and proposed for each power generation facilities.</p>	<p>SREIS Chapter 3 and Attachment 2, Section 3.4</p>	<p>It was expected that the estimated power generation facility footprint presented in the EIS would be contained within the central gas processing facility footprint.</p> <p>SREIS Attachment 2, Strategic Environmental Management Plan, Section 3.4 explains that electric power sourced from the Queensland electricity grid is now Arrow's preferred power supply option, with SREIS Chapter 3, Project Description further detailing the power supply network. High-voltage transmission lines (to be constructed and operated by the transmission network service provider) are expected to transmit power from the Queensland electricity transmission grid to zone or Arrow substations established in the vicinity of or adjacent to central gas processing facilities.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16k (cont'd)			<p>The Arrow substations at the central gas processing facilities will provide power to the production facilities, production wells and associated infrastructure, including the water treatment facilities proposed at CGPF2 and CGPF9. A 330-m by 280-m footprint is typically required to establish a 132-kV zone substation. A 500-m by 500-m footprint is typically required to establish a 275/132-kV zone substation. The Arrow substations will be incorporated within the footprint of the central gas processing facilities.</p> <p>Electricity transmission infrastructure required to connect supply points to the Queensland electricity grid will be subject to subsequent environmental approvals processes by the transmission network service provider.</p> <p>In relation to noise mitigation required at the central gas processing facilities (including associated infrastructure such as substations), the location of the facilities on Arrow owned and/or leased properties and their proximity to the nearest sensitive receptor will determine the extent to which noise abatement measures are applied to meet the statutory noise compliance limits</p>
16l	<p>Issue: High-pressure gas pipelines</p> <p>Section 3.6 of the EM Plan does not detail the extent of the high-pressure gas pipelines required for the Surat Gas Project.</p> <p>Recommendation:</p> <p>The EM Plan must include details of the expected extent of the high-pressure gas pipelines including the number of pipelines required, the length of the pipelines, the maximum right of way proposed and the minimum depth the pipeline will be buried.</p>	<p>EIS</p> <p>Chapter SREIS</p> <p>Chapter 3</p>	<p>EIS Chapter 5, Project Description explains that for the Surat Gas Project, high-pressure gas pipelines are only required for the short connection from a central gas processing facility to the Arrow Surat Pipeline (i.e., pipeline lengths of a couple of kilometres each, connecting the eight facilities). Once the locations of the central gas processing facilities are identified in relation to the Arrow Surat Pipeline, the length of the high-pressure gas pipelines will be accurately known.</p> <p>The SREIS Chapter 3, Project Description presents the revised right-of-way required for high-pressure gas pipeline construction, which is up to 40 m wide and the minimum depth of cover required by AS 2885, Pipelines: gas and liquid petroleum (Standards Australia, 2008a), which is 750 mm.</p>
16m	<p>Issue: Accommodation Facilities</p> <p>Section 3.7.2 of the EM Plan states construction camps will be required as part of the Surat Gas Project but does not detail the expected size or location of the camps.</p> <p>Recommendation:</p> <p>Revise the EM Plan to include the expected number and size of the camps required over the life of the project and the proposed location of the camps. Also include the maximum total disturbance area required for each camp.</p>	<p>EIS</p> <p>Chapter 5, Section 5.2 and Attachment 5</p> <p>SREIS</p> <p>Attachment 2</p>	<p>EIS Attachment 5, Environmental Management Plan (EMP), which has been updated in SREIS Attachment 2, Strategic Environmental Management Plan (Strategic EMP), is a preliminary document that will be further developed to support the application for development approval of all of the project components. The number and footprint of typical infrastructure components are provided in EIS Chapter 5, Project Description, Section 5.2. The revised number, capacity and approximate footprint of the temporary worker accommodation facilities (TWAFs) required (six) is presented in SREIS Chapter 3, Project Description. The property on which one of the TWAFs will be located is also presented (see Figure 3.6).</p> <p>Statutory information requirements, including details on proposed and existing infrastructure will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16n	<p>Issue: Air contaminants likely to cause nuisance</p> <p>Section 4.1 of the EM Plan does not address the air contaminants that are likely to cause nuisance (dust, odour, light) in adequate detail.</p> <p>Recommendation:</p> <p>The EM Plan must be revised to include an evidenced based discussion on the propose activities that may cause nuisance impacts to sensitive receptors. This must include dust, odour and light. The EM Plan must include adequate detail on the proposed mitigation measures to reduce air contaminant nuisance to sensitive receptors and the environment.</p>	<p>EIS</p> <p>Chapter 9, Chapter 17, Chapter 18, Appendix C, Appendix L and Attachment 5</p> <p>SREIS</p> <p>Attachment 2</p>	<p>A summary of the detailed assessments of potential impacts from air contaminants (including odour) is included in EIS Chapter 9, Air Quality, with more detailed information provided in EIS Appendix C, Air Quality Impact Assessment. Activities generating lighting that may cause nuisance to sensitive receptors have been identified in EIS Chapter 18, Landscape and Visual Amenity, which summarises the detailed study presented in EIS Appendix L, Landscape and Visual Impact Assessment. The potential impacts that lighting may have on terrestrial ecology is also captured in EIS Chapter 17, Terrestrial Ecology. The proposed commitments (i.e., avoidance, mitigation and management measures) to address these impacts are presented in EIS Attachment 5, Environmental Management Plan (EMP), which has been updated in SREIS Attachment 2, Strategic Environmental Management Plan (Strategic EMP). The EMP (and subsequent Strategic EMP) is a preliminary document that will be further developed to support the application for development approval of all of the project components.</p> <p>Statutory information requirements, including details on proposed and existing infrastructure will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p>
16o	<p>Issue: Point source emissions</p> <p>Section 4.1.2 of the EM Plan provides some information regarding the key pollutants (VOCs, CO₂, H₂S) and flaring stacks, production facility gas engine stack and wellhead gas engine stacks. Ground level concentrations for key quality indicators based on modelling has not been included in the EM Plan. The identification and location of each release point and contaminant and details of the monitoring program have not been provided for the fuel burning equipment existing and proposed on the Surat Gas Project area.</p> <p>Recommendation:</p> <p>The EM Plan must be revised to include the following information:</p> <ul style="list-style-type: none"> • Identification of all point sources from fuel burning equipment that is capable of burning 500 kg or more fuel per hour by name and location and clarify whether this equipment is to be located in hubs or populated areas. • The locations of any existing and proposed point sources of contaminant emissions to air, along with all sensitive places, must be depicted on a map. Identify all the sensitive places that may be adversely affected by the release of contaminants. • The following must be specified for each existing and proposed release point and contaminant: <ul style="list-style-type: none"> – expected contaminants (e.g. NO_x, CO, particulates); – release point references; 	<p>EIS</p> <p>Appendix C and Attachment 5</p> <p>SREIS</p> <p>Attachment 2</p>	<p>Major fuel burning infrastructure (including central gas processing facilities) will not be located within 2 km of the nearest town. The EIS Appendix C, Air Quality Impact Assessment identified ground level emission concentrations based on dispersion modelling.</p> <p>The exact locations where facilities and infrastructure will be sited is not yet known. EIS Attachment 5, Environmental Management Plan (EMP), which has been updated in SREIS Attachment 2, Strategic Environmental Management Plan (Strategic EMP), is a preliminary document that will be further developed to support the application for development approval of all of the project components.</p> <p>Statutory information requirements, including details on proposed and existing infrastructure, as well as proposed management measures will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16o (cont'd)	<ul style="list-style-type: none"> – fuel burning reference name/number; – stack emission heights; – minimum efflux velocities; – maximum concentrations (mg/Nm³); and – mass emission rates (g/sec). <p>Clearly differentiate between the existing release points and proposed release points.</p> <ul style="list-style-type: none"> • The results of air dispersion modelling carried out for all combined point source emissions to air from all fuel burning equipment that is capable of burning fuel at a rate of 500 kg or more per hour. The results of this modelling must include ground level concentrations for key air quality indicators (e.g. NO_x, CO and particulates) and demonstrate that the air quality objectives in the EPP Air, for the protection of the relevant air quality values, have been met. • For venting and / or flaring surplus gas, provide details of contaminant concentrations and mass loads likely to be released to the atmosphere and discuss any impacts. • For fuel burning equipment that burns less than 500 kg of fuel per hour, the EM Plan must contain a register including, as a minimum, the following information for each piece of equipment: <ul style="list-style-type: none"> – fuel burning or combustion equipment name and location; – stack emission height (metres); – minimum efflux velocity (m/s); and – mass emission rates (g/s). • Describe an appropriate monitoring program commensurate to the risk of the proposed fuel burning activities. Monitoring provisions for the release points will need to comply with the most recent edition of Australian Standard AS 4323.1-1995: Stationary Source Emissions – Selection of Sampling Positions. Samples taken should be representative of the contaminants discharged when operating under maximum operating conditions. Monitoring of contaminant release should be carried out in accordance with the latest edition of the 'Air Quality Sampling Manual'. <p>The emissions data used in air dispersion modelling along with any relevant control strategies will be prescribed as point source air emission limits in the environmental authority.</p>		

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16p	<p>Issue: Fugitive emissions</p> <p>Section 4.1 of the EM Plan does not discuss in detail the sources and release of contaminants of fugitive releases expected to be released over time or the proposed controls or strategies to prevent and reduce emissions.</p> <p>Recommendation:</p> <p>Identify the sources of fugitive releases of contaminants to air from the project activities in the EM Plan and provide details of the expected contaminants to be released over time. This should include estimates of coal seam methane to be released fugitively from well heads and any associated infrastructure. Provide details of the proposed strategies and / or control equipment to prevent and reduce the associated impacts to air quality resulting from all fugitive releases of contaminants to air.</p>	<p>EIS</p> <p>Chapter 10 and Appendix D</p> <p>SREIS</p> <p>Chapter 6 and Appendix 3</p>	<p>Estimates of fugitive emissions are made in the EIS Chapter 10 Greenhouse Gas Emissions, and the associated technical study (EIS Appendix D Greenhouse Gas Impact Assessment). As required by Section 4.6.3.1 of the Terms of Reference, current methodologies in the National Greenhouse and Energy Reporting (Measurement) Determination 2008 (NGER Determination) were used to conduct the greenhouse gas impact assessment (EIS Appendix D, Greenhouse Gas Impact Assessment). The updated 2012 NGER Determination was used in the preparation of the supplementary greenhouse gas assessment.</p> <p>The National Greenhouse and Energy Reporting methods often refer to methods published by the American Petroleum Institute (API). The API's Compendium of Greenhouse Gas Emissions Estimation Methodologies for the Oil and Gas Industry was used to estimate fugitive emissions as they provide more conservative estimates than the NGER Determination.</p> <p>The estimates are based on widely recognised industry estimates of fugitive emissions for gas infrastructure. Updated information on fugitive emissions is presented in SREIS Chapter 6, Greenhouse Gas Emissions based on revised gas production estimates.</p> <p>The emissions represent a small percentage of overall emissions and are predominantly methane, the major component of coal seam gas. Programmed maintenance is proven to be the most effective means of managing fugitive emissions.</p> <p>Arrow and other coal seam gas proponents have been working in consultation with the Clean Energy Regulator to improve measures and estimation of fugitive greenhouse gas emissions from coal seam gas exploration and production.</p> <p>Statutory information requirements, including details on proposed and existing infrastructure and proposed management measures will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p>
16q	<p>Issue: Greenhouse gas</p> <p>Section 4.1.3 of the EM Plan mentions some implementation strategies for greenhouse gas emissions but does not provide adequate detail of the proposed strategies for the Surat Gas Project to minimise greenhouse gas release to the atmosphere using best practice methods.</p> <p>Recommendation:</p> <p>The EM Plan must describe the strategies that will be employed to minimise releases of greenhouse gases to the atmosphere, using best practice methods, which may include, but not necessarily be limited to:</p>	<p>EIS</p> <p>Chapter 10, Section 10.6</p>	<p>Arrow is committed to reducing the greenhouse gas emissions of the company's operations through the support of mitigation and management measures as set out in EIS Chapter 10, Greenhouse Gas Emissions, Section 10.6. Arrow will assess the energy-efficiency opportunities and estimate greenhouse gas emissions associated with the project in accordance with regulatory requirements. A number of commitments have also been made that aim to minimise the release of greenhouse gases, including but not limited to:</p> <ul style="list-style-type: none"> • Prevent venting and flaring of gas as far as practicable and where safe to do so. • Optimise gas-engine operation to minimise duration of operation at low-efficiency levels that may result in increased emissions. • Minimise the disturbance footprint and vegetation clearing. • During the decommissioning phase, minimise greenhouse gas emissions by optimising transport logistics and minimising the footprint of disturbance.

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16q (cont'd)	<ul style="list-style-type: none"> • a description of the proposed measures (alternatives and preferred) to avoid and/or minimise greenhouse gas emissions directly resulting from activities of the project, including such activities as transportation of products and consumables, and energy use by the project; • an assessment of how the preferred measures minimise emissions and achieve energy efficiency; • a comparison of the preferred measures for emission controls and energy consumption with best practice environmental management in the relevant sector of industry; and • a description of any opportunities for further offsetting greenhouse gas emissions through indirect means; <p>Means of reducing greenhouse gas emissions could include such measures as:</p> <ul style="list-style-type: none"> • minimising clearing at the site (which also has imperatives besides reducing greenhouse gas emissions); • using less carbon-emitting transport modes or fuels; • integrating transport for the project with other local industries such that greenhouse gas emissions from the construction and running of transport infrastructure are minimised; • maximising the use of renewable energy sources; • co-locating coal seam methane use for energy production with coal extraction; and • carbon sequestration at nearby or remote locations; <p>The EM Plan should also include commitments for continuous improvements in greenhouse gas emissions, which could include, but not necessarily be limited to:</p> <ul style="list-style-type: none"> • periodic energy audits with a view to progressively improving energy efficiency • a process for regularly reviewing new technologies to identify opportunities to reduce emissions and use energy efficiently, consistent with best practice environmental management • any voluntary initiatives such as projects undertaken as a component of the national Greenhouse Challenge Plus Program (operated by the Department of Climate Change and Energy Efficiency) or research into reducing the lifecycle and embodied energy carbon intensity of the project's processes or products • opportunities for offsetting greenhouse emissions by renewable energy uses • commitments to monitor, audit and report on greenhouse emissions from all relevant activities and the success of offset measures. 		<ul style="list-style-type: none"> • Minimise fuel consumption of vehicles by optimising transport logistics. • Select gaskets, seals and vehicle exhaust systems that are suitable for the task. • During the construction phase, minimise greenhouse gas emissions through selection of equipment and the commitment to clear areas progressively. Implement rehabilitation as soon as practicable following construction activities. • Ensure all engines, machinery equipment and pollution control mechanisms are operated and maintained in accordance with manufacturers' recommendations. <p>Statutory information requirements, including a more detailed greenhouse gas management strategy will be provided in accordance with the EHP Guideline 'Application requirements for petroleum activities' to accompany the application for an environmental authority (EA) or EA amendment.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16q (cont'd)	The EM plan should assess the potential impacts of the project on the state and national greenhouse gas inventories and describe the strategies that will be employed to minimise releases of greenhouse gases to the atmosphere, using best practice methods.		
16r	<p>Issue: Contaminated Land</p> <p>Section 4.2.1 of the EM Plan states 'many notifiable activities will have been carried out somewhere within the project development area' and that there is an absence of detailed information on the actual extent of contaminated land. As the proponent currently holds and has access to the tenures proposed for the Surat Gas Project, this description of existing contaminated land sites is unacceptable for inclusion in the EM Plan.</p> <p>Also, Table 4.6 in the EM Plan provides a list of values of the existing environment for contaminated land that does not sufficiently capture the diversity and extent of the existing environments.</p> <p>Recommendation:</p> <p>The EM Plan must be revised to include a detailed list of the known contaminated land parcels that the proponent is aware of, either through existing operations, the affected parcels listed on the Environmental Management Register and Contaminated Land Register. Details of whether these affected parcels of land will be accessed and / or managed as part of the Surat Gas Project is required.</p> <p>Table 4.6 of the EM Plan must be revised to include sufficient examples of the existing environment that is being referred to, such as listing the national parks and conservation areas etc.</p> <p>The EM Plan must include a discussion of the proposed management and mitigation measures of affected parcels if the project cannot avoid contaminated land.</p>	<p>EIS</p> <p>Chapter 12, Box 12.1 and Attachment 5</p> <p>SREIS</p> <p>Chapter 3, Figure 3.6 and Attachment 2, Section 1.8</p>	<p>EIS Attachment 5, Environmental Management Plan, which has been updated in SREIS Attachment 2, Strategic Environmental Management Plan (Strategic EMP), is a preliminary document that will be further developed to support the application for development approval of all of the project components.</p> <p>Arrow recognises that the property on which notifiable activities will take place must be identified and listed on the Environmental Management Register (EMR). EIS Chapter 12, Geology, Landform and Soils, Box 12.1 presents the notifiable activities listed in Schedule 3. Given that the location at which project activities will occur (including the construction of infrastructure and facilities) is not yet known, the lot on plan location for existing or proposed notifiable activities could not be determined for the EIS.</p> <p>The SREIS presents properties acquired by Arrow since the publication of the EIS, on which four central gas processing facilities and one temporary workers accommodation facility (TWAF F), will be sited. The properties are located within drainage areas (DAs) DA2, DA7, DA8, DA9, which are shown on Figure 3.6 of SREIS Chapter 3, Project Description. None of the identified properties are currently listed on the EMR or CLR. Within these properties, the lot on plan location for siting a facility has not been determined.</p> <p>Statutory information requirements, including details on proposed notifiable activities will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p> <p>Environmentally relevant activities anticipated to be applicable to the project, and providing an indication of notifiable activities are presented in SREIS Attachment 2, Strategic EMP, Section 1.8.</p>
16s	<p>Issue: Soils</p> <p>Section 4.2 of the EM Plan does not adequately describe the environmental values of the soil health and function and the ability for soil to sustain growth of native vegetation, crops and/or other flora.</p> <p>Recommendation:</p> <p>The EM Plan must be revised to include an evidence based discussion on the soil health, soil function and the ability for soil to sustain growth of native vegetation, crops and/or other flora.</p>	<p>EIS</p> <p>Chapter 12, Chapter 13 and Appendix F</p> <p>SREIS</p> <p>Attachment 2</p>	<p>The environmental values of soil health and function are discussed in EIS Chapter 12, Geology, Landform and Soils, and the associated technical study (Appendix E Geology, Landform and Soils Impact Assessment). The importance of productive soils to agriculture is further discussed in EIS Chapter 13, Agriculture and the associated technical study (Appendix F, Agricultural Report).</p> <p>EIS Attachment 5, Environmental Management Plan (EMP), which has been updated in SREIS Attachment 2, Strategic Environmental Management Plan (Strategic EMP), is a preliminary document that will be further developed to support the application for development approval of all of the project components.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16s (cont'd)	Management procedures should also be included in the EM Plan adequately detailing the various management strategies proposed to minimise impact to each soil type including productive soils and problematic soils.		Statutory information requirements, including details on proposed management strategies will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.
16t	<p>Issue: Erosion and Sediment Control</p> <p>Section 4.2 of the EM Plan briefly outlines some of the potential erosion and sedimentation impacts and states that a erosion and sediment control plan will be developed but does not detail what is to be included in the plan.</p> <p>Recommendation:</p> <p>An Erosion and Sediment Control Plan must be included in the EM Plan and must include but not necessarily be limited to the following:</p> <ul style="list-style-type: none"> • diverting uncontaminated stormwater run-off around areas disturbed by petroleum activity(ies) or where contaminants or wastes are stored or handled that may contribute to stormwater; • ensuring that contaminated stormwater runoff and incident rainfall is collected, treated, reused, or released in accordance with the conditions of this environmental authority; • roofing or minimising the size of areas where contaminants or wastes are stored or handled; • identification of erosion risks areas; • implementation of preventative and control procedures for identified erosion risk areas; • procedures for avoiding disturbance to riparian areas; • topsoil management procedures, including but not limited to: <ul style="list-style-type: none"> – stripping and storing topsoil during clearing and grading activities for restoration and/or decommissioning; <ul style="list-style-type: none"> – stabilisation of topsoil stockpiles; – minimisation of loss of topsoil due to erosion; – seeding of long term topsoil stockpiles to prevent erosion; – locating topsoil stockpiles in areas segregated from construction works activities and to minimise soil structure degradation; – constructing a diversion drain around the topsoil stockpile area; – implementing erosion control measures around the topsoil stockpile area; and • identification of vegetated buffer strips between construction works and wetlands and surface water boundaries; 		<p>An erosion and sediment control plan will be developed for the project as outlined in EIS Chapter 12, Geology, Landform and Soils, Section 12.6.4.</p> <p>Due to the site-specific nature of erosion and sediment control, controls will be tailored to reflect the specific impacts and mitigation measures required for individual sites. The Best Practice Erosion and Sediment Control Manual (IECA, 2008) will be used in the preparation of the erosion and sediment control plan.</p> <p>EIS Attachment 5, Environmental Management Plan (EMP), which has been updated in SREIS Attachment 2, Strategic Environmental Management Plan (Strategic EMP), is a preliminary document that will be further developed to support the application for development approval of all of the project components.</p> <p>Statutory information requirements, including details on erosion and sediment control will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16t (cont'd)	<ul style="list-style-type: none"> • procedures for revegetating disturbed areas as soon as practicable after the completion of works; • using materials and / or processes (such as dry absorbents) to clean up spills that will minimise contamination of waters; • placing erosion and sediment control structures to minimise erosion of disturbed areas and prevent the contamination of waters; • an inspection, maintenance and monitoring program for the erosion and sediment control measures, including but not limited to; <ul style="list-style-type: none"> – silt fences on a daily basis; – erosion and sediment control devices on a daily basis; – disturbed areas; – topsoil stockpile areas; and – stormwater drainage channels. • provision for adequate access to maintain all erosion and sediment control measures especially during the wet season months from November to April; • additional erosion and sediment control measures for construction of on slopes >10%; • a surface water monitoring program designed to detect sediment runoff into watercourses; • identification of remedial actions that would be required to ensure compliance with the conditions of this environmental authority; and; • details of community consultation strategies and processes to be used in further developing and implementing the Erosion and Sediment Control Plan. 		
16u	<p>Issue: Release of water to land</p> <p>Table 4.7 of the EM Plan lists avoiding excessive watering of saline soils and of surface-crusting soils as an implementation strategy for land degradation. It is unclear in Section 4.2.2 what activities would be occurring as part of the Surat Gas Project that would require the watering of soils.</p> <p>Recommendation:</p> <p>The EM Plan must be revised to identify the proposed activities that may result in excessive watering of soils.</p>	<p>EIS</p> <p>Attachment 5, Table 4.7</p>	<p>Arrow does not propose the release of water to land as part of its construction and operation activities other than for dust suppression. The commitment in Table 4.7 relates to an acknowledged risk to cracking clays (vertisols) from excessive watering. Due to the high water holding properties of vertisols there is potential for leaching of salts and the formation of surface crusts. The commitment was included in the EIS to protect Good Quality Agricultural Land and potential Strategic Cropping Land.</p> <p>The discharge of hydrostatic test water and treated effluent will be regulated under the appropriate approval and detailed in applications for or to amend Environmental Authorities. This will necessitate site assessments of the suitability of the receiving environment including the potential for adverse effects on productive soils.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16u (cont'd)	<p>If any activities are proposed that involve releasing water to land (such as dust suppression, irrigation of treated sewage effluent, release of hydrostatic test water and / or low point drains to land etc) they must be clearly identified in the EM Plan with an evidence based assessment for each treatment or disposal proposal. This must include but not necessarily limited to:</p> <ul style="list-style-type: none"> • a description of the system: <ul style="list-style-type: none"> – its peak design capacity in equivalent persons – proposed plant specification and performance – proposed operational parameters • the systems operation, maintenance, and management arrangements • the proposed method of disposal for treated wastewater (such as effluent and biosolids including water, salt and nutrient balances if proposing to dispose treated effluent to land) and the method of application (e.g. drip irrigation, spray irrigation) • detailed site information for the receiving land using MEDLI modelling or equivalent including: <ul style="list-style-type: none"> – topography including flooding potential – climatic conditions affecting the land – proposed location and area of the relevant land – the existing soil characteristics and vegetation cover – the potential impacts and mitigation measures to protect soil and vegetation – potential infiltration of the wastewater to groundwater – potential generation of odour from wastewater – impact of any transfer or run-off of contaminants from the relevant land to surface waters – the ongoing availability of the land for the release of the wastewater • details of a monitoring program to assure the performance of the system and that adverse environmental impacts are prevented. 		<p>Arrow's Coal Seam Gas Water and Salt Management Strategy includes the option to provide coal seam gas water to third parties as part of a beneficial use network. Arrow will supply water that meets the water quality requirements of the end use. The beneficiary of the water will be responsible for any environmental effects associated with its use.</p>
16v	<p>Issue: Landscape and visual amenity</p> <p>Section 4.3.2 of the EM Plan does not include regulated structures as a potential impact to the landscape and visual amenity. Table 4.8 of the EM Plan includes implementation strategies for various locations. However, no locality map has been provided indicating the specific areas that will be avoided. Also details regarding the specific management of various strategies discussed have not been included.</p>	<p>EIS Chapter 18, Figure 18.4 and Attachment 5, Section 4.3.2</p>	<p>EIS Attachment 5, Environmental Management Plan (EMP), which has been updated in SREIS Attachment 2, Strategic Environmental Management Plan (Strategic EMP), is a preliminary document that will be further developed to support the application for development approval of all of the project components.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16v (cont'd)	<p>There is no mention in Section 4.3 of the EM Plan regarding whether horizontal directional drilling is proposed for wells/well pads to minimise disturbance and impacts on visual amenity.</p> <p>Recommendation:</p> <p>The EM Plan must be revised to include the following:</p> <ul style="list-style-type: none"> • A discussion of the impact on the landscape and visual amenity due to regulated structures; • Locality map/s depicting the areas that will be avoided, the areas that require specific management and the areas that are preferred for development; • Specify the length and the maximum width required for road and tracks. Also specify the minimum width required for roads and tracks in Environmentally Sensitive Areas (ESAs); • Whether HDD wells/well pads are proposed to minimise disturbance and impacts on visual amenity; • Detail how the construction time will be minimised near sensitive visual receptors. 	<p>SREIS</p> <p>Attachment 2, Section 4.3.2</p>	<p>EIS and SREIS Section 4.3.2 explains that during operations, the presence and operation of production wells, gathering lines, power reticulation, production facilities and associated infrastructure (i.e., regulated structures) could disrupt landscape character, views and visual amenity. EIS Chapter 18, Landscape and Visual Amenity, Figure 18.4 presents a map of the sensitive visual receptors identified in the project development area.</p> <p>Statutory information requirements, including details of management and implementation strategies to minimise the impact to landscape and visual amenity will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p>
16w	<p>Issue: Environmentally Sensitive Areas</p> <p>Figure 4.9 in the EM Plan shows the Environmentally Sensitive Areas (ESA) located within the Surat Gas Project area but a list of the ESA types that are present has not been included. There is no discussion on the ESAs that the proponent will require access to or that will require disturbance.</p> <p>Recommendation:</p> <p>In the EM Plan, identify and detail the ESAs present on the Surat Gas Project area. Discuss which ESAs the proponent will require access to and the extent of the proposed disturbance to the ESAs. Discuss whether disturbance to the ESAs can be avoided or minimised. This information may be arranged in a tabular form.</p>	<p>SREIS</p> <p>Chapter 11, Attachment 2 and Attachment 7</p>	<p>ESAs within the project development area has been included in SREIS Attachment 2, Strategic EMP, Figures 4.6a,b and c.</p> <p>A conceptual field layout has been used to develop maximum clearing footprints as part of the offsets framework. A description of the process used to calculate the disturbance area and the estimated area of disturbance is included in SREIS Chapter 11, Terrestrial Ecology, and Attachment 7, Draft Environmental Offsets Strategic Management Plan.</p> <p>At this stage, beyond known properties, the location of infrastructure is unknown, and the area of disturbance based on a conceptual field development layer. Statutory information requirements, including details of ESAs will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p>
16x	<p>Issue: Regional Ecosystems</p> <p>Section 4.4.1 of the EM Plan has included the number of regional ecosystems (RE) and a locality map of the RE's according to their Vegetation Management Act 1999 status. There is no listing of each of the RE's and their status provided in the EM Plan.</p>	<p>SREIS</p> <p>Chapter 11, Attachment 2, Section 4.4.1 and Attachment 6</p>	<p>A list of regional ecosystems within the project development area and their status (both biodiversity and listing under the Vegetation Management Act 1999) has been included in SREIS Attachment 2, Strategic Environmental Management Plan, Section 4.4.1. These are shown in Figures 4.6a, 4.6b and 4.6c.</p> <p>Further work undertaken for the SREIS Chapter 11, Terrestrial Ecology, Section 11.5 demonstrates a targeted approach to how Arrow will continue to refine knowledge of regional ecosystem extent a presence of fauna and flora habitat. Through the refinement of vegetation mapping and the use of planning and design tools, Arrow will aim to avoid sensitive areas.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16x (cont'd)	<p>Recommendation: Provide a list of the regional ecosystems mapped in the Surat Gas Project Area in the EM Plan. Include the status of each regional ecosystem and the total area (in hectares) of disturbance proposed for each RE. Include the status of each RE under the Vegetation Management Act 1999 and the biodiversity status. This information may be arranged in a tabular form.</p>		<p>Potential site locations (beyond the five potential locations presented in the SREIS) have not yet been determined. The environmental framework incorporates constraints maps which inform site selection, with the aim to avoid sensitive areas.</p> <p>Updated regional ecosystem information is presented in SREIS Chapter 11, Terrestrial Ecology and SREIS Attachment 6, Draft Environmental Offsets Strategic Management Plan. Information in Attachment 6 on estimated areas of disturbance is based on a conceptual field development layer and will be further refined prior to construction, once the framework approach is fully implemented.</p>
16y	<p>Issue: Animal breeding places Section 4.4.1 of the EM Plan does not include a discussion of the existing animal breeding places located in the Surat Gas Project Area.</p> <p>Recommendation: Revise the EM Plan to include a description of the existing animal breeding places, how any future animal breeding places will be identified and how animal breeding places will be managed to reduce impacts.</p>	<p>EIS Chapter 17, Table 17.8</p> <p>SREIS Attachment 1, Appendix C and Attachment 5</p>	<p>EIS Chapter 17, Terrestrial Ecology, Table 17.8 identifies breeding places in the existing environment of the project development areas. Species dossiers are presented in SREIS Attachment 1, Matters of National Environmental Significance (MNES) for each MNES species. These will include details of species ecology such as breeding places and breeding ecology. Information contained in these dossiers will be used to update Arrow's preconstruction clearance survey procedures to reduce impacts on animal breeding places.</p> <p>EIS Attachment 5, Environmental Management Plan (EMP), which has been updated in SREIS Attachment 2, Strategic Environmental Management Plan, is a preliminary document that will be further developed to support the application for development approval of all of the project components.</p> <p>Statutory information requirements will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p>
16z	<p>Issue: Areas with high ecological significance values Section 4.4 of the EM Plan has not addressed all of the areas with high ecological significance values (HES values) such as protected estate (protected areas under the Nature Conservation Act 1992 (NC Act)) and wetlands that are present within the Surat Gas Project area.</p> <p>Recommendation: The EM Plan must clearly identify all areas with HES values that are present in the Surat Gas Project area. HES values include protected estate (protected areas under the NC Act), World Heritage Areas, marine parks, wetlands, habitat for endangered, vulnerable, rare or near threatened species (listed under the NC Act and Environment Protection and Biodiversity Conservation Act 1999), and regional ecosystems that are endangered, or of concern, or have other significant values (e.g. wetlands, nationally threatened ecological communities, large tracts of remnant vegetation, corridors and special biodiversity areas).</p>	<p>EIS Attachment 5 and Appendix K</p> <p>SREIS Attachment 2 and Appendix 9</p>	<p>Areas with high ecological significance values have been identified in EIS Appendix K, Terrestrial Ecology Impact Assessment. This information has been updated for the purposes of the SREIS and is included in SREIS Appendix 9, Terrestrial Ecology Assessment, and referenced in SREIS Attachment 2, Strategic EMP.</p> <p>EIS Attachment 5, Environmental Management Plan (EMP), which has been updated in SREIS Attachment 2, Strategic Environmental Management Plan (Strategic EMP), is a preliminary document that will be further developed to support the application for development approval of all of the project components.</p> <p>Statutory information requirements will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16aa	<p>Issue: State significant biodiversity values</p> <p>Section 4.4 of the EM Plan has not identified the state significant biodiversity values that are mapped on the Surat Gas Project area.</p> <p>Recommendation:</p> <p>The EM Plan must include identification of all state significant biodiversity values, which are regional ecosystems, essential habitat, wetlands, watercourses, legally secured offset areas and connectivity areas provided in Appendix 1 of the Queensland Biodiversity Offset Policy.</p>	<p>EIS</p> <p>Attachment 5 and Appendix K</p> <p>SREIS</p> <p>Attachment 2 and Attachment 6, Section 7</p>	<p>Areas with state significant biodiversity values have been identified in EIS Appendix K, Terrestrial Ecology Impact Assessment. This information has been updated for the purposes of the SREIS and is included in SREIS Appendix 9, Terrestrial Ecology Assessment, and referenced in SREIS Attachment 2, Strategic EMP. A summary of Arrow's activities against state significant biodiversity values under the Queensland Biodiversity Offset Policy is provided in Attachment 6, Draft Environmental Offsets Strategic Management Plan, Section 7.</p> <p>EIS Attachment 5, Environmental Management Plan (EMP), which has been updated in SREIS Attachment 2, Strategic Environmental Management Plan, is a preliminary document that will be further developed to support the application for development approval of all of the project components.</p> <p>Statutory information requirements will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p>
16ab	<p>Issue: Strategic Cropping Land</p> <p>The EM Plan does not adequately address the implications of Strategic Cropping Land (SCL) covering 49% of the Surat Gas Project area. There is no discussion in the EM Plan regarding part of the project area being located in the Southern SCL Protection Area and whether any impacts are proposed on SCL.</p> <p>Recommendation:</p> <p>If impacts to SCL are proposed, the EM Plan must include information regarding the proposed activities that will impact SCL, their location and amount of land affected, the soil type and local and regional soil mapping and any ground truth data, soil surveys, monitoring or advice obtained by experts.</p> <p>Constraints mapping should be provided in the EM Plan showing the proposed activities in relation to potential SCL (in the SCL Management Area and Southern SCL Protection Area) and ESA's, sensitive receptors etc.</p>	<p>SREIS</p> <p>Chapter 2 and Chapter 7</p>	<p>Strategic Cropping Land is administered under the Strategic Cropping Land Act 2011. Arrow will comply with requirements of the Strategic Cropping Land Act, and other relevant legislation as discussed in SREIS Chapter 2, Project Approvals and Chapter 7, Agriculture.</p>
16ac	<p>Issue: Hydrostatic test water</p> <p>Section 4.6.2 of the EM Plan refers to hydrostatic test water but the EM Plan does not include adequate detail on the water including where it is sourced, whether additives are required and how it is stored and disposed.</p> <p>Recommendation:</p> <p>The EM Plan must include sufficient information regarding hydrostatic test water including but not limited to:</p> <ul style="list-style-type: none"> • The quantity of water required; • Where the water will be sourced; 	<p>EIS</p> <p>Chapter 5</p> <p>SREIS</p> <p>Chapter 3</p>	<p>As described in EIS Chapter 5, Project Description, and SREIS Chapter 3, Project Description, Arrow intends to be independent of the public water infrastructure for construction purposes to the maximum practicable extent. SREIS Chapter 3, Project Description further explains that hydrostatic test water is normally obtained from existing sources in proximity to where the testing will occur, such as property dams and local watercourses. Where required, environmental approvals will be obtained from the government or the owner of the water. Options from which to source and dispose of the water will be explored with the aim to maximise efficiency of testing, reduce the timing of construction and commissioning and exhibit environmental good practice.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16ac (cont'd)	<ul style="list-style-type: none"> • Whether additives are required and if so, identify the additives; • How the water will be stored; • How the water will be disposed. If disposal to land is proposed then the Recommendations discussed in 'Issue: Release to land' above must be addressed. 		<p>Arrow has made a commitment (Commitment C168) to develop and implement a hydrostatic testing procedure prior to commencement of hydrostatic testing activities.</p> <p>Consultation with landholders and relevant regulatory authorities will occur prior to sourcing and disposing of hydrostatic test water. Hydrostatic test water that is discharged or recycled for secondary uses will meet relevant statutory water quality guidelines.</p> <p>Statutory information requirements, including details on hydrostatic test water management will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p>
16ad	<p>Issue: Flood modelling</p> <p>The EM Plan does not address the proposed management and location of infrastructure in floodplains.</p> <p>Recommendation: Demonstrate in the EM Plan that consideration has been given to the natural flow paths on floodplains in the Surat Gas Project area. Provide flood modelling in the EM Plan to determine the proposed infrastructure (including the depth of flowlines and pipelines in floodplains) is designed and located in the most suitable location to minimise the impacts of flooding. Provide a map showing the location of the proposed infrastructure on the Surat Gas Project area, indicating where the proposed infrastructure is to be located in any floodplains.</p>	<p>SREIS</p> <p>Chapter 9, Section 9.5, Attachment 2, Figures 9.11, 9.12 and 9.13</p>	<p>Arrow has committed to site facilities above the 1-in-100-year average flood recurrence interval where practicable, and design infrastructure taking into consideration overland flow and flooding regimes to reduce impacts on immediate and surrounding areas. An overland flow and flooding regime assessment is presented in SREIS Chapter 9, Surface Water, Section 9.5, and for the properties where four central gas processing facilities and one TWAF. Figures 9.11, 9.12 and 9.13 show the predicted 1-in-100-year ARI flood extent and depth for the receiving environment of the CGPF2, CGPF7, CGPF8, CGPF9 and TWAF F properties.</p> <p>SREIS Attachment 2, Strategic EMP provides an update to the EMP which identifies high level management controls for the project. These controls, and any additional site-specific controls, will be set out in the statutory information requirements to support the application for an environmental authority (EA) or an EA amendment, in accordance with EHP Guideline "Application requirements for petroleum activities".</p> <p>The location and design of infrastructure will have regard to flood mapping and natural flow paths on floodplains. Maintenance of overland flow will be a key input to route selection and rehabilitation methods that will be determined at a property level. Further details will be made available after the completion of detailed field development planning which is yet to be completed. Statutory information requirements will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p>
16ae	<p>Issue: Discharge to waters</p> <p>Section 4.8 of the EM Plan briefly discusses the possibility of discharging to water in some situations. If discharge to water is proposed a comprehensive evidenced based assessment is required which addresses the environmental values of the surface water, a characterisation of the proposed discharge water quality and velocity, volume, rate and timing of the release and whether it is compatible with the natural flow regime.</p>	<p>EIS</p> <p>Attachment 5</p> <p>SREIS</p> <p>Attachment 2</p>	<p>EIS Attachment 5, Environmental Management Plan (EMP), which has been updated in SREIS Attachment 2, Strategic Environmental Management Plan (Strategic EMP), is a preliminary document that will be further developed to support the application for development approval of all of the project components.</p> <p>Exact locations of proposed discharge points have not yet been identified and studies undertaken for the SREIS will inform siting of infrastructure and discharge points.</p> <p>Arrow recognises that specific assessment is required for approval under the Water Supply (Safety and Reliability) Act which will involve modelling of both flows and quality and the potential to impact on water supply providers.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16ae (cont'd)	<p>Recommendation:</p> <p>If discharge to waters is proposed for the Surat Gas Project, the EM Plan must include an evidence based assessment addressing the hydrological and ecological impacts on the watercourse/s from the release of water. The following must be included in the EM Plan:</p> <ul style="list-style-type: none"> • a location (coordinates in latitude and longitude (GDA94)) and description of each release point ; • contaminant source; • monitoring points specifying the name, coordinates in latitude and longitude (GDA94) and receiving water location description; • description of the receiving waters at each release point; • maximum release volume of contaminants (ML/d); • contaminant release limits for each monitoring point including the quality characteristic, the release limit, the limit type and the minimum monitoring frequency; • velocity, volume and rate of release; • timing of the release; • method of release; • depth and length of the discharge pipe diffuser; • environmental values of the surface water including the environmental values of the aquatic ecosystem to be enhanced or protected under the EPP Water including: <ul style="list-style-type: none"> – uses of water that are conducive to a healthy ecosystem and that require protection from the effects of habitat alteration, waste releases, contaminated runoff and changed flows; – aquatic ecosystems to be enhanced or protected under this policy includes the attributes of the water's aquatics ecosystem including its biota, physical form, riparian vegetation, flow and physiochemical water quality. • the management goals, management intent and water quality objectives of the surface water as per the EPP Water and the Queensland Water Quality Guidelines, State and Regional planning documents as well as ANZECC Guidelines 		<p>Further details will be made available after the completion of detailed field development planning which is yet to be completed. Statutory information requirements will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16ae (cont'd)	<ul style="list-style-type: none"> • a description of the character and resilience of the surface water including: <ul style="list-style-type: none"> – identification of potentially impacted water bodies and catchment areas (to the most downstream point where impacts could occur) – the pre-development flow regime conditions and definition of background hydrological conditions in the surface water system including the proposed release site and details on the current hydrological regime. Where possible, this should include modelling (e.g. IQQM for larger catchment scales, GoldSim for smaller catchment scales) using available hydrological data and agreed modelling assumptions. Modelling must be supported by an interpretation of the results and justification that the models have been used appropriately. 		
16af	<p>Issue: Criteria for magnitude for the impact assessment method</p> <p>Table 14.4 of the EIS states the criteria for magnitude of an impact which includes the duration of the impact. Time periods are not quantified as terms such as “persist over time”, “short durations”, medium-term” and “long-term” are used. Groundwater resources with differing characteristics can influence the extent to which time affects the magnitude of impacts; therefore time periods should be quantified to clearly articulate the impact assessment method.</p> <p>Recommendation:</p> <p>The EIS must be revised to quantify the time periods for magnitude criteria to clearly articulate the impact assessment method. This information should be summarised in the EM Plan.</p>	<p>EIS</p> <p>Chapter 14 and Appendix G</p> <p>SREIS</p> <p>Chapter 8 and Appendix 4</p>	<p>The time scale component of the magnitude rankings developed for the groundwater impact assessment (EIS Chapter 14 and EIS Appendix G, Groundwater Impact Assessment) reflect the range in the length that time impacts may persist within aquifers, as follows:</p> <ul style="list-style-type: none"> • Very low magnitude rankings reflect impacts that could persist up to a month, or would not be readily noticeable within the aquifer, or would be difficult to distinguish from natural causes or variation. • Low magnitude rankings reflect impacts that may persist for up to a year. • Moderate magnitude rankings reflect impacts that may persist for up to a decade. • High magnitude rankings reflect impacts that may persist for up to a century. • Very high magnitude rankings reflect impacts that may persist for hundreds of years, or impacts that would be considered permanent. <p>These time frame ranges were applied in the impact assessment presented in the EIS, and the outcomes therefore do not vary from those presented. Given that the EIS is a finalised document; this information will not be revised and re-presented. The results of the revised groundwater model are presented in SREIS Chapter 8, Groundwater and Appendix 4, Groundwater Impact Assessment, and demonstrate that the magnitude of impacts identified in the EIS are not exceeded and can be managed in accordance with the mitigation measures identified in the EIS.</p> <p>Statutory information requirements will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16ag	<p>Issue: Groundwater dependent ecosystems</p> <p>Section 14.3.3 of the EIS acknowledges wetlands, vegetation and base flows dependent on groundwater but does not identify the location of these.</p> <p>Figure 14.6 of the EIS does not identify Great Artesian Basin (GAB) watercourse springs or wetlands, vegetation and groundwater dependent base flows from non-GAB formations.</p> <p>Recommendation:</p> <p>The EIS and EM Plan must identify the location of all wetlands, vegetation and base flows dependent on groundwater from both GAB formations and shallow non-GAB formations.</p> <p>Chapter 14 of the EIS must be amended to include provisions for these groundwater dependent ecosystems.</p>	<p>EIS</p> <p>Chapter 14</p> <p>SREIS</p> <p>Chapter 8</p>	<p>Additional information on groundwater and surface water interaction is presented in SREIS Chapter 8, Groundwater.</p> <p>The management of any potential impacts on groundwater dependant springs will be regulated by the Office of Groundwater Impact Assessment (OGIA) and the tenure holder for the tenure in which the spring is located. There are no groundwater dependent springs mapped by the OGIA within the project development area.</p> <p>The location of groundwater/surface water interactions within the project development area is presented in SREIS Chapter 8, Groundwater. Knowledge of areas of interaction will be refined as Arrow conducts interconnectivity studies endorsed by the OGIA. This scope of work is described in SREIS Chapter 8, Groundwater.</p> <p>Statutory information requirements will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p>
16ah	<p>Issue: Groundwater Monitoring</p> <p>The TOR states that the EIS should describe a monitoring program, including a network of observation points that would satisfactorily monitor groundwater resources both before and after commencement of operations. Section 14.8 of the EIS states the objectives of the groundwater monitoring and inspection program but does not describe the network of observation points, parameters to be measured, frequency of monitoring and trigger values that would satisfactorily monitor groundwater resources.</p> <p>The 'implementation strategy for construction' and 'Inspection and monitoring' section of Table 4.16 of the EM Plan, does not state the parameters to be monitored or the frequency of measurements. In addition, details of locations and formations are not provided.</p> <p>Table 4.16 also states that 'The number of monitoring bores or associated monitoring frequencies will be increased and further investigation will be triggered where impacts are identified'. No further details are given regarding what any further investigation will entail.</p> <p>Recommendation:</p> <p>The groundwater monitoring and inspection program in the EIS and EM Plan must:</p> <ul style="list-style-type: none"> • identify a network of locations, formations and parameters to be monitored and the frequency of measurements; and • identify trigger values or detail the process for developing the trigger values for the parameters to be measured; 	<p>SREIS</p> <p>Chapter 8</p>	<p>Arrow will implement a water monitoring strategy in accordance with the Underground Water Impact Report for the Surat Cumulative Management Area. EHP will be responsible for regulating compliance by petroleum tenure holders with their underground water obligations. Chapter 8, Groundwater describes Arrow's Groundwater Monitoring Strategy.</p> <p>Statutory information requirements will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p> <p>It is likely that groundwater management programs will be required to be developed as a condition of the environmental authority (EA) or EA amendment. As such, the details of the monitoring plan, including the approximate locations of monitoring wells, the frequency of monitoring and the type of data to be collected will be provided in response to the conditions of the EA.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16ai	<p>Issue: Regional Hydrogeology</p> <p>Section 4.5.1 of the EM Plan only discusses GAB formations and the Condamine River Alluvium. Discussion of the other non-GAB formations has not been included in the EM Plan.</p> <p>Recommendation:</p> <p>The EM Plan must include all other non-GAB formations in the tenement area and/or the groundwater model area into the EM Plan.</p> <p>These formations should include but not be limited to:</p> <ul style="list-style-type: none"> • Border River Alluvium • Main Range Volcanics • Chinchilla Sands • Nobby Basalts • Oakey Ck Alluvium • Upper Hodgeson Ck Alluvium • Dalrymple Ck Alluvium • Kings Ck Alluvium • Myall & Moola Creek Alluvium • Swan Creek Alluvium. 	<p>EIS</p> <p>Chapter 12, Chapter 14 and Attachment 5</p>	<p>The groundwater information presented in EIS Attachment 5, Environmental Management Plan is based on the groundwater impact assessment and associated technical report. In these reports, the hydrogeology within the study area is presented as groundwater systems (i.e., shallow, intermediate, coal seam gas and deep groundwater systems).</p> <p>The shallow groundwater system within the project development area is dominated by the Condamine Alluvium. The other alluvial formations identified by EHP are more limited in extent and not targeted by the impact assessment, having been incorporated into the shallow groundwater system as a whole.</p> <p>The Main Range Volcanics (which include the Nobby Basalts) are identified in EIS Chapter 14. They exist outside the project development area, but within the groundwater model extent. They are represented in the assessment as a groundwater recharge zone (basaltic upland areas).</p> <p>The Chinchilla Sands are acknowledged in EIS Chapter 12, Geology, Landform and Soils, however, are not included in the description of the regional hydrogeology due to their limited distribution and localised nature (i.e., not a regional aquifer).</p> <p>Further details will be made available after the completion of detailed field development planning. Arrow will set out in the statutory information requirements to support the application for an environmental authority (EA) or an EA amendment, in accordance with EHP Guideline “Application requirements for petroleum activities”.</p> <p>Details of the monitoring plan, including the specific groundwater conditions and the distribution of specific alluvial or volcanic units that do not form part of the Great Artesian Basin will be included in statutory information requirements.</p> <p>Note that the Underground Water Impact Report (UWIR) prepared by Office of Groundwater Impact Assessment (OGIA) did not consider the following formations:</p> <ul style="list-style-type: none"> • Border River Alluvium. • Nobby Basalts. • Oakey Ck Alluvium. • Upper Hodgeson Ck Alluvium. • Dalrymple Ck Alluvium. • Kings Ck Alluvium. • Myall & Moola Creek Alluvium. • Swan Creek Alluvium. <p>The UWIR prepared by OGIA includes information on these formations:</p> <ul style="list-style-type: none"> • Main Range Volcanics. • Chinchilla Sands.

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16ai (cont'd)			However, they are included in the description of the stratigraphy, and do not form part of the model by way of aquifers included in the drawdown predictions.
16aj	<p>Issue: Summary of groundwater values & biological integrity able to be maintained by groundwater systems</p> <p>The EM Plan does not include a description of all springs and groundwater dependant ecosystems, particularly GAB watercourse springs and any potential springs connected to non-GAB formations.</p> <p>Table 4.13 of the EM Plan describes the biological integrity able to be maintained by groundwater systems. The EM Plan provides no further supporting evidence on how the value of the groundwater dependant ecosystems was determined. For example, the Condamine Alluvium is predominantly able to maintain slightly to moderately disturbed ecological systems.</p> <p>Recommendation:</p> <p>The EM Plan must identify and include a description of all springs and groundwater dependant ecosystems and a description of their values were determined.</p>	<p>SREIS Chapter 8</p>	<p>Based on the findings of the Queensland Water Commission report with respect to springs (QWC, 2012a), additional information provided on groundwater/surface water interactions, is presented in SREIS Chapter 8, Groundwater.</p> <p>The management of any potential impacts on groundwater dependant springs will be regulated by the Queensland Government Office of Groundwater Impact Assessment (OGIA) and the tenure holder for the tenure within which the spring is located. There are no groundwater dependent springs mapped by OGIA within the project development area.</p> <p>The location of groundwater/surface water interactions within the project development area is presented in SREIS Chapter 8, Groundwater, and is based on available desktop and literature information. These areas of interaction will be refined as Arrow conducts interconnectivity studies endorsed by OGIA. This scope of work is described in SREIS Chapter 8.</p> <p>Statutory information requirements, including relevant details of groundwater values will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p>
16ak	<p>Issue: Management measures for groundwater across all project related activities</p> <p>The EM Plan must clearly identify specific impacts that are being addressed, the extent to which the strategy may minimise these impacts and propose performance indicators that could be used to assess the effectiveness of the strategy.</p> <p>Table 4.16 of the EM Plan outlines the management measures for each issue including performance criteria and implementation strategies. The performance criteria is not measurable as the terms "adversely affected", "maintained" and "respond" have not been defined.</p> <p>Recommendation:</p> <p>The EM Plan must be revised to include proposed measurable performance indicators which can be used to assess the effectiveness of the management measures.</p>	<p>SREIS Chapter 2</p>	<p>Statutory information requirements, including relevant details of groundwater values and proposed groundwater monitoring programmes will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p>
16al	<p>Issue</p> <p>Page 4-80, Areas of environmental sensitivity</p> <p>Oakey Creek has been "designated highly sensitive" in the specialist report but has been omitted in the EMP.</p>	<p>EIS Chapter 16 and Appendix J</p>	<p>Upstream of Oakey Creek has been assigned a high sensitivity value, as it provides habitat for locally threatened species. The locally threatened species identified, were recorded 48 km upstream of the project development area.</p> <p>As no project activities will occur in Oakey Creek (upstream of site C), direct impacts on aquatic habitat will not occur; however, indirect impacts are possible. The presence of buffers around this site will reduce the potential for, and magnitude of, indirect impacts.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16al (cont'd)	<p>Recommendation</p> <p>As mentioned above, the EIS chapter and EMP need to include Oakey Creek as an area of high environmental sensitivity.</p>	<p>SREIS</p> <p>Chapter 10 and Appendix 8</p>	<p>Further discussion of aquatic ecology values is included in SREIS Chapter 10, Aquatic Ecology and SREIS Appendix 8, Supplementary Aquatic Ecology Assessment.</p> <p>Statutory information requirements will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p>
16am	<p>Issue</p> <p>Pages 4-80/4-81, Permanent and semi-permanent watercourses</p> <p>Summary of the existing environment does not represent exactly what the specialist report stated. This statement when read alone is misleading.</p> <p>For example the EMP states "Surveys of the permanent and semi-permanent watercourses within the project development area indicate that the aquatic flora is in very poor condition and that the fish and aquatic reptile species present are generally resilient species that tolerate a wide range of conditions."</p> <p>While this is partly accurate, the specialist report states on page 60: "Permanent and semi-permanent streams are considered to have a moderate sensitivity to impacts associated with the project because: They support a number of species of conservation significance, including Murray cod, golden perch and silver perch, although the value of these communities is reduced by the fact that they are maintained by artificially restocking. [...]"</p> <p>And further down: "Ranging from minimally disturbed to highly disturbed, these systems contain many areas of good quality aquatic habitat that are known to support a relatively diverse range of aquatic species including fish, turtles and invertebrates.</p> <p>Spawning habitat for aquatic species is present but does not represent critical spawning habitat. [...]"</p> <p>On page 48 the reports reads: "Combined, the OE50 and OE50 Signal scores indicate that while the sampling sites have been substantially impacted by current catchment activities, pollution-sensitive taxa are still abundant, suggesting the most significant impact to the system is water extraction, rather than a combination of water extraction and pollution caused by anthropogenic influences such as poor management of agricultural runoff (Figure 4.3)."</p> <p>Recommendation</p> <p>Rephrase this section to represent the balanced findings of the specialist. There is no need to re-write this section if the specialist report already presented a more than adequate summary.</p>	<p>SREIS</p> <p>Chapter 10 and Appendix 8</p> <p>SREIS</p> <p>Chapter 10</p>	<p>Noted. Further details of the aquatic ecology values of the project development area are presented in SREIS Appendix 8, Supplementary Aquatic Ecology Assessment and summarised in SREIS Chapter 10, Aquatic Ecology.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16an	<p>Issue Pages 4-82/4-86, Table 4.19</p> <p>Management strategies discussed in the specialist report (e.g. p. 83) have not been incorporated, such as a Vegetation management plan for riparian vegetation, topsoil management, placing of soil and clearing of riparian vegetation and other points outlined above.</p> <p>These include, but are not limited, to:</p> <ul style="list-style-type: none"> • Streamline mitigation measures outlined in the specialist report, the EIS chapter and the EMP to allow for a direct comparison and cross-checking. • The Oakey Creek has been identified as one of two “highly constrained” zones and will need to be discussed in full, including impact assessment and mitigation, in the EIS chapter and EMP. Include the environmental significance, avoidance, mitigation and management measures of the Oakey Creek in the EIS and EMP. • Furthermore, mitigation measures outlined in the specialist report, the EIS chapter and the EMP outline each a different approach, which makes a direct comparison and cross-checking impossible. • Avoid general comments in the mitigation measures section and specify mitigation measures outlined in the specialist report (i.e. state the buffer zones listed in the report). Include the same in the EMP. • Impacts on migration and movements of fauna (fish, turtle) will need to be included, especially in context to the pipeline construction through waterways (open-cut waterway crossings (cofferdams)). • Emergency discharge of CSG water should include additional details of the possible impacts on downstream aquatic flora and fauna. <p>Recommendation Include all issues discussed above which directly relates to the EMP.</p>	<p>EIS Attachment 8 and Attachment 5 SREIS Chapter 9 and Chapter 10</p>	<p>Commitments have unique numbers which are set out in EIS Attachment 8, Commitments and EIS Attachment 5, Environmental Management Plan (EMP), allowing the reader to trace them through the documents. The management measures in the technical specialist reports were rationalised to eliminate redundancy across separate studies, and therefore are not identified by unique number, nor re-produced in the EMP verbatim.</p> <p>Impacts on migration and movements of fauna (fish, turtle), especially in context to the pipeline construction through watercourses (open-cut watercourse crossings (cofferdams)) are addressed generally in the EIS and SREIS, and will be specifically addressed in watercourse barrier permits at a later date, when actual locations are known.</p> <p>Upstream of Oakey Creek has been assigned a high sensitivity value, as it provides habitat for locally threatened species. The locally threatened species identified, were recorded 48 km upstream of the project development area.</p> <p>As no project activities will occur in Oakey Creek (upstream of site C), direct impacts on aquatic habitat will not occur; however, indirect impacts are possible. The presence of buffers around this site will reduce the potential for, and magnitude of, indirect impacts.</p> <p>The SREIS has undertaken extensive site-specific surveys at two proposed discharge locations, to validate the findings of the EIS and to provide further mitigation measures where appropriate. The findings of these surveys are outlined in SREIS Chapter 9, Surface Water.</p> <p>Statutory information requirements will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p>
16ao	<p>Issue Pages 4-84, Table 4.19</p> <p>The EMP contains statements like “relevant buffer”, “routinely”, “minimise”, “procedures” (and other non-descriptive terminology) but little information is given how these mitigation and management measures have to and can be achieved.</p>	-	<p>Mitigation measures have undergone further refinement for the SREIS, although will require further detail in site specific plans to be developed once locations of infrastructure are confirmed.</p> <p>Statutory information requirements, including definitions will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16ao (cont'd)	<p>Recommendation</p> <p>Management and mitigation measures stated in the EMP must be more specific. For example, define the buffer zones (as per specialist report) and intervals of routine monitoring, state clear mitigation measures and outline how disturbance can be minimised.</p>		
16ap	<p>Issue: Environmental management plan (EM Plan) for Coal Seam Gas (CSG) environmental authority required</p> <p>The Surat Gas Project will require a coal seam gas environmental authority as defined under section 310D(7) of the Environmental Protection Act 1994 (EP Act). The EM Plan provided in Attachment 5 of the EIS has not been developed in accordance with the 'Coal Seam Gas Water Management Policy' and section 310D (5) of the EP Act.</p> <p>Recommendation:</p> <p>The EM Plan must be revised to adequately address the following matters:</p> <ul style="list-style-type: none"> • how the Coal Seam Gas Water Management Policy, including the preferred management options, has been considered by the applicant; and • if a non-preferred management option is proposed to be used by the applicant instead of a preferred management option, the reason for using the non-preferred management option. • the quantity of CSG water the applicant reasonably expects will be generated in connection with carrying out each relevant CSG activity as part of the Surat Gas Project including: <ul style="list-style-type: none"> – unforeseen or non-compliant monitoring results. – volume of CSG water produced for each year over the life of the project; – volume of CSG water produced by activity type (i.e. exploration, appraisal and production) • A complete water balance for the Surat Gas Project area which includes: <ul style="list-style-type: none"> – Volumes of CSG water extracted; – Volumes of CSG water to be stored in evaporation or aggregation dams; – Volumes of CSG water to be treated via identified water treatment processes; – Likelihood of using CSG water (volumes) for purposes such as dust suppression and stock; – Estimation of direct rainfall into storages. – Evaporative losses from storages (including tanks and dams). 	<p>EIS</p> <p>Attachment 5 and Attachment 9</p> <p>SREIS</p> <p>Attachment 2</p>	<p>The current Queensland Coal Seam Gas Water Management Policy was released in December 2012 at the time when the EIS went to print. EIS, Attachment 9, Coal Seam Gas Water Management Strategy was subsequently revised to align with the priorities described in the policy and is presented in SREIS Attachment 5, Coal Seam Gas Water and Salt Management Strategy.</p> <p>EIS Attachment 5, Environmental Management Plan (EMP), which has been updated in SREIS Attachment 2, Strategic Environmental Management Plan (Strategic EMP), is a preliminary document that will be further developed to support the application for development approval of all of the project components.</p> <p>Statutory information requirements, including details relating to Section 310D of the EP Act will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16ap (cont'd)	<ul style="list-style-type: none"> – Volumes of CSG water after treatment. – Volumes of concentrated waste streams including brine. • the flow rate at which the applicant reasonably expects the water will be generated on the Surat Gas Project area. • the quality of the water, including changes in the water quality that the applicant reasonably expects will happen while each relevant CSG activity is carried out on the Surat Gas Project area with additional parameters including: <ul style="list-style-type: none"> – Temperature [°C]. – Dissolved oxygen [mg/L]. – Gross alpha + gross beta or radionuclides by gamma spectroscopy [Bq/L]. – The biological, carcinogenic, mutagenic or toxic properties of the water (particularly with reference to those elements which have exceedence levels set in the Australian Drinking Water Guideline). • the proposed management of the water including the use, treatment, storage or disposal of the CSG water. • the measurable criteria (the management criteria) against which the applicant will monitor and assess the effectiveness of the management of the CSG water. The following criteria must be provided for: <ul style="list-style-type: none"> – the quantity and quality of the water used, treated, stored or disposed of. Include a description of the contaminants expected to be present at critical control points across the entire water management system; – protection of the environmental values affected by each relevant CSG activity and criteria proposed for how the protection of the environmental values will be monitored and assessed; – the disposal of waste, including, for example, salt generated from the management of the water (including management objectives, environmental values, tasks and performance indicators). – the action that is proposed to be taken, if any of the management criteria are not satisfied, to ensure the criteria will be able to be satisfied in the future. – detail of how performance indicators will be auditable (i.e. quantitative and able to be objectively and repeatedly measured by defined methodologies). – Detail regarding monitoring for meeting performance indicators. For example: <ul style="list-style-type: none"> <input type="checkbox"/> Details of monitoring locations, frequency, parameters and testing methodologies. 		

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16ap (cont'd)	<ul style="list-style-type: none"> <input type="checkbox"/> Monitoring practices that will be able to identify any failures and/or poor performance of any aspect of the CSG water management system. <input type="checkbox"/> Monitoring practices that will trigger investigations into the identified failures and/or poor performance. <input type="checkbox"/> Monitoring practices that will allow for continuous improvement in CSG water management over the life of the project. – procedures that will be adopted to regularly review and update the measurable criteria. – procedures to be adopted to report to management and the administering authority unforeseen or non-compliant monitoring results. – procedures to be implemented to prevent unauthorised environmental harm from unforeseen or non-compliant monitoring results. 		
16aq	<p>Issue: CSG evaporation dams</p> <p>The EM Plan does not adequately detail whether there are any existing or proposed CSG evaporation dams on the Surat Gas Project area. Under section 310D (6) of the EP Act, the EM Plan must not provide for using a CSG evaporation dam in connection with carrying out a relevant CSG activity unless the plan includes an evaluation of:</p> <ul style="list-style-type: none"> • best practice environmental management for managing the CSG water • alternative ways for managing the water • the evaluation shows there is no feasible alternative to a CSG evaporation dam for managing the water. <p>Recommendation:</p> <p>The EM Plan must be revised to identify all evaporation dams or dams that are used for the purpose of evaporating CSG water both existing and proposed on the Surat Gas Project area. If evaporation of CSG water is proposed, demonstrate why CSG evaporation ponds are the only feasible option for the storage and disposal of CSG water on the Surat Gas Project area including:</p> <ul style="list-style-type: none"> • Whether there is a physical barrier, tenure constraint or factor of remoteness that prevents exploration or appraisal wells or groups of wells from being connected to other water treatment or disposal facilities; • The proposed quantity of water to be produced from the wells located in the Surat Gas Project area and how it been considered in sizing the dams; 	<p>EIS Attachment 2</p> <p>SREIS Attachment 5</p>	<p>In October 2008, the government released the Queensland Coal Seam Gas Water Management Policy. That policy outlined the discontinuation of evaporation dams as a primary means to dispose of coal seam gas water. This policy document was revised in 2012 and retains the prohibition of evaporation dams (with the exception of dams required in remote areas or required for brine management). Consequently, the proposal does not use evaporation dams for disposal of coal seam gas water.</p> <p>EIS Attachment 5, Environmental Management Plan (EMP), which has been updated in SREIS Attachment 2, Strategic Environmental Management Plan (Strategic EMP), is a preliminary document that will be further developed to support the application for approval of project components.</p> <p>Statutory information requirements will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16aq (cont'd)	<ul style="list-style-type: none"> • The location (latitude and longitude coordinates), surface area (in hectares), capacity (in megalitres) and containment standards including leak detection of each of the existing and proposed evaporation dams or dams that are used for the purpose of evaporating CSG water in the Surat Gas Project area in hectares. Clearly differentiate between existing and proposed dams; • The best practice environmental management for managing CSG water, alternative ways for managing the water and enough information to demonstrate there is no feasible alternative to a CSG evaporation dam for managing the water in the Surat Gas Project area; • The nature and management of, including the use and availability of technology relating to, the process being, or to be, used in the carrying out of the activity; • Evidence based demonstration that all reasonable measures have been considered to minimise the footprint of the CSG evaporation dams. <p>The EM Plan must also provide detail on the final landform, rehabilitation commitments and acceptance criteria for the CSG evaporation dams and timeframes for rehabilitation of all CSG evaporation dams proposed to be rehabilitated.</p> <p>Further information about CSG evaporations dams is available in the 'Coal Seam Gas Water Management Policy'.</p>		
16ar	<p>Issue: Salt precipitation plant</p> <p>Section 3.4 and Section 4.8 of the EM Plan does not contain sufficient information on the proposal to commission selective salt precipitation trials using a salt precipitation plant.</p> <p>Recommendation:</p> <p>The EM Plan must be revised to include an evidence based assessment for the proposal to trial salt precipitation using a salt precipitation plant. The following matters must be addressed in the evidence based assessment:</p> <ul style="list-style-type: none"> • Process options and justification; • Detailed process description including unit operations, mass flow rates, energy consumption, consumables; • Plant metallurgy; • Plant layout; • Raw material input specification (and tolerance levels) and process chemical specifications (type, CAS number, mass flow rates); • Start-up and shutdown procedures; 	<p>SREIS</p> <p>Chapter 3, Section 3.7.5</p>	<p>Should Arrow proceed with the Arrow-only selective salt recovery plant, it will be assessed under a separate approval process. SREIS Chapter 3, Project Description, Section 3.7.5 provides an update on the progress of investigations into selective salt recovery as the preferred brine management option, as both a joint-industry and Arrow-only solution.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16ar (cont'd)	<ul style="list-style-type: none"> • Secondary containment design; • Operating schedule; • Energy source and use; • Loss monitoring program; • Sound power emission levels and design of acoustic barriers; • Product specification; • Waste characteristics including a detailed description of waste, reactivity, toxicity, mass flow rates; • Groundwater baseline data (within 1 km of plant) and ongoing monitoring program; • Plant decommissioning program including all land rehabilitation of plant and any dams or impoundments; • Process alternatives including a discussion regarding the proposed options if this process is unsuccessful. 		
16as	<p>Issue: Injection where detrimental impact unlikely</p> <p>Section 4.8 of the EM Plan states an injection feasibility study has been undertaken and shallow and deep aquifer trials are proposed in the future. Section 4.8 of the EM Plan also states that the criterion for injection is finding a target formation where the water quality is lower than that of the brine and that to date, no such target formations have been identified.</p> <p>Section 2.7.2.3 of the EIS states “Note: at present, the legislative framework to enable injection of coal seam gas water into aquifers has not been fully developed. Arrow is committed to engaging with all relevant stakeholders on this topic to facilitate the development and implementation of a regulatory solution for injection into groundwater aquifers.” It is unclear what aspect of the regulatory framework Arrow believes requires a solution or how this has limited the progression of their injection feasibility study.</p> <p>Recommendation:</p> <p>The CSG Water Management Strategy and the EM Plan must include an evidenced based injection feasibility study in line with current legislative framework and policies. The EM Plan must include an evidenced based study identifying the formations which have been considered and the extent to which these formations are feasible for brine injection. Further information regarding the timing of the proposed shallow and deep aquifer trials must also be included in the EM Plan.</p>	<p>EIS Attachment 5</p>	<p>As discussed in EIS Attachment 5, Environmental Management Plan, Arrow conducted an injection feasibility study in 2010 and has submitted environmental authority amendment applications to conduct aquifer injection trials. The purpose of these trials is to identify the volumes and rates of water that can be sustainably injected.</p> <p>Results from Arrow's coal seam gas water injection pilot trials are not yet available as the approvals are still pending. If an injection trial is approved and executed, and it identifies an aquifer suitable for coal seam gas water injection, the results from the pilot trials will be used to generate an amendment to the environmental authority (EA).</p> <p>The Coal Seam Gas Water Management Policy 2012 does not mandate that an evidence based feasibility study be conducted.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16at	<p>Issue: Dams manual</p> <p>Version 2 of the Manual for Assessing Hazard Categories and Hydraulic Performance of Dams' has been referred to in the EM Plan has been superseded by Version 3.1 of the 'Manual for Assessing Hazard Categories and Hydraulic Performance of Dams'.</p> <p>Recommendation:</p> <p>Version 3.1 of the 'Manual for Assessing Hazard Categories and Hydraulic Performance of Dams' must be referred to in the EM Plan and used for designing and assessing regulated structures.</p>	<p>SREIS</p> <p>Attachment 2 and Attachment 4</p>	<p>EIS Commitment C141, which refers to the use of the Manual for Assessing Hazard Categories and Hydraulic Performance of Dams, has been updated in SREIS Attachment 4, Commitment Summary Update and SREIS Attachment 2, Strategic Environmental Management Plan, to reference the most current version of the manual.</p> <p>Statutory information requirements will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment. Relevant details relating to the most current version of the 'Manual for Assessing Hazard Categories and Hydraulic Performance of Dams' will be included in statutory information requirements.</p>
16au	<p>Issue: Definition of dams</p> <p>Section 4.9 of the EM Plan refers to a number of dams including holding dams, water transfer dams and surge dams. The terms used for these dams referred to in the EM Plan are not inline with the regulated structures definitions used by the administering authority.</p> <p>Recommendation:</p> <p>The EM Plan must clearly name the existing and proposed dams on the Surat Gas Project using the dam name and definitions from the 'Structures which are dams or levees constructed as part of environmentally relevant activities guideline'. i.e. low hazard dam, aggregation dam, coal seam gas evaporation dam or brine dam. The purpose of the dam can also be included to clearly demonstrate the use of the dam for example, transfer dam from A to B, surge dam etc.</p>	<p>SREIS</p> <p>Chapter 24</p>	<p>SREIS Part C, Chapter 24, Glossary and Abbreviations has been updated and where possible, adopts the definitions set out in statutory and regulatory documents. Applications for or to amend Environmental Authorities will include the terminology used in relevant guidelines and standards including as revised from time to time.</p>
16av	<p>Issue: Existing and proposed low hazard dams and regulated dams</p> <p>Section 4.9 of the EM Plan does not list the number and type of existing and proposed low hazard dams and regulated dams as required for the Surat Gas Project.</p> <p>Recommendation:</p> <p>The EM Plan must contain details of all existing low hazard dams and regulated dams used in the carrying out of petroleum activities including the following information:</p> <ul style="list-style-type: none"> • location details including latitudes and longitudes, camp accommodation, creeks, rivers, wetland and public recreational areas; • purpose of the dam (e.g. aggregation dam, brine dam, permeate dam, production evaporation dam, exploration and appraisal evaporation dam); • the anticipated hazard category ; 	<p>–</p>	<p>Arrow will comply with appropriate legislation and guidelines, including the Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (EHP, 2012f) and any other documents relevant to the compliant design, operation and monitoring of such structures.</p> <p>Arrow notes that dam approvals are a subsequent process to the EIS process and a dam register will be maintained.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16av (cont'd)	<ul style="list-style-type: none"> • hydraulic performance; • the maximum surface area (ha); • the maximum volume of dam (m³); • maximum depth of dam (m); • liner selection; and • leak detection system (if applicable). <p>All new or proposed dams in an EM Plan must be detailed (addressing the points above to as the extent possible, and be assessed, designed and constructed in accordance with the 'Manual for Assessing Hazard Categories and Hydraulic Performance of Dams' and the accompanying 'Structures which are dams or levees constructed as part of Environmentally Relevant Activities guideline'. A register for any existing regulated dams must also be included in the EM Plan.</p>		
16aw	<p>Issue: Existing activities in proximity to sensitive receptors</p> <p>Section 4.10.1 of the EM Plan states 'elevated levels were recorded as sensitive receptors in proximity to existing production facilities'. No other detail has been identified in the EM Plan regarding the distance of the production facilities from the sensitive receptors or the elevated levels that were recorded. The EM Plan also states that baseline monitoring has occurred at four representative locations in the Surat Gas Project area. The following information has not been included in the EM Plan, the location of the four representative locations, justification as to why these locations have been selected and why additional locations have not been monitored to ensure noise levels can be met across the whole project area.</p> <p>Recommendation:</p> <p>The EM Plan must be revised to include an evidence based assessment of the existing infrastructure in relation to sensitive receptors including minimum distance and elevated noise levels. The EM Plan must address where the proposed infrastructure will be located and the mitigation measures that are proposed to ensure noise levels are not elevated at sensitive receptors. The EM Plan should state why only four representative locations have been selected, identify where they are located and provide information regarding the noise sources at these locations.</p> <p>Background noise monitoring should be undertaken at relevant sensitive receptors that could potentially be affected by the proposed petroleum activities. The results of the background noise monitoring should be reported in the EM Plan.</p>	<p>EIS</p> <p>Chapter 20 and Appendix N</p>	<p>The monitoring locations for background noise were chosen to be representative of the ambient noise conditions of the project development area and included sites that reflected the broad spectrum of noise environments from rural to industrial. In the absence of known locations for production facilities, a typical layout of a facility with typical equipment was used to predict the noise contours and hence separation from sensitive receptors with and without acoustic treatment. This provided Arrow with an indication of the distance it should site facilities from sensitive receptors and of the level of acoustic treatment required to reduce separation distances. The noise impact assessment (EIS Chapter 20, Noise and Vibration) and associated technical study (Appendix N to the EIS) found that noise from facilities and production wells could be managed based on representative meteorological and background noise levels. Detailed site specific noise monitoring and modelling required to support an application for or to amend an Environmental Authority will be undertaken when the location of production facilities is confirmed.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16aw (cont'd)	Measured background noise levels should be described in terms of LA90,T, LA10,T and LA1, T, where T should not be less than 15 minutes. Measured background noise levels should be representative of day (7 am to 6 pm) evening (6 pm to 10 pm) and night (10 pm to 7 am) periods.		
16ax	<p>Issue: Blasting</p> <p>Section 4.10.2 of the EM Plan states 'blasting is not anticipated during construction, but it was considered in the assessment'.</p> <p>Recommendation:</p> <p>If blasting is proposed to be carried out, or vibration impacts are likely at sensitive receptors, the EM Plan must clearly identify the environmental values that may be affected by vibrations and the nature of any adverse impacts, including any potential structure borne vibration impacts at sensitive receptors. The EM Plan should also detail the necessary procedures to develop Blast Management Plan's in accordance with Australian Standard AS2187.2–2006: Explosives - Storage and Use which are used for every blasting activity. Blast Management Plans ensure that all measures are taken to minimise the likelihood of any adverse effects being caused by airblast overpressure and/or ground borne vibrations at any sensitive receptor and demonstrate current best practice environmental management. All blasting activities must be designed to meet a maximum airblast overpressure level of 120 dB (linear peak) and ground-borne vibration peak particle velocity of 10 mm/s at any time when measured at or extrapolated to any sensitive receptor.</p>		Blasting is not anticipated to occur at any stage of the project. Should blasting be required, it will be conducted in accordance with the noise criteria set out in the <i>Environmental Protection Act 1994</i> and <i>DERM Noise and Vibration from Blasting</i> guideline (DERM, 2006). Statutory information requirements, including details on blasting, if relevant, will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.
16ay	<p>Issue: Wastes generated as part of the project</p> <p>Section 4.11 of the EM Plan does not include adequate detail on the wastes that will be generated as part of the Surat Gas Project area.</p> <p>Recommendation:</p> <p>The EM Plan must be revised to include a description of the proposed source, nature, composition, rate and the immediate or ultimate destination of all wastes generated as part of the Surat Gas Project. The following information must be addressed in the EM Plan:</p> <ul style="list-style-type: none"> • the types and amounts of the waste expected to be generated, including characterisation of drilling fluids, drilling muds, waste waters including sewage effluent and oily waters. • the likely impact of the waste on the environment. • the hazardous characteristics of the waste. • how the waste will be dealt with, including, in particular: 	<p>EIS</p> <p>Chapter 26 and Chapters 9 to 25</p>	<p>EIS Chapter 26, Waste Management provides a summary of identified waste streams expected to be generated by project activities and an assessment of the potential for identified environmental values to be affected by impacts associated with waste generated in each phase of the project. Furthermore, EIS impact assessment chapters 9 to 25 present more specific details on waste stream generation and management measures, relevant to the environmental values identified.</p> <p>Statutory information requirements, including details on wastes produced will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16ay (cont'd)	<ul style="list-style-type: none"> – the amount of the waste that is proposed to be disposed of to a landfill. – the amount of the waste that is proposed to be dealt with. – location of waste management storage or disposal facilities and – the location of any land that will become contaminated as a result of the storage or disposal of waste. <ul style="list-style-type: none"> • contamination risks from the storage, transport and any proposed disposal of wastes (such as drilling fluids, drilling muds, waste waters including sewage effluent and oily waters) • discussion regarding whether there are any waste reduction and recycling plans in force in the local government area where the waste is generated and / or dealt with and any implications of the project on these plans. 		
16az	<p>Issue: Landfilling and incineration</p> <p>Section 4.11.3 of the EM Plan discusses the hierarchy of management options for waste generated during the project activities with treatment and disposal being the least preferred option. The treatment and disposal options suggest waste products may be disposed in landfills or by incineration. No detail is given in the EM Plan regarding whether landfilling or incineration will occur on the project site.</p> <p>Recommendation:</p> <p>Identify in the EM Plan where landfilling and incineration activities will be undertaken for the waste generated as part of the Surat Gas Project area.</p>	<p>EIS Attachment 5 SREIS Attachment 2</p>	<p>EIS Attachment 5, Environmental Management Plan (EMP) presents Arrow's commitment to dispose of waste that cannot be reused or recycled at appropriately licensed facilities (Commitment C257).</p> <p>The EMP, which has been updated in SREIS Attachment 2, Strategic EMP, is a preliminary document that will be further developed to support the application for development approval of all of the project components.</p> <p>Statutory information requirements, including details on waste disposal will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p>
16ba	<p>Issue: Drilling muds and cuttings</p> <p>Table 4.26 of the EM Plan states reuse will include the treatment and reuse of solid wastes, such as drilling muds and cuttings, as soil conditioners, road base or construction material. No characterisation of solid wastes such as drilling muds and cuttings or a discussion regarding the proposed management strategy of the drilling muds has been included in the EM Plan.</p> <p>Recommendation:</p> <p>The EM Plan must include a systematic assessment to determine the appropriate management option for drilling muds and sump area after drilling. The assessment must include:</p> <ul style="list-style-type: none"> • characterising the waste in relation to the items in Schedule 7 of the EP Reg and Schedule 1 of the Environmental Protection (Waste Management) Regulation 2000; 	<p>EIS Attachment 5 SREIS Attachment 2</p>	<p>EIS Attachment 5, Environmental Management Plan (EMP), which has been updated in SREIS Attachment 2, Strategic Environmental Management Plan (Strategic EMP), presents three commitments to specifically manage the potential impacts from use and disposal of drilling fluids including:</p> <ul style="list-style-type: none"> • When operating on black soils, collect, contain and store drilling fluids and waste (solid and liquid) on site in appropriate storage tanks until recycled, treated (if necessary) or disposed of off site (Commitment C100). • Select drilling fluids to minimise potential groundwater impacts. Do not use oil-based drilling fluids (Commitment C139). • Use surface tanks (not pits) to manage drilling muds on black soils when drilling production wells (Commitment C096).

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16ba (cont'd)	<ul style="list-style-type: none"> • consideration of the environmental risks of each of the additives present in the drilling muds. The information must be from a referenced source such as a Material Safety Data Sheet (MSDS) and/or scientific publication. The environmental risk information must include: <ul style="list-style-type: none"> – chemical and physical properties (such as pH, solids content, emulsive properties, solubility in water); – environmental fate and transport; – ecotoxicity (including chronic and acute); – biodegradation (in anaerobic and aerobic conditions); and – potential for bioaccumulation. • a separate characterisation assessment of drill cuttings and fines according to the National Environment Protection (Assessment of Site Contamination) Measure (NEPM) 1999 to determine whether the material is suitable for any intended use/re-use, or be disposed to landfill; • proposed management strategy for drilling muds and cuttings including storage, transport requirements and method and location of disposal. 		<p>In addition, the EMP (and subsequent Strategic EMP) presents Arrow's commitment to 1) develop and implement waste management procedures in accordance with the Queensland Environmental Protection (Waste Management) Policy 2000 (Commitment C281) and 2) to store and manage all waste materials (domestic and industrial) in accordance with industry regulations and EHP conditions, to use licensed waste management contractors and conduct audits of disposal facilities, disposal permits and onsite operations to ensure adherence to regulations (Commitment C149).</p> <p>EIS Attachment 5, EMP, which has been updated in SREIS Attachment 2, Strategic EMP, is a preliminary document that will be further developed to support the application for development approval of all of the project components.</p> <p>Statutory information requirements, including details on waste management will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p>
16bb	<p>Issue: Rehabilitation Plan</p> <p>Section 5 of the EM Plan does not include a rehabilitation plan for the Surat Gas Project area.</p> <p>Recommendation:</p> <p>The EM Plan must be revised to include a rehabilitation plan, which must include:</p> <ul style="list-style-type: none"> • a rehabilitation hierarchy for: <ul style="list-style-type: none"> – reinstating a native ecosystem as similar as possible to the original ecosystem as the preferred option; then – establishing an alternative outcome with a higher environmental value than the previous land use; then – reinstating the previous land use (e.g. grazing or cropping); and • methods to achieve rehabilitation goals including, but not necessarily being limited to: <ul style="list-style-type: none"> – establishing final land use(s) in consultation with affected landholder(s) and the administering authority; – identifying suitable analogue sites to measure rehabilitation success that may either be the pre-disturbed area or another area that has equivalent values and characteristics as the intended final land use(s); and 	<p>EIS Attachment 5 SREIS Attachment 2</p>	<p>Arrow will develop a rehabilitation plan based on environmental sensitivities that address ground preparation requirements, natural and constructed drainage patterns, soil erodibility, contamination, slope steepness and length, rainfall frequency and intensity, potential flow magnitudes, vegetation cover, land use and landholder requirements (Commitment C070).</p> <p>Site specific details will be provided as the development progresses, and infrastructure locations are determined and negotiated with landholders. The rehabilitation plan will be developed prior to commencing ground disturbance activities, and will detail the procedures and methods that are to be used.</p> <p>EIS Attachment 5, Environmental Management Plan (EMP), which has been updated in SREIS Attachment 2, Strategic Environmental Management Plan (Strategic EMP), is a preliminary document that will be further developed with consideration for the 24 commitments made relating to rehabilitation requirements, to support the application for development approval of all of the project components.</p> <p>Statutory information requirements, including details on rehabilitation will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16bb (cont'd)	<ul style="list-style-type: none"> – for sites that are being reinstated to a land use other than a native ecosystem, the Rehabilitation Plan must identify any additional and relevant indicators to be measured at both the analogue and rehabilitation site(s) so as to assess progressive and final rehabilitation success for that land use; – for sites that are being reinstated to native ecosystems and the analogue site is the pre-disturbed site, the Rehabilitation Plan must include indicators will be able to measure success against the progressive and final rehabilitation criteria in this environmental authority; – identification of any land use constraints which have resulted from the petroleum activity(ies); – residual pollution risks with strategies for managing and mitigating them; – landscape planning and landform design principles to achieve stable landforms including slope designs, erosion controls and drainage lines; – integrating rehabilitated areas so they are compatible with the surrounding landscape, including linking rehabilitated areas of native vegetation with undisturbed native vegetation to provide larger areas and wildlife corridors where feasible; – ensuring that significantly disturbed areas are rehabilitated progressively and that the progressive rehabilitation criteria are routinely measured; – site preparation such as re-profiling, re-instating surface drainage systems; – top soil management such as top soil handling and stockpiling to preserve soil fertility and biota, respreading techniques, planned thickness, ripping, top soil treatments / amendments and mulching in consideration of analogue data; – flora to be established, including required species diversity, abundance and composition and projective cover in consideration of analogue data; – plant propagation and / or supply methods including using seeds / spores of local provenance where feasible; – establishment methods to maximise rehabilitation success such as seed treatments, seed spreading, timing of seeding to suit best local climatic conditions, hydroseeding, transplanting; – weed control; – sourcing habitat structures for native fauna and installation methods in consideration of matching analogue data; – on going maintenance program for rehabilitated areas; and – rehabilitation monitoring program; and 		

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16bb (cont'd)	<ul style="list-style-type: none"> timeframes for commencing rehabilitation of significantly disturbed areas that are not required for the ongoing conduct of the petroleum activity(ies), not greater than three (3) months for the rehabilitation of buried pipelines and not greater than nine (9) months for any other significantly disturbed area. 		
16bc	<p>Issue: Gas and water gathering lines and pipelines</p> <p>Section 5.4.2 of the EM Plan discusses what the decommissioning of gas and water gathering lines and high-pressure pipelines will involve. There is no information included in the EM Plan regarding the minimum depth that the gathering lines and pipelines will be buried, the maximum width of the ROW and whether subsidence may occur and how it will be managed.</p> <p>Recommendation:</p> <p>The EM Plan must be revised to address the following information for gathering lines and pipelines:</p> <ul style="list-style-type: none"> the minimum depth the gathering lines and pipelines will be buried and whether the depth will vary depending on the land use; the maximum width of the ROW, specifying the construction width required and the operation width required; the timing on when the ROW is rehabilitated; the methods used to detect subsidence and erosion rates at rehabilitated sites and associated management procedures and mitigation measures. 	<p>EIS</p> <p>Chapter 5, Section 5.2.2</p> <p>SREIS</p> <p>Chapter 3, Attachment 2 and Attachment 4</p>	<p>EIS Chapter 5, Project Description Section 5.2.2, explains that low-pressure pipelines will be 100- to 630-mm-diameter, high-density, polyethylene buried pipelines. A construction right-of-way (ROW) of up to 20 m will be prepared for the gathering systems including vegetation removal and stockpiling, topsoil stripping and stockpiling and grading, where required. Arrow has committed to minimise the width of the construction ROW within areas of sensitivity to the greatest extent practicable without compromising the safety of workers (Commitment C231). Landowners will be consulted to determine land use practices and pipelines will be buried to a depth that minimises risk of damage.</p> <p>SREIS Attachment 4, Commitment Summary Update presents revised Commitment C444 that confirms Arrow will design, construct, maintain and rehabilitate the gathering system network in accordance with the APIA code of practice Upstream PE gathering networks CSG industry version 2 which was reflected in Queensland legislation subsequent to the publication of the EIS. The code stipulates the construction requirements for coal seam gas gathering systems, including the minimum depth.</p> <p>The SREIS Chapter 3, Project Description presents the revised right-of-way required for high-pressure gas pipeline construction, which is up to 40 m wide and the minimum depth of cover required by AS 2885, Pipelines: gas and liquid petroleum (Standards Australia, 2008a), which is 750 mm.</p> <p>Once the gathering system is installed, the trench will be backfilled and the ground compacted to a level consistent with the surrounding land use. Arrow will backfill and rehabilitate in a manner that will promote successful rehabilitation, including capping of exposed subsoil with topsoil and replacement of the land surface to preconstruction levels to reduce trench subsidence and concentration of flow. Mounding of soils to allow for settling may be required in some areas, however, in laser-levelled paddocks, this may not be practicable, and backfilling should be carried out in consultation with the landowner (Commitment C071).</p> <p>Arrow will inspect pipeline ROWs routinely until ground stabilisation and natural revegetation or pasture grasses or crops are established (Commitment C506).</p> <p>Whilst the SREIS Attachment 2, Strategic Environmental Management Plan captures the above mentioned commitments, statutory information requirements will be met in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
16bd	<p>Issue: Water Treatment and Storage Facilities</p> <p>Section 5.4.4 of the EM Plan does not provide adequate detail on the decommissioning and rehabilitation of water treatment and storage facilities.</p> <p>Recommendation:</p> <p>The EM Plan must include objective commitments regarding the decommissioning and rehabilitation of water treatment and storage facilities including the procedures and standards proposed for decommissioning and whether monitoring and testing of the surrounding land is proposed to determine whether contamination has occurred.</p>	–	<p>Conditions of EAs issued by EHP (formerly DERM) under the Environmental Protection Act 1994 (Qld) include requirements for the decommissioning and rehabilitation of dams. The conditions set out the minimum standards decommissioning. The Queensland Dam Safety Management Guidelines (NRM, 2002) set out requirements for decommissioning dams including the preparation of a dam safety decommissioning plan. Arrow is required to report and remediate any contamination caused by its activities in accordance with the Environmental Protection Act.</p>
17a	<p>Issue: Conflicting commitments (C208)</p> <p>The EIS commits to maintaining dam banks free of vegetation to reduce mosquito breeding (C208). Dam inner and outer banks need to be vegetated to prevent erosion particularly where the dams are constructed using sodic soils. It would be detrimental to leave the inner banks bare due to the erosive nature of wave action whipped up across the dam water surface and the risk of sodic soils dissolving and eroding when left bare. Wherever possible, if sodic soils are used in the construction of dams, they should not be left exposed on the surface of the dam walls.</p> <p>Recommendation</p> <p>The supplementary report to the EIS should describe and evaluate a range of management techniques that could be employed to minimise the risk of mosquito infestation that don't compromise the integrity of the dam walls. Preferred techniques should be incorporated into the management sections of the EM Plan.</p>	<p>EIS</p> <p>Chapter 25, Section 25.6</p>	<p>Management measures in EIS Chapter 25, Hazard and Risk, Section 25.6 will minimise the risk of mosquito infestations while maintaining the integrity of the dam walls. Arrow has committed to line banks of dam with an impervious lining (Commitment C213) in order to prevent erosion. Dams will be designed in accordance with the Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (EHP, 2012f).</p> <p>Statutory information will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany environmental authority (EA) or EA amendment.</p>
17b	<p>Issue: Incorrect terminology (C405, C407, C412)</p> <p>Commitments C405, C407, C412 mention consultation with the Queensland Heritage Office, if it is intended that the consultation is to be with the administering authority of the Queensland Heritage Act 1992 (QHA), then this should be clearer, there is no actual "Queensland Heritage Office". Also consultation with the administering authority over plans is not a requirement of the act; the act only requires notification of a find (s89 QHA). The Department of Environment and Heritage Protection is the agency responsible for non-indigenous heritage protection.</p>	<p>SREIS</p> <p>Attachment 4</p>	<p>The wording of these commitments has been changed to take into account the requirements of the Queensland Heritage Act 1992 and recognises that the Department of Environment and Heritage Protection is the agency responsible for non-indigenous heritage protection. These are provided in SREIS Attachment 4, Commitments Update.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
17b (cont'd)	<p>Recommendation</p> <p>Commitments made regarding Queensland Heritage should be reworded in the supplementary report to the EIS to accurately take into account the requirements of the QHA.</p>		
17c	<p>Issue: Groundwater seepage from dams (C504)</p> <p>C504 considers the use of groundwater bores to detect leakage from dams. A more proactive approach would be to first undertake a geotechnical investigation into the most appropriate site (some sites will be inherently limited and unsuitable) as well as geotechnical investigations into the design and construction of the dams based on the soil and substrate characteristics at the site. Rather than relying on seepage from the dams being detected in an aquifer (which is a delayed impact), it would be provident to employ sump or interception methods to determine the fate of any seepage. Also the reliance on monitoring bores to detect seepage requires the determination that any changes from baseline are actually as a result of seepage from the dam, which may be problematic.</p> <p>Recommendation</p> <p>The supplementary report to the EIS should revise commitment C504 to provide a more appropriate monitoring and response mechanism for detecting leaks and seepage. It should also include Planning and Design as a relevant phase.</p>	<p>SREIS</p> <p>Attachment 2 and Attachment 4</p>	<p>SREIS Attachment 2, Strategic Environmental Management Plan and EIS Attachment 4, Commitments Update capture the planning and design phase as being relevant to actioning Commitment C504.</p> <p>Further to the measures outlined in Commitment C504, Arrow will also manage the potential for dam seepage through development of the construction, design and monitoring requirements for new dams in accordance with the requirements of the most recent version of Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (EHP, 2012f). Dams will be constructed under the supervision of a suitably qualified and experienced person in accordance with the relevant DERM schedule of conditions relating to dam design, construction, inspection and mandatory reporting requirements (Commitment C141).</p>
18a	<p>Issue: Inadequate identification and analysis of water management options and inclusion of a CSG water management plan.</p> <p>The EIS does not adequately identify the water management options being considered in each development region, or make an assessment of the feasibility of each water management option in each area. No CSG water management plan has been included in the EMP, as required by the guideline "Preparing an environmental management plan for coal seam gas activities".</p> <p>Recommendation:</p> <p>Submit a detailed CSG water management plan as part of the supplementary report to the EIS.</p> <p>At a minimum, at each of the integrated processing facilities in the project area, as well as in each development region, assess potential options for management and disposal of CSG water, including water allocations, town water supply, feasibility of injection etc. This should include assessment of contingencies as to how the water will be managed if the preferred option is not available.</p>	<p>SREIS</p> <p>Attachment 5</p>	<p>Arrow's revised Coal Seam Gas Water and Salt Management Strategy is contained in SREIS Attachment 5. The strategy aligns with the priorities described by EHP in the Coal Seam Gas Water Management Policy 2012, which was released following the submission of the EIS.</p> <p>The coal seam gas water and brine/salt management options chosen during the project will be detailed in the coal seam gas water management plan, which will be prepared to accompany an environmental authority (EA) or EA amendment application, as described in SREIS Chapter 2, Project Approvals. The management plan will include detailed coal seam gas water and brine impact assessments and management strategies. The management options for coal seam gas water and/or brine/salt will be continually reviewed as planning for field development evolves and opportunities for additional beneficial use present themselves.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
18a (cont'd)	The CSG water management plan should describe the estimated volumes of water to be managed at each location, and how the water will be stored, delivered and used.		
18b	<p>Issue: No provision of estimates of water production for each development region</p> <p>An estimate of water production for each development region has not been provided, only for the overall project area. Strategies for the management of water are not discussed in any detail for each area. The Terms of Reference for the EIS requires that the following water management information is presented:</p> <ul style="list-style-type: none"> • Chemical and physical properties of associated water; • Likely volumes/rates and areas of production of coal seam gas water; • Producing coal seam gas water over the full life of the project; • Storage of raw water; • Methods for treatment of water; • Physical and chemical properties of water after treatment; • Proposed use of the treated water and factors that may influence this use; • Managing any contaminants / associated waste arising from treatment of water; and • Managing saline waste products. <p>Recommendation:</p> <p>In the supplementary report to the EIS, for each of the five development regions, as well as for each integrated processing facility, provide an estimate of the likely water production volumes. Where estimates are variable provide a range or a best and worst case scenario. Outline how these volumes will be managed at each location (including water storage requirements), how much water is expected to be managed by each option at each location, and provide an assessment of the feasibility of options at each location, including demand for beneficial uses.</p>	<p>EIS</p> <p>Chapter 5, sections 5.2.4, 5.4.2, Figure 5.8</p> <p>SREIS</p> <p>Chapter 3, Section 3.7.2, Figure 3.8 and Attachment 5</p>	<p>Figure 5.8, Chapter 5 of the EIS presented the water production from each development region across the project development area. As described in Section 5.2.4 of the EIS, the conceptual field development plan included six integrated production facilities each containing a reverse osmosis water treatment plant with 30 to 60 ML/d modular water treatment capacity. Water storage requirements at each facility were also detailed in Section 5.4.2 of the EIS. Since the preparation of the EIS, Arrow has refined its conceptual field development plan, and revised coal seam water production volumes are presented in SREIS Section 3.7.2, Figure 3.8. Chapter 3, Project Description also contains information on revised water treatment facility locations and treatment capacities.</p> <p>Management of coal seam gas water will consist of a combination of management options, which address Arrow's statutory obligations and commitments. The field development plan, which is refined over time to incorporate learnings and improvements as the project develops, and the development sequence for the Surat Gas Project will determine the timing, combination and implementation of the management options.</p> <p>Arrow's Coal Seam Gas Water and Salt Management Strategy presented in the EIS has been revised to align with current government policy (see SREIS Attachment 5). Arrow's preference is to supply treated coal seam gas water (and untreated coal seam gas water subject to the water quality requirements of the end use and relevant approval) for beneficial use. The management options for coal seam gas water being considered are as follows:</p> <ul style="list-style-type: none"> • Distribution to existing users for substitution of their existing groundwater allocations from the Condamine Alluvium ('virtual injection') and as additional supply, and to new users. • Distribution via watercourses to existing and new users in managed schemes. • Injection into suitable aquifers to support recharge if an appropriate regulatory framework is in place and subject to trials to determine the volumes and rates of coal seam gas water that could be injected. • Discharge to watercourses under defined conditions where coal seam gas water cannot be beneficially used or due to operational, technical, environmental or economic constraints e.g., water treatment plant upset uses cannot be feasible. <p>Two potential sites for water treatment facilities have been identified in SREIS Chapter 3, Project Description, one adjacent to CGPF2 north of Miles and one adjacent to CGPF9 south of Cecil Plains. Land use and water demand for beneficial uses vary between the potential locations necessitating different management options at the locations.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
18b (cont'd)			<p>Further flexibility is proposed through interconnection of the facilities to enable local variations in demand to be managed. Chapter 3, Project Description explains the land use and water demand profile for each location, and likely management options.</p> <p>A discharge strategy informed by a detailed environmental flows assessment, and aquatic ecology and water quality monitoring programs will determine the volumes and rates of water discharged at the proposed locations adjacent to CGPF2 and CGPF9.</p>
18c	<p>Issue: Inconsistent estimates of salt production</p> <p>The EIS identifies quantities of salt produced per mega litre of CSG water produced, there are different figures given in various parts of the EIS. In the salt management information brochure it details that for each mega litre of water produced it will yield 5-8 tonnes of salt, whereas in the CSG water management strategy it quotes a yield of 4.5t of salt per ML. Due to the volumes of water being produced the amount of salt yield may be significantly underestimated if the real salt yield is in the vicinity of 8t/ML.</p> <p>Recommendation</p> <p>The supplementary report to the EIS needs to provide a consistent figure for salt yield that is as close as possible to the real figure so that any projected impacts can be properly assessed.</p>	<p>EIS</p> <p>Chapter 5, Figure 5.17</p> <p>SREIS</p> <p>Chapter 2, Chapter 3, Section 3.7 and Attachment 5</p>	<p>An estimate of salt production per annum and for the life of the project is provided in the EIS Executive Summary and EIS Chapter 5, Project Description, Figure 5.17. Refinement of Arrow's project description has resulted in revised per annum projections for coal seam gas water and brine, as shown on SREIS Chapter 3, Project Description, Figure 3.8.</p> <p>Arrow's revised Coal Seam Gas Water and Salt Management Strategy is contained in SREIS Attachment 5. Coal seam gas water and brine/salt management options selected for each site will be detailed in the coal seam gas water management plan prepared for the environmental authority (EA) or EA amendment application(s), as described in SREIS Chapter 2, Project Approvals.</p> <p>The management plan will include detailed coal seam gas water and brine impact assessments and management strategies. The management options for coal seam gas water and/or brine/salt will be continually reviewed as planning for field development evolves and opportunities for additional beneficial use present themselves.</p>
18d	<p>Issue: Incomplete information on water management</p> <p>The conceptual coal seam gas water management overview in the Environmental Management Plan (pg. 90, Figure 4.16) attempts to summarise the total volumes of water to be produced in the project area and their management, however a number of details are missing from this diagram. The amount of water to be discharged to watercourses is not included in Figure 4.16 and does not appear until Appendix I where it is stated that 0.5 GL / annum may be discharged to streams. No information is given on why 0.5 GL is required to be discharged, when, where or the circumstances in which this discharge might occur.</p> <p>In the water management section in Chapter 5 pg. 54 – "Disposal to watercourses will be considered in the event that beneficial uses of CSG water are temporarily unavailable or the demand for water decreases and alternative disposal options are required to maintain dam integrity and safety." It is now explained how this will be assessed for each location. It is assumed that discharge, as an option, is a last resort but as currently worded it sounds like it could happen relatively often.</p>	<p>EIS</p> <p>Chapter 5, Figure 5.17</p> <p>SREIS</p> <p>Chapter 2, Chapter 3, Section 3.7, Figure 3.8, Chapter 9, Attachment 5, Appendix 5, Appendix 6 and Appendix 7</p>	<p>Arrow's revised Coal Seam Gas Water and Salt Management Strategy is contained in SREIS Attachment 5. The strategy aligns with the priorities described by EHP in the Coal Seam Gas Water Management Policy 2012, which was released following the submission of the EIS.</p> <p>Chapter 3, Project Description, Section 3.7.1 of the SREIS describes the management priorities contained in the EHP policy document, which are in line with the waste management hierarchy in so far as the policy promotes beneficial reuse in the first instance, followed by treatment and disposal. Through identification of beneficial uses for coal seam gas water and brine/salt, they cease to be defined as waste streams.</p> <p>As described in SREIS Chapter 3, Project Description, Section 3.7.4, within the Surat Basin, it is possible that the full range of coal seam gas water management options will need to be utilised including beneficial use and disposal, via distribution, injection and discharge, as follows:</p> <ul style="list-style-type: none"> • Distribution to existing and new users for beneficial use. • Injection into a suitable aquifer. • Discharge to watercourses and/or the ocean under defined conditions.

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
18d (cont'd)	<p>This needs to be clarified. It is also unclear that are the potential volumes from each development region (minimum and maximum) that are being considered for disposal. It is also not clear what the buffer capacity is in storages to hold water from other beneficial uses that do not eventuate.</p> <p>Also, no information is provided on what the new uses proposed are, and what this might entail, for example possible discharge to land.</p> <p>Recommendation:</p> <p>In the supplementary report to the EIS, provide a discussion of the water management options in detail, and the feasibility of each option assessed. Also provide potential location details in relation to proposed discharge to streams as well as a discussion on the potential volumes and circumstances under which a permit to discharge to streams may be sought. As discharge to streams is a non-preferred option, provide an assessment of the feasibility of other preferred options at each location where discharge is proposed.</p> <p>All water management and brine management options should be discussed in terms of the waste management hierarchy and in relation to the preferred and non-preferred management options outlined in the guideline "Preparing an environmental management plan for coal seam gas activities".</p> <p>As requested in an earlier recommendation under surface water (Chapter 15), clarify what the basis is for the 0.5 GL / annum that are proposed to be discharged to streams. Is this just for emergencies, i.e. uncontrolled or unplanned discharges, or is it being proposed as a back-up water management option if other water uses don't eventuate? Would this include treated or untreated water or both?</p> <p>Provide information on the buffer capacity in storages to hold water from other beneficial uses that do not eventuate. Provide information on potential new uses being proposed and what impacts may be associated with these uses.</p>		<p>Disposal to watercourses and the ocean are not preferred options but variability in rainfall between seasons and from year to year and demand for coal seam gas water over time will determine the volumes of coal seam gas water that can be managed through application of the identified options. Water demand, land use, weather, watercourse type and morphology, and aquatic ecosystems at the two proposed water treatment facility sites will dictate how the management options may be utilised at each site. It should be noted that disposal to watercourses and the ocean are only preferable when there is low alternative demand for coal seam gas water.</p> <p>Coal seam gas water and brine/salt management options selected for each site will be detailed in the coal seam gas water management plan prepared for the environmental authority (EA) or EA amendment application(s), as described in SREIS Chapter 2, Project Approvals.</p> <p>The management plan will include detailed coal seam gas water and brine impact assessments and management strategies. The management options for coal seam gas water and/or brine/salt will be continually reviewed as planning for field development evolves and opportunities for additional beneficial use present themselves.</p> <p>The value of 0.5 GL/annum of discharge to watercourses was selected in the EIS to allow potential impacts of releases of coal seam gas water to be assessed during emergency conditions only.</p> <p>Further assessment of the potential impacts of discharge to watercourses has been undertaken for the SREIS. Two receiving environments have been investigated, based on two potential water treatment facility sites. The assessment includes characterisation of the physical, chemical and ecological aspects of the receiving environment, to help inform the determination of appropriate release limits and conditions. The results of the assessment are described in SREIS Chapter 9, Surface Water and SREIS Surface Water Appendices 5, 6 and 7.</p>
18e	<p>Issue: Potential impacts of project on salinity in the Murray—Darling Basin</p> <p>Due the lack of detailed information on the proposal to discharge water, it is not possible to assess the impact of the proposed development on the standard criteria, including the ability of Queensland to meet its requirements under the proposed Murray Darling Basin Plan (i.e. Water Quality and Salinity Management Plan).</p>	<p>EIS</p> <p>Chapter 5, Figure 5.17</p> <p>SREIS</p> <p>Chapter 2, Chapter 3, Section 3.7, Figure 3.8, Chapter 9, Attachment 5</p>	<p>Arrow's revised Coal Seam Gas Water and Salt Management Strategy is contained in SREIS Attachment 5. An estimate of salt production per annum and for the life of the project is provided in the EIS Executive Summary and EIS Chapter 5, Project Description, Figure 5.17. Refinement of Arrow's project description has resulted in revised per annum projections for coal seam gas water and brine, as shown on SREIS Chapter 3, Project Description, Figure 3.8.</p> <p>Further assessment of the potential impacts of discharge to watercourses has been undertaken for the SREIS. Two receiving environments have been investigated, based on two potential water treatment facility sites. The assessment includes characterisation of the physical, chemical and ecological aspects of the receiving environment, to help inform the determination of appropriate release limits and conditions.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
18e (cont'd)	<p>Recommendation:</p> <p>The supplementary report to the EIS should provide an estimate of salt production per annum and for the life of the project. Where discharge to streams is proposed, provide modelling of possible cumulative effects of salt loads released to streams, including best and worst case scenarios.</p>	<p>SREIS (cont'd)</p> <p>Appendix 5, Appendix 6 and Appendix 7</p>	<p>The results of the assessment are described in SREIS Chapter 9, Surface Water and SREIS Surface Water Appendices 5, 6 and 7.</p> <p>Coal seam gas water and brine/salt management options selected for each site will be detailed in the coal seam gas water management plan prepared for the environmental authority (EA) or EA amendment application(s), as described in SREIS Chapter 2, Project Approvals.</p> <p>The management plan will include detailed coal seam gas water and brine impact assessments and management strategies. The management options for coal seam gas water and/or brine/salt will be continually reviewed as planning for field development evolves and opportunities for additional beneficial use present themselves.</p>
18f	<p>Issue:</p> <p>A coal seam gas water management plan is required to be submitted as part of the Environmental Management Plan. The strategy lacks the detail that is required in a coal seam gas water management plan. It is unclear why a strategy has been submitted instead of a plan.</p> <p>Section 1.3 pg. 2 – a single diagram called ‘document hierarchy’ is presented without any explanatory text. It is unclear what this diagram is attempting to convey.</p> <p>Section 2.2 pg. 4 – Discharge into watercourse and section 2.2 pg. 5 – Injection into an aquifer - There is no provision for a CSG water to be exempted from the recycled water provisions of the Water Supply (Safety and Reliability) Act 2008. Requirements under Chapter 3 Part 5 require that all CSG schemes are defined to be critical schemes. The separate exclusion provisions in sections 320-329 of Part 9A apply instead.</p> <p>Section 2.2, pg. 6 – This section does not specify how the water quality of CSG water compares to the water quality of the watercourses in the project area.</p> <p>Section 2.4.1 pg. 10 – It is not clear where are the outputs of the water balance model mentioned for the Surat Basin. They do not appear to have been presented in the EIS.</p> <p>Section 2.7.5 pg.17 – It is not clear when water production forecasts will be available. In the meantime can best and worst case scenarios should be considered.</p> <p>Section 3.2 pg. 20 – The document should specify make good arrangements and recovery of aquifers / remediation of impacts due to impacts of the project.</p>	<p>EIS</p> <p>Attachment 9</p> <p>SREIS</p> <p>Chapter 2, Chapter 3, Section 3.7, Figure 3.8, Chapter 9 and Attachment 5</p>	<p>Specific sites for water treatment facilities had not been identified at the time of publication of the EIS. EIS Attachment 9, Coal Seam Gas Water Management Strategy, set out the high level strategy for managing coal seam gas water and salt associated with the project.</p> <p>Arrow’s revised Coal Seam Gas Water and Salt Management Strategy is contained in SREIS Attachment 5. The strategy aligns with the priorities described by EHP in the Coal Seam Gas Water Management Policy 2012, which was released following the submission of the EIS.</p> <p>As set out in SREIS Chapter 3, Project Description, Section 3.7.4, two water treatment facilities are now proposed. Coal seam gas water and brine/salt management options selected for each site will be detailed in the coal seam gas water management plan prepared for the environmental authority (EA) or EA amendment application(s), as described in SREIS Chapter 2, Project Approvals.</p> <p>The management plan(s) will include detailed coal seam gas water and brine impact assessments and management strategies. The management options for coal seam gas water and/or brine/salt will be continually reviewed as planning for field development evolves and opportunities for additional beneficial use present themselves.</p> <p>It should be noted that water demand, land use, weather, watercourse type and morphology, and aquatic ecosystems at the two proposed water treatment facility sites will dictate how the management options may be utilised at each site.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
18f (cont'd)	<p>Recommendation: Submit the required coal seam gas water management plan for the Surat Basin. Provide responses and further information in the Supplementary EIS to address the concerns and questions raised above.</p>		
19a	<p>Issue: Constraints mapping –agricultural production (Attachment 10, Ch 8) The constraints mapping 'low constraint area' category includes large amounts of good quality agricultural land (GQAL) and strategic cropping land (SCL). Whilst there are various commitments to reduce impacts and mitigation measures for operations in agricultural lands, it would be prudent to elevate the constraint level where there is mapped GQAL and SCL as there are inherent constraints on activities in these mapped areas.</p> <p>Recommendation In the supplementary report to the EIS, the constraints mapping must be revised to include GQAL and SCL as constraints.</p>	<p>EIS Chapter 8 and Attachment 10</p>	<p>The preliminary constraints maps provided in EIS Attachment 10, Preliminary Constraints Maps, do not include GQAL and potential SCL for reasons described in EIS Chapter 8, Environmental Framework. Arrow acknowledges the constraint posed by GQAL and SCL and notes that it is subject to site assessment and validation which will determine the level of constraint at a property level where it will be managed through landholder negotiation and the conduct and compensation agreement.</p>
19b	<p>Issue: Wells drilled and tracks already constructed in areas of 'high constraint' (Attachment 10, Ch 8) The 2009 satellite imagery shows wells and tracks already constructed in areas mapped as 'high constraint area' in the constraints mapping, as well as many wells and roads through areas marked as 'moderate constraint area' in the Tipton region. The layout of these constructed roads and wells follows a distinct grid like pattern, with apparently little regard for the other land users or the integrity of the wider landscape. This type of development does not appear to meet one of the main purposes of the P&G Act: to ensure petroleum activities are carried on in a way that minimises conflict with other land uses (section 3 Petroleum and Gas (Production and Safety) Act 2004). As bore field development will impact on most types of underlying land use, commitments to minimise disruption to land holders should not be restricted to controlled traffic (irrigation) enterprises.</p> <p>Recommendation In the supplementary report to the EIS, Arrow Energy should commit to consulting with all land holders (including State land managers) to ensure that gas and petroleum activities minimise conflict with other land uses. This commitment should be added and be activated in the Planning & Design phase of project activities.</p>	<p>–</p>	<p>The development identified in the comment is the Tipton gas field for which Environmental Authorities (EA) were issued by DERM (now EHP) under the Environmental Protection Act 1994 (Qld). The development continues to operate under the conditions of the EAs. Expansion of the Tipton gas field was approved by the EA issued for the Dalby Expansion Project which incorporates revised conditions that reflect current policy with regard to coal seam gas development. Constraints mapping developed as part of the EIS was not available at the time and consequently did not inform siting of the infrastructure. Nevertheless, detailed ecological surveys were undertaken to support the EA applications and constraints to be considered in siting the infrastructure identified. EA conditions ensure sensitive environmental values are protected or managed to reduce impacts on environmental values. A moderate or high constraint does not preclude development. The level of constraint identifies the need for specific environmental controls to manage the potential impacts identified through detailed surveys.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
19c	<p>Issue: Location of major infrastructure</p> <p>It is not clear if major infrastructure has been excluded from possible location on the floodplain. One of the recommendations of the Flood commission report was to ensure that this consideration is accepted.</p> <p>Recommendation</p> <p>The supplementary report to the EIS, in describing major infrastructure required for the project including quarries, should show how major infrastructure can be located off floodplains above the highest recorded flood level. Should this not be possible, the report should show how infrastructure can be designed and placed so that it minimises disruption to overland flows and floods.</p>	<p>SREIS</p> <p>Chapter 9, Section 9.5, Attachment 2, Figures 9.11, 9.12 and 9.13</p>	<p>Arrow has committed to site facilities above the 1-in-100-year average flood recurrence interval where practicable, and design infrastructure taking into consideration overland flow and flooding regimes to reduce impacts on immediate and surrounding areas. An overland flow and flooding regime assessment is presented in SREIS Chapter 9, Surface Water, Section 9.5 for the properties where four central gas processing facilities and one TWAF will be sited.</p> <p>SREIS Chapter 9, figures 9.11, 9.12 and 9.13 show the predicted 1-in-100-year ARI flood extent and depth for the receiving environment of the CGPF2, CGPF7, CGPF8, CGPF9 and TWAF F properties. The final location and design of infrastructure will have regard to flood mapping and natural flow paths on floodplains. Maintenance of overland flow will be a key input to route selection and rehabilitation methods that will be determined at a property level. Further details will be made available after the completion of detailed field development planning which is yet to be completed.</p> <p>SREIS Attachment 2, Strategic Environmental Management Plan (EMP) provides an update to the EIS Attachment 5, EMP which identifies high level management controls for the project. These controls, and any additional site-specific controls, will be set out in the statutory information requirements to support the application for an environmental authority (EA) or an EA amendment, in accordance with EHP Guideline "Application requirements for petroleum activities".</p>
19d	<p>Issue: Management of water in storage dams (C069)</p> <p>The flood events of 2010 and 2011 have shown the necessity to respond to potential heavy wet seasons in a more proactive and planned manner. Whilst C069 mentions an emergency response plan, it would be prudent to prepare for predicted wet seasons rather than relying on emergency response plans.</p> <p>Recommendation</p> <p>The supplementary report to the EIS should include a commitment that water levels in storage dams (raw and treated) would be drawn down in the spring and early summer for those years when a La Nina event is predicted (above average rainfall).</p>	<p>SREIS</p> <p>Attachment 5</p>	<p>Arrow will develop the construction, design and monitoring requirements for new dams (either raw water, treated water or brine dams) and determine the hazard category of the dam in accordance with the requirements of the most recent version of Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (EHP, 2012f). Arrow will construct the dams under the supervision of a suitably qualified and experienced person in accordance with the relevant DERM schedule of conditions relating to dam design, construction, inspection and mandatory reporting requirements (Commitment C141). Arrow will have a suitably qualified person routinely monitor the integrity and available storage of dams (Commitment C532).</p>
19e	<p>Issue: Water quality changes (C145)</p> <p>The EIS predicts a drawdown of approximately 1.2m on the western edge of the Condamine floodplains in the vicinity of Cecil Plains. The alluvium in this area abuts the Kumbarilla beds where the water is of poorer quality than in the Condamine Alluvium. The change in hydraulic gradient is likely to cause poorer quality water from the Kumbarilla beds to migrate into the Condamine alluvium. The issue of make-good for deterioration of water quality in this area is not addressed in the EIS.</p>	<p>EIS</p> <p>Chapter 14, Section 14.6.3</p>	<p>Since the release of the EIS, the Underground Water Impact Report (UWIR) for the Surat Cumulative Management Area (CMA) was released by the Queensland Water Commission (QWC), now identified as the Office of Groundwater Impact Assessment (OGIA). The UWIR forms part of the regulatory framework for managing the cumulative impacts associated with groundwater extraction within the Surat Cumulative Management Area (CMA). The OGIA developed a regional groundwater flow model to predict the impacts of groundwater extraction by the petroleum and gas activities planned and occurring within the Surat CMA.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
19e (cont'd)	<p>Recommendation</p> <p>Arrow Energy should detail how it will go about responding to deterioration of water quality induced by the draw down and subsequent hydraulic changes.</p>		<p>The UWIR defines Immediately Affected Areas and Long-term Affected Areas based on the predicted groundwater drawdown in aquifers identified in the regional model. An Immediately Affected Area for an aquifer is defined as the area within which groundwater drawdown is predicted to exceed the bore trigger threshold (2 m for an unconsolidated aquifer and 5 m for a consolidated aquifer) within three years. The Long-term Affected Area for an aquifer is defined as the area within which groundwater drawdown is predicted to exceed the bore trigger threshold at any time in the future.</p> <p>Under the <i>Water Act 2000</i> (Qld) and the Underground Water Obligations determined by OGIA, Arrow is required to undertake bore assessments in the Immediately Affected Area to evaluate whether bores are likely to experience an impaired capacity i.e., no longer be able to supply the quantity or quality of water it is authorised for as a result of extraction of water during production of coal seam gas. Baseline assessments of potentially impacted third party bores currently accessing groundwater from the Condamine Alluvium will collect information on the water quality at these locations in accordance with a baseline assessment plan approved by EHP.</p> <p>If an impaired capacity is identified, the tenure holder must negotiate a make good agreement with the bore owner. A range of make good measures are presented in the EIS. Arrow will enter into individual agreements with each potentially affected bore owner (as defined in UWIR) and the most suitable option will be agreed between the parties, i.e., it may be more suitable in one instance to deepen the bore, whereas in another instance, a more suitable option could be to lower the pumping infrastructure.</p> <p>Arrow is legislatively obligated to adhere to these requirements and has commenced this process for bores identified in the current UWIR.</p>
20a	<p>Issue: Missing State government approvals required</p> <p>In appendix A4 – Project relevant legislation Table 1.1 Supplementary information on relevant legislation (p4-2), there is no reference to State government approvals required in accordance with the Sustainable Planning Act 2009 for related activities which are off tenure.</p> <p>State approvals required under the provisions of the Land Act 1994 in relation to the use of State owned land administered by the Department of Natural Resources and Mines (DNRM) should be included in the event that a lawful authority is not provided for under another act. While it is understood that approvals will be obtained under the Petroleum and Gas (Production and Safety) Act 2004 for proposed works within the Petroleum Lease (PL), works for supporting infrastructure may require approval under the Land Act 1994 if the proposed works are to be located on State owned land.</p>	<p>SREIS Attachment 7</p>	<p>SREIS Attachment 7 Legislation and Policy references the approvals required in relation to the use of state owned land and resource entitlement under the provisions of the <i>Land Act 1994</i>.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
20a (cont'd)	<p>Furthermore, the provision of evidence of resource entitlement (where a General Authority does not apply) to the lodgement of a proposed development application to satisfy section 264 of the Sustainable Planning Act 2009 (SPA) is required to be obtained from the Department of Natural Resources and Mines (DNRM) in accordance with Item 2 of Schedule 14 State Resources of the Sustainable Planning Regulation 2009 (SP Reg) in relation to State owned land.</p> <p>Recommendation</p> <p>Arrow Energy should note that the written agreement of the Chief Executive administering the Land Act 1994 (or his authorised delegate) is required from DNRM to accompany a Request to Change an Existing Approval Application to be assessed in terms of section 383, 369 or 379 of the Sustainable Planning Act 2009 (SPA). The supplementary report to the EIS should be updated accordingly.</p>		
20b	<p>Issue: Incorrect reference to permanent road closure process under the Land Act 1994.</p> <p>The Department of Natural Resources and Mines (DNRM) is responsible for administering roads under the Land Act 1994 while the day-to day management, control and regulation of roads lies with either the relevant local government (under the Local Government Act 1993 (Qld)) or in the case of a declared road under the Transport Infrastructure Act 1994 (Qld), the Department of Transport and Main Roads.</p> <p>Consequently, a proposal in relation to road closures/alterations must be referred to DNRM for consideration in consultation with the relevant road manager. In the event that a decision is made to support a proposed permanent road closure, the resulting land is required to be included into the adjoining land parcel/s.</p> <p>Recommendation</p> <p>Arrow Energy should consult with the department to determine process requirements in relation to the closure of roads.</p>	-	Arrow notes the advice and will consult with the Department of Natural Resources and Mines and local council or TMR in relation to any proposal to close roads.
21a	<p>Issue: Increased uncertainty associated with generalisations and assumptions</p> <p>A very large area (Area - 122,210 km², vertical depth - 2.5 km, model structure -15 layers) has been modelled on MODFLOW- 2000 software to describe groundwater impacts for the project. Consultants have used the data collected by Arrow Energy and available geological and hydrogeological data from published material and from other company works to develop the regional scale geological model that provided the basis for the numerical model.</p>	<p>SREIS</p> <p>Chapter 8 and Appendix 4</p>	<p>The numerical model prepared for the EIS was peer reviewed and considered appropriate for the purposes of predicting groundwater drawdowns in key aquifer units on a regional scale in response to coal seam gas extraction.</p> <p>For the SREIS, Arrow has prepared a numerical groundwater model using the Office of Groundwater Impact Assessment (OGIA) model as a base, and updating it to include to Arrow's current development case. This approach was endorsed by EHP. The predicted groundwater drawdown is presented in SREIS Chapter 8, Groundwater.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
21a (cont'd)	<p>This process involved assumptions and generalisations as follows:</p> <ul style="list-style-type: none"> • Uncertainty associated with structure tops and isopachs (Section 2.2.4): The report states “A Convergent Interpolation Algorithm has been used to generate representative structural tops, and in this process number of well sites has been removed as part of outlier discrimination process”. The impact of the simplification associated with this process is not known and it could compromise the actual structural configuration and thereby increases the uncertainty of the model output. • Limited understanding of the vertical hydraulic conductivity (Section 2.5.3): It appears that there is very little knowledge on the vertical movement of water through confining layers and inter-connectivity of confined aquifers. The report states “Measured Kv data are scarce. The values presented in Table 2.7 have been defined based on the general description of units provided by Green (1997) and Goscombe and Coxhead (1995)”. This adds uncertainty to the calculation of the vertical movement of water between aquifers. Vertical movement of water between aquifers is a crucial issue because when stressed by dewatering during mining operations water could vertically move between aquifers in response to changed hydraulic heads. Hence rigorous monitoring is required to monitor impact areas. • Incomplete boundary conditions (Fig 3.6): Constant head boundaries had been applied in the western, southeastern and in the northeastern borders of the model. Most of the other border areas are bounded by no flow cells. There is no information for the rest of the border area in the south west. • Inaccuracies in the groundwater abstraction data (Section 2.6). Groundwater abstraction data is a very important component of the water balance and inaccuracies in the location and abstraction rates lead to erroneous results. The following aspects of the model are important in this regard: <ul style="list-style-type: none"> – Agree with the consultant’s comment “Accurate and complete records are not available to describe the location and abstraction rates for non-CSG abstractions and an assessment is required independent of the non-CSG abstractions. – Projected groundwater abstraction rates from Arrow and other CSG producers in the Surat Basin have been used in the model. The actual future abstractions could differ from projected rates. – Abstraction data has been assigned evenly between the wells for each O. 		<p>The OGIA model also considers information available since the preparation of the EIS, and has applied them as new model inputs, including a detailed sub-model of the Condamine Alluvium, additional data defining hydraulic parameters, and groundwater level information from existing coal seam gas fields and ongoing groundwater monitoring programs.</p> <p>The process adopted to develop this model demonstrates the evolution since the EIS, through the use of additional information to refine the model.</p> <p>Any further updates of the Underground Water Impact Report (by OGIA) will consider changes to proponents’ production plans and the results of their groundwater monitoring programs.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
21a (cont'd)	<p>– The length of the stress periods for the model simulation is based on the division of historical CSG abstraction into 6 Monthly averages. (Stress Periods are computational time intervals for MODFLOW simulations).</p>		
21b	<p>Issue: Homogeneous hydraulic parameter distribution for model calibration (Section 3.8.4):</p> <p>The hydraulic parameter distribution for all layers is homogeneous throughout their extent. This is unlikely to be valid throughout the model domain as pointed out by consultants, and will add uncertainty to the model output.</p> <p>In summary, the objective of the modeling exercise is to provide estimates of the groundwater impacts in response to CSG activities. Uncertainties associated with the conceptual model, input data and model calibration will translate into the model predictions. Therefore adequate monitoring should be in place to identify impacts in response to CSG activities.</p> <p>Recommendations</p> <p>It is recommended that Arrow Energy:</p> <ol style="list-style-type: none"> 1. uses the model as a guide; 2. develops a detailed monitoring program that would address uncertainties and unknowns in the management of groundwater impacts; and 3. refines the model when new data becomes available. 	<p>SREIS Chapter 8 and Appendix 4</p>	<p>Arrow have used the OGIA model and updated it to include the current development case. This model has been used to predict groundwater drawdown under a cumulative scenario, and the results are presented in SREIS Chapter 8, Groundwater. The OGIA model also considers information available since the preparation of the EIS, and has applied them as new model inputs, including a detailed sub-model of the Condamine Alluvium, additional data defining hydraulic parameters, and groundwater level information from existing coal seam gas fields and ongoing groundwater monitoring programs.</p> <p>The process adopted to develop this model demonstrates the evolution since the EIS, through the use of additional information to refine the model.</p> <p>Any further updates of the Underground Water Impact Report (by OGIA) will consider changes to proponents' production plans and the results of their groundwater monitoring programs.</p>
21c	<p>Issue: Presence of complex structural features such as faults in the model area (Section 2.2.4)</p> <p>Vertical faults are commonly believed to act as either barrier to horizontal groundwater flow normal to the fault, or conduits to horizontal flow tangential to the fault, or a combination of both. As a result complicated preferential flow patterns could develop in case faulted zones are hydraulically connected with depressurised aquifers. As the effect of faults is difficult to predict, on going monitoring is needed to detect their impact on groundwater.</p> <p>Recommendation</p> <p>It is recommended that Arrow Energy establishes monitoring wells in target fault zones as part of the management of groundwater impacts from the project.</p>	<p>SREIS Chapter 8</p>	<p>Arrow will implement a groundwater monitoring program in consultation with, and regulated by the Office of Groundwater Impact Assessment (OGIA) as part of the Surat Cumulative Management Area and the associated Underground Water Impact Report. The location of monitoring wells will consider structural features such as faults.</p>
21d	<p>Issue: Inadequate consideration of mitigation strategies for cumulative impacts Appendix G, Section 10.8, pg. 109 -115: The EIS treatment of mitigation strategies to address cumulative impacts is inadequate.</p>	<p>EIS Chapter 28</p>	<p>Cumulative impacts were described in EIS Chapter 28, Cumulative Impacts. Moving forward, the management of cumulative groundwater impacts will be regulated by OGIA, and managed in accordance with the requirements set out in the Surat CMA UWIR. Arrow is required to comply with these measures (e.g. make good obligations) and associated reporting requirements.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
21d (cont'd)	<p>Recommendation: In the supplementary report to the EIS provide a specific section on mitigation strategies for cumulative impacts to groundwater.</p>		
22	<p>Issue: Inadequate discussion of impacts and proposal to discharge water to streams Appendix I, section 4.2, pg. 29-30 – The discussion on impacts and beneficial uses in this section has not been included in the main report. An allowance for 0.5 GL discharge of treated coal seam water per annum is mentioned for the first time in this appendix. However, no information is provided on how this has been determined, when and where it would be expected that a discharge permit may be required, and what other options were considered and why they are not suitable.</p> <p>Recommendation: In the supplementary report to the EIS describe where the proposed amount of discharge (0.5 GL) came from. Describe situations where (and when) it would be expected that a discharge permit may be required. Describe the other options that were considered in the waste management hierarchy and why they are not suitable.</p>	<p>EIS Chapter 8 SREIS Chapter 9, Section 9.6, Chapter 10 and Attachment 4 and Attachment 5</p>	<p>The SREIS provides further details on Arrow's water management options, including an updated Coal Seam Gas Water and Salt Management Strategy (SREIS Attachment 5, Coal Seam Gas Water and Salt Management Strategy).</p> <p>At the time of publication of the EIS, specific locations of project infrastructure were unknown. As such, Arrow conducted the impact assessment under the structure of the environmental framework which is presented in EIS Chapter 8, Environmental Framework.</p> <p>Since the publication of the EIS, Arrow has identified four properties to potentially locate central gas processing facilities, two of which will have water treatment facilities located adjacent to them and are proposed to discharge coal seam gas water to nearby watercourses. The SREIS surface water study investigates impacts of coal seam gas water discharge, which will now occur under normal operating conditions, on water quality and other surface water aspects including geomorphology and hydrology (SREIS Chapter 9, Surface Water, Section 9.6). This investigation provides recommendations for preliminary guidelines for initial discharge within which impacts to erosion are likely to be negligible. Arrow has committed to develop a strategy for the discharge of coal seam gas water to watercourses in accordance with relevant legislation. The strategy will incorporate a water quality monitoring program with locations upstream and downstream of the discharge point to inform site specific water quality objectives. A detailed environmental flows assessment informed by water quality monitoring data and an aquatic ecology monitoring program will inform the discharge strategy. Periodic inspections of the physical form and hydrology of the watercourse are to be incorporated in the strategy to monitor geomorphic performance (Commitment C498).</p>
23a	<p>Issue It is unclear from the report which species of conservation interests (both under NC Act and EPBC Act) were found in the study area as part of the database searches, which of them (or new species) have been found during field surveys and which are likely to be present (if not found but the habitat is present).</p> <p>Recommendation The supplementary report to the EIS should present a list which identifies clearly which species were found from which database as well as the likelihood of this species to be present in the project area based on habitat assessment. This should include an assessment of likelihood of presence of potential listed species in the survey area based on survey results (species is either present or not present).</p>	<p>EIS Chapter 16, Appendix J, Section 14 and Table 3-2 SREIS Chapter 10, Section 10.4 Appendix 7, Attachment 2</p>	<p>EIS Appendix J, Aquatic Ecology Impact Assessment, identifies legislatively significant species, i.e., Table 3-2 lists any fish species previously recorded as per the desktop reviews, with any EPBC listed species highlighted.</p> <p>Greater detail is provided in EIS Appendix J, Aquatic Ecology Impact Assessment, Section 14 regarding any fish species recorded in field studies or desktop reviews, including their listing under the NC Act and/or EPBC Act.</p> <p>It should be noted that in the EIS Chapter 16, Aquatic Ecology, the conservation status of a species is listed when the species is first mentioned in the text.</p> <p>The species, Murray Cod is discussed in both the technical report and the EIS Chapter 16, despite the species not being recorded during field surveys (as its habitat requirements are present in the area).</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
23a (cont'd)	<p>And if the species is not present if the species is possible or unlikely to be found on the survey area based on survey results, database searches and habitat assessments.</p> <p>The list should also contain the status of each species under each Act (NC Act and/or EPBC Act and/or local conservation significance).</p> <p>Furthermore, mention the conservation status of each species the first time a species is mentioned in the text.</p> <p>Discuss in the text any species which are likely to be present based on habitat requirements but have not been found during studies.</p>		<p>Species dossiers are presented for all conservation significant species likely to occur in the project development area in SREIS Appendix 8, Supplementary Aquatic Ecology Assessment, Attachment 2.</p> <p>SREIS Chapter 10, Aquatic Ecology, Section 10.4 describes each species recorded during the supplementary field surveys, including their conservation status.</p>
23b	<p>Issue</p> <p>The text contains a mixture of common names and scientific species names. It is understood that not all species have a common name, but the text must be consistent in the approach.</p> <p>Recommendation</p> <p>The supplementary report to the EIS should amend the EIS text such that when mentioned first in the text, list the species in common names and in brackets state the scientific name and conservation status under the NC Act (even if it is least concern). List if the species is also listed as threatened under the EPBC Act and/or local conservation significance.</p> <p>If the species does not have a common name, mention it and list in brackets its conservation status as stated above.</p>	<p>SREIS Chapter 10</p>	<p>The SREIS Chapter 10, Aquatic Ecology, provides the scientific names of all species when first mentioned, and describes the conservation status if applicable.</p>
23c	<p>Issue: Pages ii-iii, Executive summary, Study findings</p> <p>It is unclear where the freshwater blackfish and the purple spotted gudgeon were recorded and what conservation status they have (NC Act and/or EPBC Act and/or local conservation significance).</p> <p>Recommendation</p> <p>The supplementary report to the EIS should describe where the freshwater blackfish and the purple spotted gudgeon were recorded (the term "at a site just outside the study area" is not specific enough) and state their conservation status under both Acts. The report should state local conservation significance (if applicable) and the source of this information.</p>	<p>EIS Chapter 16, Figure 16.1 Appendix J, Section 14 and Figure 3-2</p> <p>SREIS Appendix 8, Attachment 2</p>	<p>Both species were recorded at the Westbrook Creek site, labelled incorrectly as Site 61 in EIS Appendix J, Aquatic Ecology Impact Assessment, Figure 3-2 and labelled correctly as Site 62 in EIS Chapter 16, Aquatic Ecology, Figure 16.1.</p> <p>EIS Appendix J, Aquatic Ecology Impact Assessment, Section 14 provides further detail (such as conservation status) regarding each species recorded, including the purple-spotted gudgeon and freshwater blackfish.</p> <p>SREIS Appendix 8, Supplementary Aquatic Ecology Assessment, Attachment 2 includes species dossiers for all significant species within the project development area, including the freshwater blackfish and purple spotted gudgeon.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
23d	<p>Issue: Page iii, Executive summary, Project constraints - Second paragraph (see also comments on s.16.2.2)</p> <p>It is unclear how the assessment of the project development area which covers approximately 65,000 ha can be assessed on 11 sites. All four rivers drainage basins impacted by the project should be covered in identifying impacts.</p> <p>Recommendation</p> <p>The supplementary report to the EIS should clarify the specialist methodology used to describe the aquatic ecology of the project area and explain in more detail the findings and implications for the project.</p>	<p>EIS</p> <p>Appendix J, Section 3.3</p> <p>SREIS</p> <p>Chapter 10, sections 10.4.3 and 10.4.4</p>	<p>The site-selection methodology is described in greater detail in EIS Appendix J, Aquatic Ecology Impact Assessment, Section 3.3.</p> <p>Additional surveys have been undertaken as a part of the SREIS to further characterise the existing environment, including assessing survey sites within the Dawson River and Macintyre and Weir rivers sub-basins (SREIS Chapter 10, Aquatic Ecology, Section 10.4.3).</p> <p>As two proposed discharge locations have been identified (following submission of the EIS), extensive site-specific field surveys have been undertaken to further characterise the environments at these two locations (as described in SREIS Chapter 10, Aquatic Ecology, Section 10.4.4). The potential impacts at these two locations are identified in addition to proposed additional mitigation measures.</p>
23e	<p>Issue: Page iii, Executive summary, Project constraints</p> <p>Last dot point: It is unclear what “all remaining areas” refer to if the dot points above state all sites are either of ‘no go zones’, ‘highly constrained’ and ‘moderately constrained’ and that there are ‘no aquatic ecosystems of low sensitivity’ as ‘every site is linked to every other site’.</p> <p>Recommendation</p> <p>The supplementary report to the EIS should provide information on the term “all remaining areas”.</p>	<p>–</p>	<p>The term all remaining areas, used in this context, is referring to areas that are not aquatic ecosystems. These areas allow for construction and operation in compliance with standard environmental procedures (and in accordance with other non-aquatic constraints).</p>
23f	<p>Issue: Page iv, Executive summary, Project constraints</p> <p>Second paragraph: Buffer zones around Lake Broadwater Conservation Park. The term “Limited Petroleum Activities” is not explained here or anywhere in the report. It is not clear what the 1 km buffer and the 200 m buffer means.</p> <p>Recommendation</p> <p>In the supplementary report to the EIS define the term “Limited Petroleum Activities” and describe the significance of the 1 km and 200 m buffer areas.</p>	<p>EIS</p> <p>Chapter 16, Table 16.6</p> <p>SREIS</p> <p>Chapter 11, Section 11.5.2</p>	<p>The described buffer zones in the EIS are in accordance with model conditions for Level 1 Environmental Authorities for Coal Seam Gas Activities.</p> <p>SREIS Chapter 11 Terrestrial Ecology, Section 11.5.2 describes the requirements for buffers. Where necessary, buffers will be applied to protect significant environmental values, particularly where indirect impacts (e.g., edge effects, displacement) are likely. An example of regulated buffer distances for ESAs is proposed in the Model Conditions for Level 1 Environmental Authorities for Coal Seam Gas Activities (DERM, 2011d). This example was used to inform ecological assessments in the EIS and SREIS. It is noted that regulatory policy is evolving to an outcome-based approach.</p> <p>Impacts to sensitive areas will be avoided or minimised through environmental management controls that reflect the sensitivity of the environmental value. The need for buffers and buffer distances will be determined by legislative requirements at the time of development of a site or management measures set out in species-specific management procedures.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
23f (cont'd)			Limited Petroleum Activities refer to activities that include well sites not exceeding 1 ha of disturbance and multi-well sites not exceeding 1.5 ha of disturbance, geophysical surveys, ecological geological surveys, gathering/flow pipelines from a wellhead to the initial production facility, supporting access tracks and communication and powerlines necessary for the undertaking of petroleum activities. The definition excludes construction of dams, borrow pits, production facilities and construction camps.
23g	<p>Issue: Page vi, Glossary of terms The terms "lotic" and "lentic" used in the text are not listed.</p> <p>Recommendation In the supplementary report to the EIS, include the terms "lotic" and "lentic" and define them.</p>	<p>EIS Appendix J</p>	EIS Appendix J, Aquatic Ecology Impact Assessment, Glossary of Terms describes lotic and lentic as flowing water and non-flowing water respectively.
23h	<p>Issue: Page 13, Desktop study, third paragraph The EPA Wildlife Online Search Tool is referenced as EPA 2009 and the Regional Ecosystem Mapping and Moratorium Mapping Tool as DERM 2009. This is inconsistent.</p> <p>Recommendation Arrow Energy should check reference (EPA or DERM) and correct the reference if necessary.</p>	<p>SREIS Chapter 23</p>	Noted. The SREIS will provide an updated reference list (SREIS Chapter 23, References).
23i	<p>Issue: Page 17, Figure 3-2 The study site 61 on the map does not exist in the text. The study area is not shown on the map. It is described in the text but a figure must be self-explanatory and hence must present an outline of the study area as well as the project development area.</p> <p>Recommendation The supplementary report to the EIS, should clarify the site and label accordingly. The study area should be outlined on the map.</p>	<p>EIS Chapter 16, Figure 16.1 and Appendix J, Figure 3-2</p>	<p>EIS Appendix J, Aquatic Ecology Impact Assessment, Figure 3-2 mislabelled Site 62, with the figure showing it as Site 61. EIS Chapter 16, Aquatic Ecology, Figure 16.1, identifies Site 62 correctly, and provides an outline of the study area for the aquatic ecology impact assessment.</p>
23j	<p>Issue:Pages 35/36, Water quality, Tables 4-4 and 4-5 Average values of in-situ physico-chemical water quality measurement can not averaged across all sites for both surveys (dry and wet season). This is not scientifically sound. The current EIS has included two tables with averages of in-situ physico-chemical water quality results. As outlined before, the use of averages and range is inappropriate and instead site data should be provided.</p>	<p>EIS Appendix J, tables 4-2 and 4-3 SREIS Chapter 10, Section 10.4</p>	<p>The survey sites used in the EIS were to provide an indication across a large area, not to identify an absolute water quality result. The water quality results recorded at each EIS survey site is presented in EIS Appendix J, Aquatic Ecology Impact Assessment, Table 4-2 and Table 4-3. SREIS Chapter 10, Aquatic Ecology, Section 10.4 presents the water quality results of the additional field surveys undertaken. These results are presented in summary tables, separated by the two survey areas proposed to receive discharge.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
23j (cont'd)	<p>Recommendation</p> <p>Arrow Energy should amend the EIS by deleting tables 4-4 and 4-5.</p>	<p>SREIS (cont'd)</p> <p>Appendix 8, Section 4.2.3 and Appendix 8, Addendum</p>	<p>The complete water quality results recorded at each individual site is presented in SREIS Appendix 8, Supplementary Aquatic Ecology Assessment, Section 4.2.3, for sites surveyed in February and March 2013 and in the addendum report to Appendix 8, for sites DA2-8 and DA2-9 that were surveyed in May.</p>
23k	<p>Issue: Page 58, Macrophytes, Bray Curtis similarity matrix</p> <p>The implications of the Bray Curtis similarity matrix results are not explained. For example; "Sites 1 (Condamine River) and 72 (Brigalilly Creek) were distinctly different from all other sites being the only two sites to have Typha orientalis (Cumbungi) present" does not mean anything to an untrained ecologist.</p> <p>Recommendation</p> <p>The supplementary report to the EIS should discuss what this analysis means in the context of the overall study.</p> <p>Relate data to the water quality/sediment/fauna results.</p> <p>Apply this comment also to all other statistical analyses carried out as part of the aquatic ecology study.</p>	<p>SREIS</p> <p>Appendix J, Figure 4-9</p> <p>Chapter 10, Section 1.4</p>	<p>The Bray Curtis similarity matrix is a tool to graphically show a statistical description, used in this instance to display a table of presence/absence graphically for ease of interpretation.</p> <p>The Bray Curtis similarity matrix presented in EIS Appendix J, Aquatic Ecology Impact Assessment, Figure 4-9, shows that sites 1 and 72 had less than 30% similarity, whilst the remaining nine EIS sampling locations were similar in terms of macroinvertebrates composition. These findings provide justification of the EIS assessment that the majority of the project development area is relatively similar in terms of habitat and biota, with few pockets of unusual or locally endemic species or communities identified.</p> <p>SREIS Chapter 10, Aquatic Ecology, Section 10.4, provides context to results from surveys undertaken.</p>
23l	<p>Issue: Page 60, Sensitivity of aquatic environmental values, Lake Broadwater</p> <p>Lake Broadwater is discussed several times as of conservation significant. However, it is unclear, why this area was not part of the survey effort.</p> <p>Recommendation</p> <p>Arrow Energy should undertake aquatic ecology field sampling at Lake Broadwater or discussed why this area should not be part of the survey effort.</p>	<p>SREIS</p> <p>Chapter 10, Section 10.4.2</p>	<p>The methods employed in the study were designed to identify aquatic values that may constrain development and provide a baseline for compliance monitoring during construction, operation and decommissioning of the project.</p> <p>Lake Broadwater is a Category A ESA and a listed nationally important wetland. Petroleum development is prohibited in Category A ESAs. Arrow has committed to avoiding the wetland system, through the implementation of relevant buffer distances. Aquatic ecology qualitative visual surveys were conducted for the SREIS and discussed in SREIS Chapter 10, Aquatic Ecology, Section 10.4.2. Aquatic ecology values were identified for the properties where Arrow proposes to locate infrastructure. The property where CGPF8 is proposed was found to have a watercourse that is situated in the catchment feeding Lake Broadwater. Arrow recognises Lake Broadwater as having high sensitivity.</p>
23m	<p>Issue: Page 62, Summary of existing aquatic ecosystems</p> <p>While this provides a summary of the presented study but it could be improved by relating the statements to the study sites. For example the statement "Macroinvertebrate assemblages from pool beds were markedly healthier than those in edge or riffle habitat [...]" would benefit from stating the study sites.</p>	<p>SREIS</p> <p>Chapter 10, Section 10.4</p> <p>Appendix 8, Addendum</p>	<p>SREIS Chapter 10, Aquatic Ecology, Section 10.4 provides descriptions of macroinvertebrate findings in relation to the survey areas they were recorded within. Details of findings at each individual site are presented in SREIS Appendix 8, Supplementary Aquatic Ecology Assessment, Addendum Report.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
23m (cont'd)	<p>Recommendation</p> <p>Arrow Energy should revise the summary to make it consistent and relate the overall findings to the study area.</p>		
23n	<p>Issue: Lack of evidence to support statement on the resilience of biota</p> <p>Appendix J pg. 79 – “The biota living within these systems are generally resilient species that tolerate a wide range of conditions and are not affected by disturbances of the nature posed by this project”. No information is provided to support this statement. Also, it is a broad generalisation across a range of aquatic systems.</p> <p>Recommendation:</p> <p>In the supplementary report to the EIS, Arrow Energy should discuss this statement and provide references to scientific studies that support the statements made in the EIS.</p>	<p>EIS</p> <p>Appendix J, Section 4.4</p> <p>SREIS</p> <p>Chapter 10, Section 10.3.2</p>	<p>This statement is referring to the generally ephemeral watercourses identified within the study area, which were assessed as having relatively low sensitivity (as detailed in EIS Appendix J, Aquatic Ecology Impact Assessment, Section 4.4). Attributes of the ephemeral watercourses that informed these conclusions included that:</p> <ul style="list-style-type: none"> • They provide marginal aquatic habitat due to the short periods during which they contain water, lack of connectivity to larger, permanent watercourses and minimal spawning/nursery habitat. • They are not unique on a local or regional scale and represent a very small proportion of similar aquatic habitat regionally. • They are likely to be opportunistically utilised by aquatic fauna and flora that are tolerant of significant disturbance events and which are adapted to rapidly colonise and regenerate when conditions are suitable. <p>SREIS Chapter 10, Aquatic Ecology, Section 10.3.2 outlines the further field surveys undertaken of ephemeral watercourses in the project development area and the findings of these surveys.</p>
23o	<p>Issue: Inadequate assessment of water management options including beneficial use</p> <p>Appendix J pg. v – “This report excludes assessment of hydrologic and/or water quality impacts associated with beneficial use of treated or untreated CSG water. These considerations are outside the scope of the EIS and have therefore not been considered as part of this assessment.” While the impacts of the use of the water under a beneficial use agreement (BUA) may be out of scope of the EIS, the supply of water to meet these uses is within the scope, and the feasibility and potential impacts of all water management options being considered must be presented.</p> <p>Recommendation:</p> <p>In the supplementary report to the EIS, Arrow Energy should provide a thorough analysis of all water management options being considered, including beneficial uses. This should include a feasibility assessment at each proposed integrated processing facility location as well as for each development region, and assessment of potential impacts related to each option.</p>	<p>SREIS</p> <p>Chapter 3, Section 3.7, Chapter 9 and Chapter 10</p>	<p>As described in SREIS Chapter 3, Project Description, Section 3.7, within the Surat Basin, it is possible that the full range of coal seam gas water management options will need to be utilised including beneficial use and disposal, via distribution, injection and discharge, as follows:</p> <ul style="list-style-type: none"> • Distribution to existing and new users for beneficial use. • Injection into a suitable aquifer. • Discharge to watercourses and/or the ocean under defined conditions. <p>Disposal to watercourses and the ocean are not preferred options but variability in rainfall between seasons and from year to year and demand for coal seam gas water over time will determine the volumes of coal seam gas water that can be managed through application of the identified options. Water demand, land use, weather, watercourse type and morphology, and aquatic ecosystems will dictate how the management options may be utilised at each water treatment facility site. It should be noted that disposal to watercourses and the ocean are only preferable when there is low alternative demand for coal seam water.</p> <p>Further detailed site-specific surveys have been undertaken at the locations of two potential discharge locations. SREIS Chapter 3, Project Description, Section 3.7.4 presents conceptual water management at the conceptual water treatment facilities at CGPF2 and CGPF9.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
23o (cont'd)			<p>SREIS Chapter 9, Surface Water and Chapter 10, Aquatic Ecology identified the additional potential impacts following discharge at these locations, and propose further mitigation measures to minimise potential impacts.</p> <p>The specific details for coal seam gas water management options will be developed further through detailed engineering design. Chosen management options will be detailed in the coal seam gas water management plan required for the EA or EA amendment application. The management plan will include detailed coal seam gas water and brine impact assessments and management strategies in accordance with the EHP Guideline "Application requirements for petroleum activities".</p>
23p	<p>Issue: Presentation of water quality results</p> <p>Appendix J pg. 35-37 - The means, minimums and maximums for water quality have been derived by summarising information across all sites in the project area. Because of the high variability between sites, it would be more useful to characterise the water quality at a number of locations, from which an overall maximum or minimum value for the project area can be derived if required.</p> <p>Recommendation:</p> <p>The supplementary report to the EIS should provide a summary of water quality results at a larger spatial scale.</p>	<p>SREIS</p> <p>Chapter 10, Section 10.6.2</p> <p>Appendix 6, Tables A1T-2 and A1T-3 and Appendix 8</p>	<p>The water quality results of the additional field surveys undertaken to inform the SREIS are presented in SREIS Chapter 10, Aquatic Ecology, Section 10.6.2. These results are presented in summary tables, separated by the two survey areas proposed to receive discharge. The complete water quality results recorded at each individual site are presented in SREIS Appendix 8, Supplementary Aquatic Ecology Assessment.</p> <p>Additionally, the SREIS includes a site-specific surface water assessment of the impacts on watercourses proposed to receive discharge. As part of this assessment, water quality sampling was undertaken at several sites at each watercourse. Results are presented in tables, separated according to the two survey areas and by flow condition, in Appendix 6, Supplementary Surface Water Assessment Part B – Water Quality, Table A1T-2 and A1T-3.</p>
23q	<p>Issue: Limitations of AUSRIVAS health assessment for ephemeral streams</p> <p>Appendix J pg. 43 -49. While the AUSRIVAS model is the appropriate assessment tool to be used, the results should be interpreted with caution in lowland ephemeral streams. One of the problems with the existing models is the lack of reference sites available in these areas to inform the calculation of expected taxa. Therefore if the expected taxa are based on more upland streams, the resulting Observed / Expected (O/E) ratios may be lower and therefore ecological health assessments may also be lower than is actually the case. The fact that the edge results are a grade higher suggests there may be a problem (usually the two habitats should provide fairly consistent assessments). The assessment is likely to vary considerably in these systems depending on the flow / climate conditions at the time.</p> <p>Recommendation:</p> <p>In the supplementary report to the EIS, explain that although many sites may be impaired, these sites are naturally less diverse in fauna but may still contain some important instream values.</p>	<p>SREIS</p> <p>Chapter 10</p>	<p>The higher edge results do not suggest a problem. Rather, these are consistent with common ephemeral watercourse findings (where the middle of the watercourse is silty, turbid and of lower habitat quality, compared to the edge of the watercourse, where pockets of vegetation provide a higher habitat value).</p> <p>The EIS acknowledged the limitations of using AusRivAS models on an ephemeral system with low overall diversity, and so a multivariate statistical approach was also utilised to determine whether the sites upstream of the project development area differed in terms of macroinvertebrate assemblages.</p> <p>Additional field surveys undertaken to inform the SREIS (described in SREIS Chapter 10, Aquatic Ecology) provide additional information on the in-stream values of watercourses within the project development area that have the potential to be affected by the project. This includes watercourses identified as potential receiving systems for coal seam gas water discharge.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
23r	<p>Issue: Inadequate assessment of possible impacts of emergency discharges Appendix J pg. 74 section 5.1 - Table 5.7 is one on the few places where the impact of an emergency discharge is considered. This has a higher impact across all locations than any of the other impacts considered, which suggests that consideration of this impact should be presented in the main text of the report.</p> <p>Recommendation: In the supplementary report to the EIS, include a discussion on emergency discharges. Also present further analysis of the possible water quality and quantity impacts at each of the proposed production facility locations that will store water.</p>	<p>SREIS Chapter 3, Chapter 9, Chapter 10, sections 10.6.4 and 10.6.5 and Chapter 11</p>	<p>Discharge to watercourses is now proposed under normal operating conditions as well as emergency conditions as detailed in SREIS Chapter 3, Project Description. SREIS Chapter 9, Surface Water, Chapter 10, Aquatic Ecology and Chapter 11, Terrestrial Ecology outline the two proposed discharge locations and present the findings of site-specific field surveys undertaken at both sites.</p> <p>SREIS Chapter 10, Aquatic Ecology, Section 10.6.4 describes the potential impacts identified through assessments of discharge to watercourses and Section 10.6.5 proposes additional mitigation measures to reduce the potential impacts to the identified watercourses.</p>
23s	<p>Issue: Incomplete cumulative impact assessment Appendix J pg. 109 – It is unclear what the assessments in bold e.g. ‘negligible’, ‘moderate’ etc. in this section are based on. There is no assessment presented of the cumulative impacts of CSG water extraction or disposal on watercourse quality or quantity.</p> <p>Recommendation: Arrow Energy, in the supplementary report to the EIS, should include information on the basis for these assessments. Include modelling of potential cumulative impacts of water extraction and potential discharge to streams (best and worst case scenarios).</p>	<p>EIS Chapter 28, Section 28.3.5 SREIS Chapter 10, Section 10.9</p>	<p>To assess cumulative impacts, third-party projects must have sufficient information in the public domain to identify potential impacts, and available information must indicate that a project could potentially impact on one or more of the environmental values directly or indirectly affected by the Surat Gas Project. The potential for cumulative impacts on aquatic ecology were considered where future developments included clearing or disturbance in or near watercourses and were located within the same drainage basin as the Surat Gas Project. Further discussion is contained in EIS Chapter 28, Cumulative Impacts, Section 28.3.5. Further assessment of potential cumulative impacts resulting from discharge to watercourses is contained in SREIS Chapter 10, Aquatic Ecology, Section 10.9.</p> <p>Develop a strategy for the discharge of coal seam gas water to watercourses in accordance with relevant legislation. The strategy will incorporate a water quality monitoring program with locations upstream and downstream of the discharge point to inform site specific water quality objectives. A detailed environmental flows assessment informed by water quality monitoring data and an aquatic ecology monitoring program will inform the discharge strategy. Periodic inspections of the physical form and hydrology of the watercourse are to be incorporated in the strategy to monitor geomorphic performance (Commitment 498).</p>
24a	<p>Issue The noise criteria have been correctly established however they have not been represented on a graphical output in coordination with the output of the noise modelling. The results of the noise modelling have not been overlaid onto a map of the areas. Three scenarios were selected but no graphical output were provided corresponding to those three selected scenario</p> <p>Recommendation In the supplementary report to the EIS, provide the output of the modelling in conjunction with the selected noise criteria and overlaid onto the map of the area.</p>	<p>SREIS Chapter 13 and Appendix 11</p>	<p>The noise criteria modelled for the SREIS are shown on contour plots within SREIS Appendix 11, Supplementary Noise and Vibration Assessment. These contours were developed at various assessment locations from which the predicted noise levels generated by the central gas processing facility and multi-well pads for the temporary and permanent power options are modelled in the assessment.</p> <p>Contour plots are not overlaid on map areas as exact locations of facilities are not yet known.</p> <p>Once exact facility and infrastructure locations are known, graphical representation of the noise contours relating to the specific site location can be re-modelled and provided as part of the statutory information requirements to support the application for an environmental authority (EA) or an EA amendment, in accordance with EHP Guideline “Application requirements for petroleum activities”.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
24a (cont'd)	Provide graphical output corresponding to the three scenarios.		
24b	<p>Issue</p> <p>The sound power level for the V8 gas engine and the water pump are relatively high if it is going to be considered that those noise sources will be active during night time during the life time operation.</p> <p>Recommendation</p> <p>In the supplementary report to the EIS, discuss design changes that could be made to the exhaust stack for the gas engine to provide lower sound power level so to minimise noise generation during night time. Commitments to reducing noise levels from this source should be made.</p> <p>It is also recommended that acoustics treatment for the water pump be designed to reduce the noise levels</p> <p>Note: Incorrect units of sound power levels are used in Annex N.</p>	<p>SREIS Chapter 13</p>	<p>Arrow is continually reviewing its technology options in order to incorporate best practice environmental management. The supplementary noise assessment incorporates a refined selection of equipment types and configurations at the central gas processing facilities (CGPFs) and multi-well pads. Where modelled noise levels associated with operation of the facilities exceed the established noise criteria, conceptual acoustic treatment options are considered to manage impacts. This includes consideration of acoustic treatment incorporated into the design of the water treatment facility. Treatment options will be developed further during the design stage of the project.</p> <p>Statutory information requirements will be provided in accordance with the EHP Guideline "Application requirements for petroleum activities" to accompany the application for an environmental authority (EA) or EA amendment.</p> <p>Arrow has committed to managing noise in accordance with the relevant environmental authority conditions.</p>
25	<p>The following minor edits and errors have been identified:</p> <ul style="list-style-type: none"> • Chapter 5, pg. 5, Figure 5.3: The geological eras are labelled incorrectly. The figure should have the lower era division as reading Palaeozoic and Upper Mesozoic, Devonian to Triassic. • Chapter 5, pg. 42, Figure 5.14: The schematic does not clearly identify stream alluvium. The figure should display and clearly label alluvium. • Chapter 14, Section 14.1, pg.1 – The EIS lists matters of environmental significance as including groundwater dependent ecosystems and groundwater springs. Springs are a groundwater dependent ecosystem so it is confusing to mention them separately. The EIS should state “including groundwater dependent ecosystems only” or identify the main categories of GDE according to Eamus et al. 2006. • Chapter 14, Section 14.1, pg.1 – The list of relevant legislation omits the Water Regulation 2002. The EIS should include the Water Regulation 2002 in the list of legislation, policy and plans. The Water Regulation 2002 regulates the Great Artesian Basin Declared Subartesian Area and the Eastern Downs Declared Subartesian Area, as these declared subartesian areas are within the project area. 	<p>SREIS Chapter 20</p>	<p>Arrow notes the minor edits and errors that have been identified. These errors have been noted in the errata table presented in SREIS Chapter 20.</p>

Table 20.1 Response to DERM Submission (cont'd)

Issue No.	Issue	Reference	Response
25 (cont'd)	<ul style="list-style-type: none"> • Chapter 14, Section 14.1, pg.2 – Under the GAB ROP summary it states that “For each groundwater management unit, a specified upper annual allocation of water is identified.” This is incorrect. General reserve volumes for each groundwater management unit are specified, but these do not equate to a specified annual allocation of water. • Chapter 15, Section 15.3.5, pg.17 – Provide a reference for the “mapped Queensland salinity zones” that are referred to. • Chapter 15, Section 15.5, pg. 28 – Environment protection objectives – include water quality objectives that will protect environmental values and the objectives of the proposed Murray Darling Basin Plan. • Chapter 28, Section 28.2, Table 28.1 pg. 9 - Nathan Dam and Pipeline (preliminary) estimated capital cost is AU \$630 million not AU \$120 million. Nathan Dam and Pipeline Project EIS were released on 23 April 2012 for public and government review, with submissions closing 5 June 2012. • Appendix G, Section 4.7.1 pg. 48 - The EIS should avoid the use of the term "mound springs". Please note that the EPBC Recovery Plan for the GAB springs uses the term "spring complexes". It says that although the name 'mound springs' is often applied to springs of the GAB, particularly in South Australia and New South Wales, many GAB discharge springs are not mounded and the term 'mound springs' is avoided. • Appendix J pg. 107 - What are the headings for the subcolumns in Table 7.11? Provide subheadings in the Supplementary EIS. 		
26	<ul style="list-style-type: none"> • Eamus D. et.al. 2006 A functional methodology for determining the groundwater regime needed to maintain the health of groundwater-dependent vegetation, Australian Journal of Botany, 2006, 54, 97–114. • Richardson S. et al 2011 Australian groundwater-dependent ecosystem toolbox part 1: assessment framework, Waterlines report, National Water Commission, Canberra 	SREIS Chapter 20	Arrow notes the reference errors that have been identified. These errors have been noted in the errata table presented in SREIS Chapter 20.

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