6

EIS Coal Seam Gas Field Environmental Values and Management of Impacts

Santos | PETRONAS

Section 6 EIS Coal Seam Gas Fields Environmental Values and Management of Impacts

The respondent comments provided in this section have been collated from all stakeholder submission comments relating to EIS Section 6 EIS Coal Seam Gas Fields Environmental Values and Management of Impacts. Please refer to **Attachment A** for copies of all submissions received.

6.1 Overall Assessment Methodology

Respondent Comment

Department of Environment and Resource Management states that the findings should include a detailed assessment of the mitigation measures provided to prevent and or minimise impacts to environmental values.

Santos Response

Please refer to the additional studies and information as presented in the EIS Supplement Attachments. In particular **Attachment D5** which provides details of supplementary assessment of impacts of the development of the CSG fields on ecological values and the proposed mitigation methods.

Respondent Comment

Department of Environment and Resource Management states that the EIS should provide a detailed assessment of mitigation measures that will appropriately avoid and or minimise impacts to environmental values identified in the EIS. Such measures should provide for the minimum standard of environmental management to be used by contractors and encourage adoption by contractors of best practice environmental management.

Santos Response

Detailed mitigation measures to avoid or minimise impacts to the CSG fields' environmental values identified in the EIS are provided in **Attachment D5** and will also be provided as part of the approvals negotiation process. Santos will avoid sensitive areas where practicable and mitigate by offset or similar where avoidance is not possible. Please refer to **Attachment B1** for the updated CSG field EMP.

Respondent Comment

Department of Environment and Resource Management states that a clear reasoned, evidence-based discussion and assessment of all mitigation measures to be adopted by the project should be provided. This assessment should take comments in this submission into consideration. As mentioned in other comments in this submission, the mitigation measures should be clear, measurable and auditable.

Santos Response

Santos has reviewed and revised the EMPs for the EIS to ensure they are clear, measurable and auditable. Refer to **Attachment B** for all revised EMPs.

Respondent Comment

Department of Environment and Resource Management states that detailed information on the following aspects will need to be provided prior to the granting of environmental authorities:

- *Point source air emissions;*
- *Air quality modelling;*
- *Point source noise emissions;*
- *Noise modelling to nearest sensitive receptors;*
- *Water releases to the environment (location, quality, quantity, frequency);*
- *Effluent irrigation modelling;*
- *Significant and high hazard dam designs and certifications;*
- *Nature and description of activities to be undertaken in environmentally sensitive areas; and*
- *Offset proposals.*

More detailed protocols under the Phase Two section of the EIS should be provided, detailing exactly what will be done to avoid, minimise and mitigate all impacts on all environmental values in all areas of the project. References to the EHSMS being the sole mitigation measure would not be considered acceptable in these circumstances.

The proponent should also detail what triggers will be included in this approvals process to amend environmental authority conditions as changes in potential environmental harm, the way in which operations are being carried out or changes to best practice environmental management occur.

Santos Response

Santos has considered each of the aspects of the above submission as follows:

Point source air emissions and air quality modelling

Details of point source air emissions and air quality modelling studies undertaken are provided in EIS Section 6.8. These studies included:

- Description of the existing air quality in the proposed CSG fields;
- An overview of applicable air quality criteria based on relevant Queensland and national legislation and guidelines;
- Description of air emissions during the construction and operational phases of the CSG field development program;
- Air quality modelling to predict the potential impacts at sensitive receptors during the operational phases of the CSG field development program; and
- A summary of possible mitigation measures which could be incorporated into the CSG field development program to minimise the potential for impacts.

Point source noise emissions and noise modelling to nearest sensitive receptors

Details of point source noise emissions and noise modelling studies undertaken are provided in EIS Section 6.10. These studies included:

- A description of the existing acoustic and vibration environment surrounding the proposed CSG fields;
- An overview of applicable construction and operational noise and vibration goals based on relevant Queensland and national legislation guidelines;
- Noise and vibration modelling to predict the potential impacts at sensitive receptors during the construction and operational phases of CSG field development;
  - Noise modelling was carried out using SoundPLAN (Version 6.4) utilising the CONCAWE prediction methodology. The computer model calculates noise emission levels and considers source sound power level (SWL) (compressor ~ 123 dBA; well heads ~ 90 dBA), location,

distance attenuation, ground absorption, air absorption, shielding attenuation, and meteorological conditions including wind effects;

- An overview of mitigation measures which will be incorporated into the CSG field development program to minimise potential impacts; and
- Traffic vibration impacts were assessed on the basis that heavy trucks passing over normal (smooth) road surfaces generate relatively low vibration levels, typically ranging from 0.01 mm/s to 0.2 mm/s at the footings of buildings located 10 m to 20 m from a roadway. Depending on the roadway surface, very large surface irregularities can cause levels up to 5 to 10 times higher than that of smooth road surfaces.

The results from the noise modelling have been incorporated into the field management protocols.

Water releases to the environment (location, quality, quantity, frequency)

Details of associated water management studies undertaken are provided in Section 6.7 of the EIS. Appendix Q of the EIS provides further technical detail on studies undertaken, including an assessment of associated water discharges to the environment. **Attachment D3** of the EIS Supplement also provides a more detailed associated water management plan to complement the associated water management strategy.

Details of surface water studies and assessment undertaken are provided in Section 6.6 of the EIS.

Effluent irrigation modelling

Effluent irrigation modelling has been assessed as part of the suite of options for the management of associated water (refer to Section 6.7 of the EIS).

Significant and high hazard dam designs and certifications

Water storage pond design best practice details are provided in Appendix C of the Associated Water Management Strategy Report (EIS Appendix Q). **Attachment D2** of the EIS Supplement also provides more detail on dam design.

Nature and description of activities to be undertaken in environmentally sensitive areas and offset proposals

Santos has undertaken a supplementary assessment of the potential impacts of the development of the CSG fields on the ecological values of the area. This assessment is presented in **Attachment D5**.

The supplementary assessment has comprised the following key elements:

- **Constraints mapping** – a detailed analysis of the ecological values of the Reasonably Foreseeable Development Area (RFDA) within the CSG fields having regard to augmented desktop and field datasets;
- **Constraints classes** – identification and mapping of five classes of land within the RFDA with graduated levels of ecological sensitivity based on the constraints mapping;
- **Field Management Protocol –** development of a field management protocol which describes the nature of development which may be undertaken within each of the constraints classes, the process to settle the specific location of the development within each constraints class having regard to the ecological values of the area and mitigation measures;
- **Indicative Field Development Plan –** identification of a field development plan (FDP) for the RFDA with preliminary locations for the wells and associated infrastructure;
- **Supplementary Impact Assessment -** an evaluation of potential impacts on ecological values of the development of the CSG fields based on three scenarios derived from implementation of the field management protocol to the field development plan;
- **Mitigation Measures –** identification of mitigation measures additional to measures outlined in the EIS; and

- **Offset Strategy –** outlining the basis of an Environmental Offset Management Strategy to offset ecological values impacted by the GLNG Project by offsite measures (such as property acquisition, covenants and reserve dedications).

Respondent Comment

Department of Environment Water Heritage and the Arts requires further information regarding (Phase 2) development related impacts, before being able to assess the impacts of the development phase of the project.

Santos Response

Santos has undertaken a supplementary assessment of the potential impacts for the development of the CSG fields on the ecological values of the CSG area (**Attachment D5**). The scope for the supplementary assessment was developed in consultation with DEWHA. The supplementary assessment includes a number of key elements including constraints mapping, constraints classes, field management protocol, preliminary field development plan, supplementary impact assessment and mitigation measures as outlined in the previous response (above).

6.2 Climate

Respondent Comment

Queensland Police Service states the EIS should include reference to:

- *District Disaster Management Group responsibilities and defined understanding of the difference between disasters and incidents and emergencies; and*
- *Provide guidance as to the response, investigation, command and control and recovery for both natural disasters and other disasters/emergencies and incidents.*

Santos Response

All of the EMPs have been updated to include the following text in the Emergency Response section.

Performance Criteria

- All personnel familiar with the District Disaster Management Group and their role in the event of a disaster.

Implementation Strategy

- Communication and coordination between Santos and the District Disaster Management Group regarding the project's activities.
- Development of a response, investigation, command, control and recovery for both Natural Disaster and other disasters/emergencies and incidents.

Refer to **Attachment B** for all revised EMPs.

6.2.2.7 Extremes of Climate

Respondent Comment

Queensland Department of Community Safety states that the EIS commits to bushfire hazard analysis to facilitate safety management procedures, management measures and strategies. These measures will achieve SPP 1/03 compliance, thus DCS requires no further information regarding bushfire hazard mitigation in addition to consultation with regional officers from QFRS in relation to emergency response.

Santos Response

Santos appreciates your support in regards to bushfire management.

6.2.3 Potential Impacts and Mitigation Measures

Respondent Comment

Queensland Department of Community Safety states that the emergency response procedures of the site's Health, Safety and Environment Plan will be established and incorporated into the proponent's Emergency Management Plan (EMP). It is advised that the EMP is to be prepared in accordance with the SPP 1/03 Guideline/Appendix 5A/Flood and in consultation with the emergency services agencies. The EIS commits to hydrological assessments and flood analysis to facilitate emergency respond procedures and mitigation measures. These measures will achieve SPP 1/03 compliance, thus DCS requires no further information regarding flood hazard mitigation.

Santos Response

Santos will prepare its Emergency Management Plan in accordance with SPP 1/03 Guideline/Appendix 5A/Flood and in consultation with emergency services agencies.

6.3 Land

Respondent Comment

Department of Environment and Resource Management states that the extent of appropriate native plant species during any landscaping and re-vegetation should be described in more detail.

Santos Response

All species to be used for revegetation will be locally native, and wherever available will also be of local provenance to ensure local genetic integrity is maintained.

A number of recommendations for rehabilitation are made in EIS Sections 6.16, 7.16, 8.16, 11.16.10 and 12.16.7. It is not prudent to specify prescriptions for species diversity, planting densities, soil and fertiliser preparation or maintenance and monitoring requirements at a broad level within the EIS as these factors need to be addressed and established in each instance at the site specific level to ensure impacts and re-vegetation are correctly managed.

Please refer to Section 11.16.11 of the CSG field EMP in **Attachment B1** for an example of the rehabilitation measures.

6.3.1 Topography, Geomorphology, Geology and Soils

Respondent Comment

Department of Environment and Resource Management notes that the EIS should include the following mitigation measures:

- *Roads or other structures on floodplains should be orientated and constructed so as not to divert or concentrate flood flows; and*
- *Road heights on floodplains should not exceed 20cm above Natural Ground Level (NGL); and invert levels should not be greater than 10cm above NGL.*

Santos Response

The CSG fields, gas transmission pipeline and LNG facility EMPs have been updated to include the following text.

Access

- Roads or other structures on floodplains should be orientated and constructed so as not to divert or concentrate flood flows;
- Roads will be designed to accommodate 2 year ARI flows and road heights above natural ground level will be kept to a minimum practical level to ensure adequate drainage can be provided to permit the safe passage of traffic; and
- Invert levels should not be greater than 10 cm above NGL.

Refer to **Attachment B** for all revised EMPs.

Respondent Comment

Department of Environment and Resource Management states that detailed soil survey information should be provided in the Supplementary EIS detailing the occurrence of problem soils. Specific mitigation measures should be developed depending on the soil characteristics. Also, include the following mitigation measures:

- *Pre-construction soil surveys should identify problem soil areas that, where practical, should be avoided for locating facilities, access tracks and pipelines;*
- *Appropriate construction methods of banks should be used to control runoff in sodic soil areas, and*
- *Alternative construction methods may be required to avoid exposing the sodic subsoil.*

Santos Response

Detailed soil maps are provided in EIS Appendices L1 (CSG fields), L2 (gas transmission pipeline) and L3 (LNG facility).

The mitigation measures provided have been incorporated into the EMP for the CSG fields.

To ensure problem soils are avoided, where practicable Santos will:

- Conduct pre-construction soil surveys which will identify problem soil areas that, where practical, should be avoided for locating facilities, access tracks and pipelines;
- Use appropriate construction methods for banks to control runoff in sodic soil areas; and
- Use alternative construction methods where required to avoid exposing the sodic subsoil.

Refer to **Attachment B1** for revised EMP.

Respondent Comment

Department of Environment and Resource Management suggests providing a detailed, evidenced based assessment for the decommissioning and rehabilitation of ponds.

Santos Response

Water management pond decommissioning and rehabilitation processes are described in EIS Appendix Q. Where appropriate, water management dams may undergo suitable decommissioning for return of the infrastructure to the landholder for ongoing use. Elsewhere, the encapsulation and burial methods described in the Associated Water Management Strategy (EIS Appendix Q) will be applied to the rehabilitation of the dam site.

This is described as an acceptable method for the decommissioning of existing ponds as acknowledged in the recent Queensland Government discussion paper, '*Management of Water Produced from Coal Seam Gas Production*' (May 2009). Encapsulation and capping is also recognised as a suitable rehabilitation method in the DERM publication '*Minesite Decommissioning'* (1995) where it is described as a suitable method for the decommissioning of tailings dams.

Decommissioning will be carried out in accordance with these (or any subsequent) requirements.

6.3.1.4 Existing Environmental Values

Respondent Comment

Department of Environment and Resource Management suggests using the following Land Management Manuals to assist in determining agricultural suitability of soils:

- *Land Management Field Manual - Roma District;*
- *Land Management Field Manual - Wandoan District; and*
- *Land Management Field Manual - Dawson / Callide District.*

Revise the potential impacts and proposed mitigation measures in accordance with these manuals.

Santos Response

The EIS assessment was undertaken using Landscape Units in the CSG field as a whole at a scale of 1:250,000. The land classes are based primarily on the regional compilation and mapping (1:250,000 of Good Quality Agricultural Land (QCAL) in the Central West Region of Queensland – NRW (2004)) which encompasses the central and northern parts of the project area.

The Land Management Field Manuals have been incorporated into the field management protocol as part of the pre-construction survey to confirm the agricultural suitability of soils for the purposes of minimising impacts on high quality agricultural soils.

Respondent Comment

Department of Environment and Resource Management suggests revision of the proposed environmental values and mitigation measures after considering the following:

- *For Series 34 - CSIRO (1974) mapping, Map code 31 should be included as Agriculture Land Class A while Map code 30 should be included as Class B land; and*

- *Identify the source of the mapping for the area south of Miles. Department mapping based on the Murilla, Tara and Chinchilla Shires Land Management Manual indicates there are significant areas of Class A and Class B Agricultural land.*

Santos Response

Some mapping discrepancies have been identified by DERM relating to the occurrence of some local areas involving the occurrence of Agricultural Land Classes A and B. These can be explained as a result of interpretation of the local area drainage conditions evident in the particular areas in question, due to the scale of mapping adopted for the CSG fields as a whole and through the interpretation of generalised land capability land class classifications based on broad-scale land system mapping (CSIRO 1974). For local small tenements to the south of Miles, land capability was assessed from interpretation of the Atlas of Australian Soils data – Stace *et al*. (1968).

6.3.1.5 Potential Impacts and Mitigation Measures

Respondent Comment

Department of Environment and Resource Management states that a detailed soil survey should be undertaken including soil types and characteristics mapped to facilitate appropriate location of works and development of effective mitigation measures. The Supplementary EIS should detail how facilities, access tracks and pipelines avoid problem soils. Where such soils cannot be avoided, specific measures should be detailed in the Supplementary EIS to prevent and or minimise impacts to environmental values.

Santos Response

As part of the EIS, overall soil maps have been prepared for the entire CSG fields area and are provided in EIS Appendices L1 (CSG fields), L2 (Gas transmission pipeline) and L3 (LNG facility).

The selection of the specific sites for the wells and associated infrastructure will be made to avoid, where feasible and practical, any problem soils. This will be done through:

- Reviewing the proposed location of the well or associated infrastructure to determine whether it is likely to fall within a problem soil area as identified on the overall soil maps and, if feasible and practical, relocating to avoid the problem soil area;
- Undertaking a pre-construction soil survey of the proposed site location for the well or associated infrastructure to determine whether the proposed site location contains problem soils. If the proposed site location contains problem soil areas, the proposed site will be relocated if feasible and practical; and
- If the proposed site location is within a problem soil area and cannot be feasibly or practically relocated then the specific measures which will be taken are set out in the CSG Field EMP (refer **Attachment B1**) and generally comprise:
  - Use of appropriate bank construction methods to control runoff in sodic soil areas; and
  - Incorporation of alternative construction methods (if required) to avoid exposing the sodic subsoil.

Respondent Comment

Department of Environment and Resource Management states that spoil management should be further addressed because inappropriate disposal of spoil from drilling can result in difficulties in establishing surface cover, resulting in increased erosion risks that have not been identified in Section 6.3.1.5. Mitigation measures should be described to prevent and or minimise impacts to environmental values.

Santos Response

Section 11.1.6.12 Waste Management for the CSG fields EMP outlines that "Management strategies for specific waste streams will be developed prior to the activity commencing". As well as on completion of each CSG field component, all general waste material will be removed from the workplace. No wastes will be buried or disposed of on-site without local government and/or DERM approval".

All waste fluids and spoil resulting from drilling and exploration activities will be contained in a dam or containment structure for disposal, remediation or reuse where applicable. Where drilling fluids and spoil are removed from site they will be disposed of at a facility licensed to accept such waste.

Where material is kept onsite, topsoil stored during the establishment of the lease will be used to cap the area and a reseeding plan based on soil type, existing local vegetation characteristics and landholder preferences will be applied. The success of the rehabilitation will be progressively monitored and managed to ensure successful rehabilitation.

Respondent Comment

Department of Environment and Resource Management states that the proposed methods to avoid GQAL should be discussed and included in the Supplementary EIS. Where there is no alternative to locating wells, pipelines and tracks within cultivation areas, they should be located on the edge of the cultivation area.

Queensland Primary Industries and Fisheries (Department of Employment, Economic Development and Innovation) recommends that the preferred option for reducing impacts on Class A - GQAL should be avoiding these areas. Where avoidance is not possible, impacts should be minimised in terms of the size of land impacted, and also the level of impact through using alternative techniques or construction methods to avoid impacts. Restoration of impacted areas must then be completed to the best standard possible.

Santos Response

Mitigation strategies to avoid, where practicable, good quality agricultural land (GQAL) are outlined in EIS Section 11 and in accordance with the principles of avoidance, minimisation, and mitigation of impacts as presented in Part 5 of **Attachment D5** of the Supplementary EIS.

Strategies to minimise land use impacts will include:

- Avoiding (where practicable) good agricultural land;
- Avoiding (where practicable) smaller land parcels where the relative impact will be greater;
- Locating (where practicable) gathering pipelines and access roads along fence lines and property boundaries;
- Locating (where practicable) development activities away from the more intensively used areas of the property;
- Liaising with each relevant landholder regarding their site-specific land use practices and ways to minimise interference from project activities;
- Minimising the lease area required for well development; and
- Rehabilitating as quickly as possible the areas no longer required following drilling and well development.

6.3.2 Land Contamination

Respondent Comment

Department of Environment and Resource Management requested that the proponent should provide detailed information on the expected nature and extent of contamination at each site and a remediation plan and validation sampling for any contaminated site.

The proponent should note that in the event that unexpected contamination is identified, action must be taken to immediately abate the potential harm, and a remediation action plan is developed. If this information is detailed in Management Procedure EHS08, a copy of this document should be provided.

Santos Response

The EIS provided detailed information on the nature and extent of sites known to host or historically hosted notifiable activities (EIS Section 7.3). In addition the EIS Supplement Report in **Attachment E2** describes these issues in more detail.

EIS Section 11.16.18 outlines a Land Contamination management plan for the CSG fields, as illustrated below. Santos believes this adequately addresses the information requested.

Element/Issue	Land Contamination
Operational Policy or Management Objective	To manage potential soil contamination during the development of the CSG fields.
Performance Criteria	• No contamination of soil. • Spill containment facilities constructed in accordance with AS 1940 (2004) and AS 3780 (1994).
Implementation Strategy	**Prevention** Strategies for the prevention of potential land contamination will include: • Consultation with landholders prior to development commencing to determine whether any potential areas of contamination are located within the proposed development area. • Avoid the disturbance of any known areas of contamination. If avoidance is not possible, the contaminated material will be excavated and with remediated or disposed of at an approved facility. Work to be undertaken in accordance with DERM requirements. • Construction of appropriate spill containment facilities for all chemicals and fuel storage areas (in accordance with AS 1940 and AS 3780). • Establishing and maintaining a hazardous materials register detailing the location and quantities of hazardous substances including their storage, use and disposal. • Induction and training of personnel and implementation of safe work practices for minimising the risk of spillage. **Containment** • If suspect contamination is found during earthworks, work in that area will stop until a suitably qualified person has inspected the site, the hazard has been assessed and appropriate action has been taken. • Any hydrocarbon spillage from storage areas, diesel and chemical spills from construction equipment, and industrial waste spills will be contained and treated/remediated in accordance with appropriate legislative requirements. • If an area of contamination is reported, the cause will be identified, the material analysed, and an appropriate management strategy developed. The impact may be contained by isolating the source or implementing controls around the affected site. • DERM approval will be obtained if contaminated material must be removed from the work area.

Element/Issue	Land Contamination
	Remediation • Remediation of contaminated land will use the most appropriate available method to achieve required commercial/industrial guideline validation results. • Validation sampling of any remediated area will be used to establish the site as "clean" as per the relevant DERM Contaminated Land and National Environment Protection Measure (NEPM) Guidelines.
Monitoring and Auditing	The integrity of storage facilities for hazardous materials and wastes and bunded areas will be routinely inspected. Any hydrocarbon spillage from storage areas or diesel or chemical spills will be reported.
Reporting and Corrective Action	The CSG fields Environmental Manager will keep records of contamination incidents. The following will be classified as an incident or failure to comply in relation to soil contamination management: • Breach in integrity of bunds. • Non-compliance with AS 1940 and AS 3780. • Known contaminated area not managed. Should an incident or failure to comply occur in relation to soil contamination management, a selection of the following corrective actions will be considered where relevant: • Rectify storage/handling non-compliance. • Contain and remediate or dispose of contaminated material/contaminants. • Investigate and implement measures to prevent recurrence. • Any known contaminated sites will be reported to the EPA.

6.4 Nature Conservation

Respondent Comment

Department of Environment Water Heritage and the Arts states that there is not enough detail on the CSG area as a result of the two phase approach and it requires further information before being able to determine whether to approve the project.

Santos Response

Santos has undertaken a supplementary assessment of the potential impacts of the development of the CSG fields on the ecological values of the area. This assessment is presented in **Attachment D5**.

The supplementary assessment has comprised the following key elements:

- **Constraints mapping** – a detailed analysis of the ecological values of the Reasonably Foreseeable Development Area (RFDA) within the CSG fields having regard to augmented desktop and field datasets;
- **Constraints classes** – identification and mapping of five classes of land within the RFDA with graduated levels of ecological sensitivity based on the constraints mapping;
- **Field Management Protocol –** development of a field management protocol which describes the nature of development which may be undertaken within each of the constraints classes, the process to settle the specific location of the development within each constraints class having regard to the ecological values of the area and mitigation measures;
- **Indicative Field Development Plan –** identification of a field development plan (FDP) for the RFDA with preliminary locations for the wells and associated infrastructure;
- **Supplementary Impact Assessment -** an evaluation of potential impacts on ecological values of the development of the CSG fields based on three scenarios derived from implementation of the field management protocol to the field development plan;

- **Mitigation Measures –** identification of mitigation measures additional to measures outlined in the EIS; and
- **Offset Strategy –** outlining the basis of an Environmental Offset Management Strategy to offset ecological values impacted by the GLNG Project by offsite measures (such as property acquisition, covenants and reserve dedications).

Respondent Comment

Department of Environment and Resource Management states a more comprehensive assessment of impacts on terrestrial ecology and mitigation measures is required. Department of Environment and Resource Management states that Table 6.4.6 of the EIS should be expanded to incorporate all recommendations.

Santos Response

The ecological impact assessment is provided to a regional and local scale in EIS Section 6.4.5 with further detail provided in Section 5 of EIS Appendix N1. Santos has undertaken a supplementary assessment of the potential impacts of the development of the CSG fields on the ecological values of the area as described above. This assessment is presented in **Attachment D5**.

Respondent Comment

Department of Environment and Resource Management suggests to:

- *Undertake a detailed assessment of the aquatic values associated with watercourses and wetland areas on the CSG field site and along the pipeline route. The assessment should identify specific values that would be potentially impacted by the project; and*
- *Develop specific mitigation measures in relation to these potential impacts.*

Santos Response

A detailed assessment of the aquatic values for the CSG field was undertaken at the catchment level and is presented in detail in EIS Appendix N4. This assessment was undertaken from 23 September 2008 to 3 November 2008, and included surveying a total of 32 waterways across three catchments at targeted and representative sites. Aquatic habitat assessments of major watercourses along the gas transmission pipeline alignment were also undertaken (refer Section 2.2 of EIS Appendix N2).

Specific impacts and the proposed mitigation measures are outlined for the values identified from both surveys. The results from the aquatic surveys have been incorporated into the field management protocol which will be used for selecting specific sites as set out in Appendix D5.

Respondent Comment

Queensland Health states the EMP for the CSG fields and the LNG facility include a mosquito management section. The proponent should develop a 'Mosquito Management Plan' for the entire project, including the Gas Transmission Pipeline. A comprehensive plan to manage mosquitoes is essential given the close proximity to towns and the number of itinerant workers/visitors who will be on site for varying periods of time.

Periodic monitoring of pounded waters and rainwater tanks will determine if proposed control measures are effective in reducing mosquito-breeding numbers.

The document "Guidelines to minimise mosquito and biting midge problems in new development areas" (http://www.health.qld.gov.au/phs/Documents/cdu/14804dmp/htm) may be of assistance.

Santos Response

All of the EMPs have been updated with the following information. Refer to **Attachment B** for all revised EMPs.

Element/Issue	Mosquito and Biting Midge Management
Operational Policy or Management Objective	To prevent the occurrence of potential mosquito and biting midge breeding sites and the presence of adult mosquitoes and biting midges.
Performance criteria	• Minimal number of potential mosquito and biting midge breeding sites created.
Implementation Strategy	• Mosquito and biting midge management will be conducted in accordance with EHS09 (*Weed and Pest Animal Control*). • Depressions in the ground surface (such as wheel ruts) will be filled as soon as practicable to prevent the ponding of water. • Pools of stagnant water will be drained and/or the depressions filled. • Storage containers capable of ponding water will be either discarded after use or stored in an inverted position (care will be taken to ensure that ponding does not occur in waste storage areas). • Erosion and washdown practices will be controlled to prevent the formation of standing water pools in natural water courses adjacent to the sites. • Staff will be trained to recognise mosquito and biting midge breeding activity and the treatment of breeding sites. • An assessment of work areas will be undertaken prior to works and on an ongoing informal basis to identify potential breeding sites. • Workforce accommodation facilities to be fitted with protective barriers, such as fly screens and air conditioning. • Insect repellent will be made available to Santos personnel as required. • Any required specific area control plans based on assessment of potential breeding sites will conform to the DERM's Mosquito Management Code of Practice for Queensland. • Queensland Health and the relevant local councils will be contacted for assistance in choosing a suitable method of laviciding / eradication should this be necessary.
Monitoring and Auditing	A record of periodic monitoring of ponding waters and rainwater tanks inspections for mosquitoes and biting midges will be maintained. Areas of ponding and pooled waster that cannot be easily removed or backfilled will be inspected regularly for presence of larvae by the CSG fields Environmental Manager.
Reporting and Corrective Action	The following represent an incident or failure to comply in regard to mosquito management: • An increase in the numbers of potential mosquito and biting midge breeding sites on-site. • An increase in the numbers of larvae and/or mature mosquitoes and biting midge on-site. • Significant incidences of mosquito and midge bites are reported. • Mosquito and biting midge management strategies are not implemented. Should an incident or failure to comply occur, a selection of the following actions will be taken: • An investigation will be undertaken into why directives are not being carried out. • Personnel will be re-educated on desired practices. • Work policies and procedures will be reviewed and modified to improve the situation.

Respondent Comment

Wildlife Preservation Society of Queensland - Policy and Campaigns Manager states that the Nature Conservation section recognises that the project area supports a range of conservation significant values including flora, fauna and regional ecosystems. Although the environmental values of watercourses are considered relatively low they are still significant to the wildlife that inhabits these streams.

Santos Response

Santos recognises that the watercourses present in the CSG project area are significant to the wildlife of the area and a comprehensive and detailed assessment of the aquatic values for the CSG field was undertaken at the catchment level and is presented in detail in EIS Appendix N4. This assessment was undertaken from 23 of September to 3 November 2008, surveying a total of 32 waterways across three catchments at targeted and representative sites. Aquatic habitat assessments of major watercourses among the Gas Transmission Pipeline alignment were also undertaken (EIS Section 2.2 Appendix N2 Fauna).

Specific impacts and the proposed mitigation are outlined for the values identified from both surveys. The results from the aquatic surveys have been incorporated into the field management protocol which will be used for selecting specific sites as set out in Appendix D5.

Respondent Comment

Wildlife Preservation Society of Queensland - Policy and Campaigns Manager states that an impact on endangered or of concern regional ecosystems should be avoided. It is appreciated that government offset policy and legislation permits the disturbance of such vegetation for mining and other selected industries. Should the offset policy be triggered then it should be like for like, like or better condition and it must be protected for perpetuity. In addition, there must be proactive management of any offsets to ensure that predevelopment stability of the ecosystem is achieved free from weeds and feral animals. Also periodic flora and fauna surveys should be carried out to confirm management objectives are being achieved. The commitment to a target ratio of up to 3:1 in terms of vegetation protected in offsets is a minimalist approach. In most situations as a matter of last resort Wildlife Queensland prefers offsets through habitat restoration and enhancement of comparable ecosystems but this may not necessarily be always the best option in this situation. The offset policy does permit the payment of funds to be purposefully directed for the benefit of conservation. Should this approach be considered by proponents that may provide a significant outcome for conservation improving the environment.

Regardless of the above there is a need to rehabilitate, restore and establish local wildlife corridor functions to facilitate natural movement of wildlife and the continued existence of plant species if the site becomes operational.

Santos Response

Santos has undertaken a supplementary assessment of the impact of the GLNG Project on the ecological values in the RFD Area of the CSG Fields. The supplementary assessment is described above and is presented in Appendix D5. The supplementary assessment has estimated the area of each regional ecosystem (RE) and other sensitive ecological classifications which are likely to be directly impacted by the GLNG Project based on three scenarios. The three scenarios are pre-avoidance and mitigation, reasonable worst case and reasonable best case.

Santos has developed the outline of an Environmental Offsets Plan which is presented in **Appendix D5**. Santos proposes to use the estimates of direct impacts from the supplementary assessment as the basis for the Environmental Offsets Plan. The Environmental Offsets Plan includes measures to monitor areas of direct impact to update the offsets required as the project proceeds. An offsets package is being developed by Santos in conjunction with Ecofund Queensland (a Queensland government advisory service) as a Biodiversity Offset Management Plan to address the objectives of both the current state &

commonwealth legislative environmental offsetting requirements. An analysis has been undertaken to identify the offset requirements for proposed impacts for the CSG field, gas transmission pipeline and LNG facility components of the GLNG Project. Analysis requirements being undertaken for offsets include:

- Extent and size of offsets required to be secured;
- Ecological values required to be offset;
- Options available for pooling or consolidation offset requirements; and
- Options for securing offsets.

Offset assessment and analysis includes the co-ordination of multiple offset requirements and is being carried out under the following policies,

- Vegetation management offsets under the *Vegetation Management Act 1999* (Qld);
- Fish habitat offsets under the *Fisheries Act 1992*;
- Protected plants offsets under the *Nature Conservation Act 1992*;
- Biodiversity offsets under the Draft Policy for Biodiversity Offsets 2008 (Qld);
- Environmental offsets under the *Environment Protection & Biodiversity Conservation Act 1999* (Cwth).

Further steps to be undertaken within a suitable timeframe as part of the process include:

- Identification of suitable offset options;
- Assessment of properties;
- Landholder liaison and negotiation to secure required offsets;
- Offset validation and preparation of specific Biodiversity Offset Management Plan(s); and
- Liaison to finalise contractual arrangements and covenants.

In addition to the objectives outlined above and those previously stated within the EIS (EIS Sections 6.4, 7.4, 8.4 and EIS Appendices N1, N2 and N3), the Environmental Offset Management Plan will be implemented over an appropriate time frame to accomplish the following specific aims:

- Identification of suitable potential offset areas with ecological values analogous to impacted ecological communities;
- Assessment of the ecological value and equivalence of offsets to ensure suitable offset extent, species assemblage, floristic structure and ecological integrity utilising an appropriate biometric field methodology;
- Development of appropriate management prescriptions to ensure long term viability of offsets (such as pest control, livestock management, access exclusion, ameliorative plantings and fire regime management);
- Placement of appropriate covenants for future conservation and management of offsets; and
- Development of appropriate monitoring and maintenance activities and performance review processes to ensure long term viability of the offsets.

The process of developing a suitable Environmental Offset Management Plan is an iterative process with State and Commonwealth regulatory bodies.

Respondent Comment

Wildlife Preservation Society of Queensland - Policy and Campaigns Manager states that weeds and feral animals are probably second only to loss of habitat in threats to our biodiversity. It is apparent that

practices are to be put in place to avoid the spread of weeds. There is a need to have eradication and or containment strategies activated from the initial implementation phase of the project.

Santos Response

Santos remains committed to proactive management of weeds and feral animals. All of the EMPs have been updated with our weed management protocols. Please refer to Section 11.16.15 of the CSG field EMP in **Attachment B1**.

Respondent Comment

Wildlife Preservation Society of Queensland - Policy and Campaigns Manager states that fire management plans need to be developed not only to protect infrastructure but also the vegetation. Ecologically sustainable fire regimes need to be implemented as and when required.

Santos Response

All of the EMPs have been updated with the following information to ensure that the fire management plans protect vegetation as well as infrastructure. Refer to **Attachment B** for all revised EMPs.

Element/Issue	Fire Management
Operational Policy or Management Objective	To prevent the initiation of bushfires as a result of GLNG Project related activities. To protect Santos personnel and key GLNG Project infrastructure from bushfire and fire impacts.
Performance Criteria	• Develop and implement emergency response plans that include fire management. • No unplanned or uncontrolled fires caused by GLNG Project relative activities. • Emergency plans for construction developed and in place prior to activities commencing. • All personnel familiar with emergency procedures and their role in the event of emergency, and drills undertaken.
Implementation Strategy	• Minimise fire risk through evaluation processes and management of those risks. • Restrict high-risk activities in accordance with local fire bans or in times of high fire danger. • Maintain a plan for rapid and co-ordinated response to the outbreak of fire through an established fire response plan in conjunction with the local metropolitan and rural fire brigades. • Implement evacuation procedures and hazard reduction. • Implement and maintain building fire detection and alarm systems, emergency lighting, fire hydrants, fire hose reels, fire extinguishers and service checks to relevant specifications as per Australian Standards. • Undertake fire safety awareness training as part of site inductions. • Conduct fire safety awareness training as part of site inductions. • Conduct regular fire drills and record exercises as actions generated. • Conduct periodic fire equipment audits. • Consult with all relevant fire management authorities.

Element/Issue	Fire Management
	Santos will minimise development in high bushfire and landslide risk areas. Where development is located in these areas, Santos will employ safety management procedures to minimise the likelihood of the project initiating or spreading bushfire. Management measures include: • Design standards to control risk of fire occurring. • Inspection and monitoring. • Area around well heads cleared of vegetation. • Emergency response procedures.
Monitoring and Auditing	The effectiveness of the fire management component of the emergency response plan will be regularly tested and audited. Fire drills to be conducted at least annually.
Reporting and Corrective Action	• Extinguish fire if safe to do so. • Report all fire events to the CSG fields Health and Safety Manager. • Notify fire brigade and implement evacuation procedure if appropriate. • Review fire management plans following fire events. • The CSG fields Health and Safety Manager will be responsible for compiling the results of testing and auditing programs.

Respondent Comment

Queensland Primary Industries and Fisheries (Department of Employment, Economic Development and Innovation) recommends the use of Biosecurity Queensland's Annual Pest Distribution Survey 2008 data and predictive pest maps available on the DEEDI website:

- *http://www.dpi.qln.gov.au/cps/rde/dpi/hs.xsl/4790_9824_ENA_HTML.htm*
- *http://www.dpi.qln.gov.au/cps/rde/dpi/hs.xsl/4790_9827_ENA_HTML.htm should be utilised in conjunction with Queensland Herbarium naturalised flora data for the GLNG Project.*

Santos Response

The Biosecurity Queensland Annual Pest Distribution Survey 2008 data and predictive pest maps have been noted and relevant information from these sources has been incorporated for use in the CSG field, gas transmission pipeline EMP (EIS Section 11.16.15). Refer to **Attachment B** for revised EMPs.

Respondent Comment

Queensland Primary Industries and Fisheries (Department of Employment, Economic Development and Innovation) recommends that:

1) All potential weeds as described above must be considered in the Weed Management Plans for each exiting or proposed operational area in the GLNG Project site.

2) A Weed Management Plan is developed for Section 13 an overview of this plan incorporated into Section 13.

Santos Response

An EMP has been developed for the GTP and will be incorporated and adapted accordingly to relate to the CSG fields. This EMP addresses the potential occurrence of *Eragrostis curvula* (African lovegrass)

within the region and includes reference to the specific Biosecurity Queensland fact sheet. The CSG EMP will also incorporate *Hyparrhenia hirta* (Coolatai grass) into the weed management plan section.

Respondent Comment

Queensland Primary Industries and Fisheries (Department of Employment, Economic Development and Innovation) comments that the development of a Plant and Animal Disease Management Plan is recommended to identity potential risk areas and mitigate risk of spread within the GLNG Project site.

Santos Response

All of the EMPs have been updated with the following text.

Flora and Fauna Management

- Plant and animal disease management plans will be developed for all GLNG Project areas.

Refer to **Attachment B** for all revised EMPs.

6.4.2.1 Terrestrial Ecology

Respondent Comment

Department of Environment and Resource Management states that to ensure potential impacts are fully assessed and appropriate mitigation measures are adopted, surveys should be expanded to target groundwater dependant ecosystems and terrestrial species that are ecologically dependant on aquifers, wetlands and waterways and therefore likely to be affected by the project. Specific mitigation measures should be assessed, detailed and provided.

Santos Response

Groundwater dependent ecosystems (GDEs) can be defined as those ecosystems whose ecological processes and biodiversity are wholly or partially reliant on groundwater. The extent of GDE dependency on groundwater can range from being marginally or episodically dependent to being entirely dependent on groundwater (SKM, 2001)[1].

Examples of GDEs include:

- Terrestrial vegetation supported by shallow groundwater;
- Aquatic ecosystems in rivers and streams that receive groundwater base flow;
- Wetlands, which are often established in areas of groundwater discharge;
- Springs and associated aquatic ecosystems in spring pools; and
- Aquifers and caves where stygofauna (groundwater-inhabiting organisms) reside.

The *Hydrogeological Framework Report for the Great Artesian Basin Water Resources Plan Area (2005)*[2] includes a discussion of the two types of GDEs that are most relevant to the GLNG Project area:

[1] SKM, 2001. *Environmental Water Requirements of Groundwater Dependent Ecosystems*. Technical Report Number 2, Sinclair Knight Mertz for Environment Australia.

[2] Queensland Department of Natural Resources and Mines, 2005, H*ydrogeological Framework Report for the Great Artesian Basin Water Resource Plan Area*.

- Springs, including mound springs of the Great Artesian Basin (GAB); and
- Rivers receiving baseflow.

Artesian spring communities that are reliant on the artesian discharge of GAB groundwater are listed as a threatened ecological community (*The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin*) under the EPBC Act.

Studies for the EIS have determined that:

- Numerous springs exist within the Upper Dawson, Condamine–Upper Balonne catchments (Appendix N4).
- The major river systems associated with the GLNG Project area include the Upper Dawson River, which transects the Fairview CSG Field, and the Condamine–Upper Balonne Rivers, which cross the Roma CSG fields. Ecological surveys carried out by URS (2009) identified established aquatic ecosystems associated with major rivers, some of which are sustained by baseflow.

Springs investigated along the Dawson River within the Arcadia Valley CSG field (URS 2008)[3] clearly exhibit characteristics of RE 11.10.14 (Springs associated with sandstone). Recharge springs are generally associated with outcropping sandstone, which can form rugged landscapes with springs often situated in gullies and providing the source for streams. Recharge springs are not included in the EPBC-listed threatened community definition.

Golder (2009)[4] was engaged to evaluate and document the potential impacts to the water resources affected by CSG development in the three RFDAs of the GLNG Project area (**Attachment D2**). The assessment of groundwater impacts included:

- Review of existing studies and associated relevant literature (including legislation);
- Development of a conceptual hydrogeological model for each of the three CSG Fields;
- Detailed risk assessment of the various activities associated with CSG production in the Project area;
- Identification of the environmental values relevant to the GLNG Project area;
- Discussion of the potential groundwater impacts associated with CSG activities, and the relative risks to environmental values in each Field;
- Discussion of risk control measures adopted or developed to address the principal risk issues associated with CSG activities;
- Discussion of the Water Monitoring Strategy and Associated Water Management Strategy developed for the GLNG Project; and
- Development of recommendations to address data gaps, manage risks or reduce uncertainty in the analysis of potential impacts.

The study included an assessment of potential impacts to GDEs within the CSG fields.

Results of groundwater modelling by Golder (2009) include a finding that groundwater extraction at the Arcadia and Fairview CSG Fields is not expected to significantly alter the baseflow contributions to the perennial portion of the Dawson River, or the groundwater discharge volumes to springs located in the vicinity of the Fairview Field. Therefore, GDEs will not be significantly impacted by groundwater extraction.

[3] Appendix O1 of the GLNG EIS.

[4] Attachment D2 of the EIS Supplement

Strategies to minimise impacts include the preparation of an Associated Water Management Plan (AWMP) (**Attachment D3**) which address the challenges with associated water produced during CSG activities. In addition, a comprehensive Water Monitoring Plan (WMP) for the GLNG Project is being developed. This will act as a specification for establishing the specific water monitoring requirements for each element of project (including gathering, ponds, treatment facilities, environmental assets etc). Water monitoring will provide a mechanism for early identification of potential impacts associated with coal seam depressurisation, so that contingency actions, if warranted, can be implemented in a timely manner.

Constraints mapping (**Attachment D5**) conducted for the CSG fields has been undertaken to provide a framework for the planning of field development and management of impacts to ecological values. The GDEs identified within the RFDAs are surface features; aquatic ecosystems in rivers and streams that receive groundwater base flow or the recharge springs that provide the baseflow. Constraints mapping for the CSG fields has identified such ecosystems as Class B areas. Strict protocols have been developed for Class B areas, including:

- Class B areas will be avoided where possible at the planning stage for the siting of wells, access routes and associated infrastructure. If the Class B area cannot be avoided through relocation at the planning stage, then well sites or associated infrastructure, will be sited in previously disturbed areas if possible, or in locations least likely to cause significant impacts based on the pre-construction surveys below;
- No disturbance is proposed to occur in any areas within 50 m of waterways wherever feasible and within 200 m of mapped wetlands; and
- A pre-construction ground survey will be undertaken to confirm that vegetation mapping associated with the planned sites is accurate and to confirm the localised ecological values. The ground survey will identify specific locations of 'Endangered' REs and EPBC-listed communities in the area of the proposed development.

The CSG EMP (**Attachment B1**) outlines a range of strategies to be employed to further minimise impacts to ecological values including aquatic ecosystems.

6.4.3 Regulatory Framework

Respondent Comment

Department of Environment and Resource Management states that mapping demonstrating restrictions under the Vegetation Management (Regrowth Clearing Moratorium) Act 2009 should be obtained. The requirements and constraints with respect to the project should be discussed.

Santos Response

Restriction for clearing vegetation under the Regrowth Moratorium ended on 7 October 2009 and has been replaced by the newly implemented Regrowth Vegetation Code taking effect 8 October 2009. All proposed vegetation clearing by the GLNG Project will be undertaken in accordance with the permitting provisions and requirements of all relevant State and Commonwealth legislation as outlined in EIS Section 6.4.3. This includes obtaining any approvals, exemptions, or regulating clearing in accordance with the newly implemented Regrowth Vegetation Code, where relevant. The following information describes the circumstances in which the GLNG Project must comply with the *Vegetation Management Act 1999* and the *Vegetation Management (Regrowth Clearing Moratorium) Act 2009* (together, VM Legislation) with respect to vegetation clearing.

Petroleum activities (including the GLNG Project) do not require a permit to clear native vegetation when the VM Legislation regards it as a 'specified activity' (under Schedule 8 of the *Integrated Planning Act 1997* (IP Act)). This exemption for clearing native vegetation does not extend to purposes outside the definition of an 'authorised activity' (Section 22 of the *Petroleum and Gas (Production and Safety) Act*

2004) or for activities outside the area of the lease or licence. Petroleum activities are also exempt from assessment against a planning scheme (under Schedule 9 of IPA). The exemption for petroleum activities also includes activities within the lease or licence area which are incidental to or reasonably necessary for the petroleum activity.

Santos must also comply with the relevant Environmental Authority (under the Queensland *Environment Protection Act 1994*) regarding vegetation management.

Incidental activities involving the clearing of vegetation may include for example:

- Clearing within the infrastructure envelope to enable construction and operation; and
- Clearing for safety / maintenance purposes (e.g. fire break).

Where the clearing of native vegetation is for purposes outside of an authorised or incidental activity, the VM Legislation applies.

Respondent Comment

Department of Environment and Resource Management states that in relation to the development of the CSG fields, and construction and operations of the pipeline, provide more detail on the management of flora and fauna. The following management plans should be developed to specifically address this issue:

- *Flora and Fauna Management Plans*
- *Biodiversity Management Plans*

[Note: These plans should be incorporated in the Environmental Management Plan covering the whole project]

Santos Response

All of the project EMPs have been updated with revised Flora and Fauna Management plans which include commitments regarding a biodiversity management plan currently being developed by Santos. EMPs are located in **Attachment B**.

6.4.4 Existing Environmental Issues

Respondent Comment

Capricorn Conservation Council states that regarding Ramsar Wetlands of International Significance: Narran Lake Nature Reserve, Shoalwater Bay and Corio Bay are located in catchments that have CSG Fields located in them. While they may not be under threat now, what condition is there that they will not be impacted in the future by drilling?

Similarly, nationally important wetlands in the CSG fields' investigation area include Boggomoss Springs Wetland and Lake Nuga Nuga Wetland.

Capricorn Conservation Council states that the aquatic functioning of these pristine, protected areas (EPBC Act) is vital to their continuance and to the many ecosystems they support. They must be protected at all costs. The proponent must stipulate now, how their future protection will be managed.

Santos Response

There are no Ramsar Wetlands of International Significance located within the CSG Fields for the GLNG Project. Given the scale of operations within the CSG Fields, impacts will generally be limited to local

catchments. Therefore given the isolation of the CSG fields from the nearest Ramsar wetlands, the impacts of the CSG will have negligible effect on the values of these sites.

In relation to other wetlands, a detailed assessment of the aquatic values for the CSG field was undertaken at the catchment level and is presented in EIS Appendix N4 and specific impacts and mitigation are outlined for wetland values.

Santos does not propose any drilling within wetland areas. The wetland areas are mapped by environmental field constraints mapping (**Attachment D5**, Part 2) as areas of high environmental constraints (Class B) and part of the field management protocols prevent drilling in wetlands. These areas have a set of field management protocols (**Attachment D5**, Part 2) that ensure site scouting entails avoidance of impacts to these areas by appropriate location of wells and associated infrastructure to avoid and minimise any potential impacts on wetlands from construction and operation.

A study was undertaken into the potential impacts of contingency discharge of desalinated water to Lake Nuga Nuga. In summary, contingency discharges of desalinated water to Lake Nuga Nuga have been evaluated and key points are as follows:

- Changes in the hydrology of the lake are likely to be minimal with no shift in seasonality, discharge frequency or inundation of critical littoral zones at the edges of the lake.
- A permanent pool circa 0.1m deep and 0.7 km^2 surface area would arise from desalinated water discharge. This pool would act as refugia for fish and other species in drought periods. The pool would not encroach on private land.
- Provided suitable measures are taken to control temperature, salinity and microbial activity discharge of desalinated water to Lake Nuga Nuga would result in a small environmental gain.
- Recreational use of the lake will be unaffected.
- There will be minimal change to lake inundation levels and/or frequency.

Refer details are provided in **Attachment D3** (Section 3.3.4.2).

6.4.4.2 Terrestrial Ecology

Respondent Comment

Department of Environment and Resource Management states that within the southern CSG fields, infrastructure should be located outside road corridors if clearing will reduce the width of vegetation on the corridor to less than 50 metres.

Santos Response

A commitment has been included in **Attachment B1** (CSG Field EMP) to avoid clearing of vegetation for any infrastructure within vegetated road corridors occurring within the southern CSG fields, (i.e. the Roma and Eastern Surat Basin CSG fields). This has also been included in the Field Management Protocol (**Attachment D5**).

Respondent Comment

Capricorn Conservation Council suggests to prevent clearing that will create edge effects and fragmentation and leave corridor links to enhance connectivity.

Santos Response

Santos has included a commitment in **Attachment B1** (CSG Field EMP) to avoid clearing of vegetation for any infrastructure within vegetated road corridors within the southern CSG Fields. This will retain corridor links along road corridors in the already fragmented southern CSG Fields.

In relation to the CSG Fields generally, clearing is to be undertaken in accordance with a number of protocols as outlined in **Attachment D5**, the mitigation recommendations in EIS Sections 6.4, and EIS Appendices N1. Clearing recommendations are also collated and summarised in the Clearing and Grading Sections of the CSG field, gas transmission pipeline and LNG facility EMPs (EIS Sections 11.16.7, 11.16.13, 12.16.2, 12.16.8, 13.16.1, 13.16.2 and 13.16.3). Prevention of fragmentation and creation of edge effects will be undertaken wherever possible. Opportunities for maximisation and / or regeneration of corridor linkages will be explored in development of the Environmental Offset Management Plan.

The Environmental Offset Management Plan will be implemented over an appropriate time frame to accomplish the following specific aims:

- Identification of suitable potential offset areas with ecological values analogous to impacted ecological communities;
- Assessment of the ecological value and equivalence of offsets to ensure suitable offset extent, species assemblage, floristic structure and ecological integrity utilising an appropriate biometric field methodology;
- Development of appropriate management prescriptions to ensure long term viability of offsets (such as pest control, livestock management, access exclusion, ameliorative plantings and fire regime management);
- Placement of appropriate covenants for future conservation and management of offsets; and
- Development of appropriate monitoring and maintenance activities and performance review processes to ensure long term viability of the offsets.

The process of developing a suitable Environmental Offset Management Plan is an iterative process with State and Commonwealth regulatory bodies.

Respondent Comment

Capricorn Conservation Council suggests to conduct a study that addresses how the impact of habitat fragmentation will affect the Bridled Nailtail wallaby in the CSG investigation area.

Santos Response

The known distribution of the 'Endangered' bridled nailtail wallaby (*Onychogalea fraenata*) is not within the CSG field area. This species is currently only found in two known small populations, Taunton National Park (scientific) and Idalia National Park in western arid Queensland. Both of these places are outside of the CSG field area.

6.4.4.4 Aquatic Ecology

Respondent Comment

Department of Environment and Resource Management recommend the collection and interpretation of water quality data associated with development of both the gas fields and the pipeline route need to be restated in a manner that is consistent with the QWQG and ANZECC 2000 guidelines.

Santos Response

The comment relates to EIS Section 6.4.4.4 (Appendix N4). The EIS section summarises the water quality, aquatic flora and fauna species present and artesian spring communities of the targeted sections of the CSG field. The section does not provide water quality recommendations. Santos understands that the response relates to the interpretation of the water quality data presented in this section of the EIS.

While the EIS section (6.4.4.4) does not make any quantitative statements about water quality, EIS Appendix N4 (Section 4.2.1) presents all the water quality monitoring results for water temperature, dissolved oxygen (DO), electrical conductivity (EC) and turbidity in terms of QWQG, ANZECC & ARMCANZ (2000). However, the guideline levels are not explicitly mentioned in the text but are shown as reference lines on the various graphs. The following is a reworking of the original EIS section:

Water Quality

At all sites dissolved oxygen (DO) concentrations were outside of the guideline ranges. Within the Condamine - Upper Balonne Catchment all sites were below the ANZECC (2000) guideline range of 90-110% saturation. Similarly, all sites within the Comet and Upper Dawson catchments were also outside the similar QWQG range of 90-110% saturation. With the exception of Carnarvon Creek (Site 24) which showed a DO level above the guideline range, all other sites were below the respective guideline ranges. Low DO concentrations were probably related to the high turbidity experienced at most sites, a high biological oxygen demand and the low mixing of waters. The high DO concentrations at Carnarvon are likely to reflect the abundance of filamentous algae in senescing pools at this location. Some caution should be exercised in interpreting this result as the QCQG notes that the DO levels should only be applied to flowing waters and that the DO within stagnated pools in ephemeral streams can be lower than 50% saturation.

Within the Condamine-Balonne catchment pH tended to fall within the lower, slightly acidic (ph<7.0) range of the ANZECC (2000) guidelines. At Tchanning, Wallumbilla and Yalebone creeks (sites 6, 10 and 11 respectively) pH was below the 6.5-7.5 guideline range. With the exception of sites 16 (Dawson river) and 21 (Commissioner Creek), all sites within the upper Dawson catchment were within the QWQG range of pH 6.5-7.5. Within the Comet catchment pH was within the QWQG range with the exception of the senescing pools at Carnarvon Creek (site 24) and the Comet River (site 27) which both exceeded the QWQG range. The range of pH across all catchments may be a reflection of local geomorphologic differences.

The mean electrical conductivity (EC) across all sites within the Condamine – Upper Balonne Catchment was 160 μScm^{-1} with all sites recording EC levels within the ANZECC (2000) guideline range of 30-350 μScm^{-1}. Mean EC across the upper Dawson was 239 μScm^{-1} with most sites below the QWQG upper limit of 350 μScm^{-1} except for the lower and mid Dawson River (sites 12 and 16). EC in the Condamine-Upper Balonne Catchment averaged 318 μScm^{-1} with only Consuelo Creek (site 26) exceeding the QWQG level.

Turbidity was high throughout the study area and was probably related to sediment-laden runoff associated with clearing of riparian vegetation and erosion of steep banks. High turbidity is characteristic of all three catchments and of the greater central Queensland region in general. All sites in the Condamine-Balonne Catchment exceeded the ANZECC (2000) guideline range of 2-25 NTU and most sites within the Upper Dawson and Comet Catchments also exceeded the QWQG upper limit of 25 NTU. The only site below the QWQG level was Consuelo Creek (Site 26) in the Comet Catchment. Due to its surrounding land uses, waterways within the region are impacted by relatively high inputs of nutrients, pesticides and other contaminants. By their nature, ephemeral streams such as those in the study area are commonly subject to a range of severe (natural) stresses, and as such the water quality of the creeks within the study area may be characterised by elevated turbidity, salinity and nutrient enrichment.

6.4.5 Potential Impacts and Mitigation Measures

Respondent Comment

Department of Environment Water Heritage and the Arts requires further discussion on threatened and migratory species impacts in Section 6.4.5.

Santos Response

Specific impacts to the 17 migratory species identified as potentially occurring within the CSG fields are addressed in EIS Appendix G Section 4.3.2, Table 4-3. Further description of potential impacts to migratory species is detailed within the Section 7.1.6 of EIS Appendix G. A specific discussion of the migratory bird species of Curtis Island is provided in Section 2.2.8 of EIS Appendix N2 outlining the values determined from the three separate seasonal migratory birds surveys conducted for faunal assemblage for this project (URS 2007, URS 2008 and BAAM 2008).

Santos has undertaken a supplementary assessment of the potential impacts of the GLNG Project within the RFD Area of the CSG Fields (**Attachment D5**). This includes further discussion on threatened and migratory species listed under the EPBC Act.

6.4.5.2 Terrestrial Flora

Respondent Comment

Department of Environment and Resource Management states the proponent should provide specific information on responsibilities for identification of significant vegetation and habitats.

Santos Response

Santos has committed to pre-construction surveys as part of the field management protocol for the confirmation of potential conservation values to minimise impact of the site selection by suitably qualified and experienced environmental scientists. The process and requirements for the suitability qualified persons are set out in the field management protocol in **Attachment D5** and the CSG EMP.

The following text has been added to the CSG field EMP.

"Ensure that professionals engaged to undertake specialist environmental investigations will:

- Preferably hold a tertiary qualification in botany, ecology, agricultural science or equivalent with specialist training in ecological assessment; and
- Have at least 2 years experience in undertaking field ecological assessment for the identification of legislatively significant species, vegetation and habitat within the same bioregion; or similar suitable experience considered acceptable to DERM and Santos."

Respondent Comment

Department of Environment and Resource Management states that within the southern CSG fields, areas of remnant and mature regrowth vegetation on roads should be avoided.

Santos Response

The following text has been added to the CSG field EMP:

"Wherever possible avoid clearing of remnant and mature vegetation for any infrastructure within vegetated road corridors occurring within the southern CSG fields (i.e. the Roma and Eastern Surat Basin CSG fields)."

Respondent Comment

Department of Environment and Resource Management states that more detail on potential impacts and mitigation measures is required with consideration of the following:

- *The actual extent and significance of vegetation removal should be discussed in more detail. Include impacts of all development infrastructures (access, pipelines) in addition to that of the well sites.*
- *Removal of any 'Endangered' or 'Of Concern' vegetation may trigger the necessity to acquire an environmental offset. The issue of 'Environmental Offsets' is mentioned but should be examined in more detail. An offsets package should be provided for assessment in accordance with the QGEOP and specific issue policies.*
- *There may be a need to obtain a Clearing Permit under the Nature Conservation Act 1992 to remove and/or translocate plants.*

Santos Response

Santos has undertaken a supplementary assessment which assesses the extent and significance of vegetation removal in more detail. The supplementary assessment is presented in Appendix D5.

Further to the detail provided in the EIS outlining the objectives of the environmental offsets strategy (EIS Sections 6.4.5.5, 7.4.5.1 and 8.4.5.1; and EIS Appendices N1, N2, and N3), the development of an Environmental Offsets Management Plan has been undertaken by Santos in conjunction with the 'Ecofund Queensland' state government offset advisory group. The Offsets Management Plan being developed specifically addresses the requirements for offsetting under both state and commonwealth legislation.

All proposed clearing of vegetation for the GLNG Project will be undertaken in accordance with the permitting provisions and requirements of all relevant state and commonwealth legislation including the *Nature Conservation Act 1992* and the *Vegetation Management Act 1999* as outlined in EIS Section 6.4.3. This includes obtaining any approvals, exemptions, or regulating clearing in accordance with the newly implemented Regrowth Vegetation Code where applicable.

Respondent Comment

Department of Environment and Resource Management requested that at least two reference sites should be selected as benchmark monitoring sites, to provide on-going reference for environmental management and rehabilitation activities. The sites should be selected to represent the major natural ecosystems being significantly impacted by the project, and should be sufficiently removed from the project to be unaffected by the project's activities. The sites should be monitored at the same intervals and with the same methodology as that used for on-site monitoring.

Santos Response

Santos will develop a rehabilitation plan incorporating monitoring sites and benchmark reference sites to guide on-going reference for environmental management and rehabilitation activities.

Respondent Comment

Department of Environment and Resource Management requested that the proponent should provide more detail on the removal and stockpiling of topsoil for future use in revegetation work. Storage of topsoil should be minimised. This is important in maintaining fertility, as well as in maintaining the viability of the seed bank. The description of topsoil management should consider transport, storage and replacement of topsoil on disturbed areas.

Santos Response

Management of topsoil is discussed in detail throughout EIS Sections 6.3.1.5, 7.3.1.5 and 8.3.1.5 and the CSG EMP (Sections 11.16.8 and 11.16.11). Key aspects of the topsoil management measures set out in the CSG EMP include the following:

- Where practicable, topsoil material will be respread directly from stripped areas to other areas being rehabilitated. Where this is not practicable, topsoil will be stored in stockpiles;
- Stockpiles will be formed in low mounds of minimum height (approximately 1.5 m maximum);
- Remove and stockpile topsoil where excavation or subsidence remediation is to occur. Replace topsoil as soon as practicable after works have finished;
- If the stockpile is retained for a period of more than six months, the stockpile will be deep ripped and sown with local grass seed-stock, legumes and where appropriate the use of any suitable potentially threatened (local) plant species in order to keep the soil healthy and maintain biological activity;
- Cleared vegetation or soil will not be pushed up against trunks of trees or against fence lines; and
- Topsoil application will only take place after subsoil respreading and compaction and will be evenly spread and left with a slightly rough surface.

Respondent Comment

Department of Environment and Resource Management requested that the principles relating to weeds and pests specified in the Land Protection Act 2002 should be incorporated into the proposed mitigation measures and included in the Supplementary EIS. Weed and pest management plans should be considered.

Santos Response

Weed management has been included in the revised EMPs and *Land Protection Act 2002* principles have been incorporated. Refer to **Attachment B** for all revised EMPs.

Respondent Comment

Department of Environment and Resource Management states more detail is required on revegetation methods and procedures with consideration of the following:

- *Revegetation should use locally indigenous species, sourced from a local seed bank where possible;*
- *Revegetation of exposed soils should be carried out as soon as practical after works have been completed;*

- *Where plantings and screening or landscaping are proposed, details should be provided of the species that will be used, and their provenance. Use of non-native and non-local species should be avoided.*

Santos Response

All re-vegetation species will be native, endemic, and wherever available will also be of local provenance to ensure local genetic integrity is maintained. A number of recommendations for rehabilitation are made in EIS Sections 6.16; 7.16; 8.16; 11.16.10 and 12.16.7. It is not prudent to specify prescriptions for species diversity, planting densities, soil and fertiliser preparation or maintenance and monitoring requirements at a broad level within the EIS as these factors need to be addressed and established in each instance at the site specific level to ensure impacts and re-vegetation are correctly managed.

6.4.5.4 Aquatic Ecology

Respondent Comment

Department of Environment and Resource Management requested more detailed information describing the mitigation measures for permanent creek crossings and other aspects of pipeline construction is needed consistent with AS2885 and the Australian Pipeline Industry Association Code of Environmental Practice, which documents the approach to be taken when determining the optimal route selection as well as engineering standards that must be applied to the construction.

Santos Response

The detailed design of the pipelines will be undertaken as set out in AS 2885.1 to develop design criteria for each potential crossing. This will include:

- Hydrological analysis to determine the stream power in AEP 0.01 (1 in 100 ARI) flow conditions;
- Geotechnical investigation to assess the physical parameters of the crossing, which will then be combined with the hydrological investigation to assess the erosion potential. The meander potential of the watercourse will also be considered in order for the limits of special construction methods to be defined;
- The requirements for external interference protection;
- The requirements for pipe stability;
- An analysis of the construction methodology will be made;
- The environmental management measures required during construction and restoration will be refined with particular reference made to the condition of the stream banks and their subsequent stabilisation and restoration; and
- The need for any specific corrosion protection measures will be addresses in the mitigation measures.

The final crossing design will be determined by Santos in conjunction with DERM following careful consideration of the relevant environmental sensitivities. The design will minimise scour potential by wherever possible locating the crossing(s) at a point where the watercourse is straight, stream velocity is a minimum and the pipe is orientated as perpendicular as practicable to stream flow. In accordance with AS 2885.1 the final designs will provide detail of the following:

- Pipe location;
- Wall thickness and material;
- Methods employed to stabilise the pipe in the trench;
- Protection of the pipe from external interference;

- The presence of adjacent structures;
- Corrosion protection measures;
- Where applicable, the relationship of the pipe to the natural bottom of the crossing;
- Methods for restoring the site after completion of construction;
- The approved flotation design and safety margin against floatation; and
- Pipe to be laid horizontal at the design depth for the full width of the crossing.

The detailed designs will also provide specific detail of the location of the pipe in the banks of the crossing and the position of the pipe across the bottom. The over and sag bends will be designed to accommodate the proposed restoration methods and will also be located away from the banks where potential for erosion exists.

Construction Planning

Site-specific management plans and engineering designs will be developed for each significant watercourse crossing and will detail construction and environmental management requirements. Wherever practicable, construction will be scheduled to avoid periods of seasonal high flow and periods of high faunal sensitivity. Crossings will be completed promptly so as to minimise impacts and due regard will be given to flood warnings and weather reports.

Respondent Comment

Department of Environment and Resource Management states alternative clearing methods such as lopping and hand clearing should be adopted adjacent to watercourses to minimise the disturbance to the riparian soils.

Santos Response

Clearing in riparian vegetation adjacent to water courses is not proposed for any of the project's clearing requirements. The only placement of infrastructure proposed near watercourses will be when the gas transmission pipeline alignment crosses a watercourse. In these instances the placement of the alignment is initially planned to avoid disturbance to vegetation and sensitive environmental receptors. Horizontal directional drilling (HDD) will be used on selected watercourses, where practicable, taking into account environmental, engineering, logistical and geotechnical issues and advice from the drilling operator.

6.4.5.5 Biodiversity Offsetting

Respondent Comment

Department of Environment and Resource Management states that an offsets proposal should be developed covering the whole project in accordance with the QGEOP and specific issue policies.

Santos Response

An environmental offsets package is being developed by Santos in conjunction with Ecofund Queensland (a Queensland government advisory service) as an Environmental Offset Management Plan to address the objectives of both the current State & Commonwealth legislative environmental offsetting requirements. An analysis has been undertaken to identify the offset requirements for proposed impacts for the CSG field, Gas Transmission Pipeline and LNG facility components of the GLNG Project. Analysis requirements being undertaken for offsets include:

- Extent and size of offsets required to be secured;
- Ecological values required to be offset;
- Options available for pooling or consolidation offset requirements; and
- Options for securing offsets.

Offset assessment and analysis includes the co-ordination of multiple offset requirements and is being carried out under the following policies:

- Vegetation management offsets under the *Vegetation Management Act 1999* (Qld);
- Fish habitat offsets under the *Fisheries Act 1992*;
- Protected plants offsets under the *Nature Conservation Act 1992*;
- Biodiversity offsets under the Draft Policy for Biodiversity Offsets 2008 (Qld); and
- Environmental offsets under the *Environment Protection & Biodiversity Conservation Act 1999* (Cwth).

Further steps to be undertaken within a suitable timeframe as part of the process include:

- Identification of suitable offset options;
- Assessment of properties;
- Landholder liaison and negotiation to secure required offsets;
- Offset validation and preparation of specific Environmental Offset Management Plan(s); and
- Liaison to finalise contractual arrangements and covenants.

In addition to the objectives outlined above and those previously stated within the EIS (Sections 6.4, 7.4, 8.4 and Appendices N1, N2 and N3), the Environmental Offset Management Plan will be implemented over an appropriate time frame to accomplish the following specific aims:

- Identification of suitable potential offset areas with ecological values analogous to impacted ecological communities;
- Assessment of the ecological value and equivalence of offsets to ensure suitable offset extent, species assemblage, floristic structure and ecological integrity utilising an appropriate biometric field methodology;
- Development of appropriate management prescriptions to ensure long term viability of offsets (such as pest control, livestock management, access exclusion, ameliorative plantings and fire regime management);
- Placement of appropriate covenants for future conservation and management of offsets; and
- Development of appropriate monitoring and maintenance activities and performance review processes to ensure long term viability of the offsets.

The process of developing a suitable Environmental Offset Management Plan is an iterative process with State and Commonwealth regulatory bodies.

Respondent Comment

Department of Environment and Resource Management requested that the EIS should examine opportunities for using offsets for any unavoidable impacts on the marine environment and wetlands.

Santos Response

Santos does not propose to locate CSG infrastructure within wetlands and it is not expected that there would be any impact on wetlands which would require offsets to be provided as part of the development of the CSG Field.

The Environmental Offsets Management Plan being developed for the GLNG Project includes proposed offsets for marine and wetland environments that are likely to be impacted by the construction of the LNG Facility and the gas transmission pipeline.

Respondent Comment

As a 'second-best' option, Capricorn Conservation Council supports Santos in securing protection such as conservation covenants and other initiatives listed in the EIS. However, they suggest that offset areas should be localised so that regional species remain viable in that area and that the same suite of plant species must be used in RE types being offset.

Santos Response

An Environmental offsets package is being developed by Santos in conjunction with Ecofund Queensland (a Queensland government advisory service) as an Environmental Offset Management Plan to address the objectives of both the current State & Commonwealth legislative biodiversity offsetting requirements. An analysis has been undertaken to identify the offset requirements for proposed impacts for the CSG field, Gas Transmission Pipeline and LNG facility components of the GLNG Project. Analysis requirements being undertaken for offsets include:

- Extent and size of offsets required to be secured;
- Ecological values required to be offset;
- Options available for pooling or consolidation offset requirements; and
- Options for securing offsets.

Offset assessment and analysis includes the co-ordination of multiple offset requirements and is being carried out under the following policies,

- Vegetation management offsets under the *Vegetation Management Act 1999* (Qld);
- Fish habitat offsets under the *Fisheries Act 1992*;
- Protected plants offsets under the *Nature Conservation Act 1992*;
- Biodiversity offsets under the Draft Policy for Biodiversity Offsets 2008 (Qld); and
- Environmental offsets under the *Environment Protection & Biodiversity Conservation Act 1999* (Cwth).

Further steps to be undertaken within a suitable timeframe as part of the process include:

- Identification of suitable offset options;
- Assessment of properties;
- Landholder liaison and negotiation to secure required offsets;
- Offset validation and preparation of specific Biodiversity Offset Management Plan(s); and
- Liaison to finalise contractual arrangements and covenants.

In addition to the objectives outlined above and those previously stated within the EIS (Sections 6.4, 7.4, 8.4 and Appendices N1, N2 and N3), the Environmental Offset Management Plan will be implemented over an appropriate time frame to accomplish the following specific aims:

- Identification of suitable potential offset areas with ecological values analogous to impacted ecological communities;
- Assessment of the ecological value and equivalence of offsets to ensure suitable offset extent, species assemblage, floristic structure and ecological integrity utilising an appropriate biometric field methodology;
- Development of appropriate management prescriptions to ensure long term viability of offsets (such as pest control, livestock management, access exclusion, ameliorative plantings and fire regime management);
- Placement of appropriate covenants for future conservation and management of offsets; and
- Development of appropriate monitoring and maintenance activities and performance review processes to ensure long term viability of the offsets.

Furthermore, offset areas will be sought in close proximity to the impacted areas where practicable depending on availability.

The process of developing a suitable Biodiversity Offset Management Plan is an iterative process with State and Commonwealth regulatory bodies.

6.4.5.6 Phase II Protocols

Respondent Comment

Department of Environment Water Heritage and the Arts states that more detail is required on proposed protocols to avoid areas of sensitivity. As a result of the two Phase approach in the EIS, and the subsequent lack of information regarding development related impacts, DEWHA requires further information to assess the impacts of the development phase of the project before considering whether to approve the project.

Santos Response

Santos has undertaken a supplementary assessment of the potential impacts of the development of the CSG fields on the ecological values of the area. This assessment is presented in **Attachment D5**.

The supplementary assessment has comprised the following key elements:

- **Constraints mapping** – a detailed analysis of the ecological values of the Reasonably Foreseeable Development Area (RFDA) within the CSG fields having regard to augmented desktop and field datasets;
- **Constraints classes** – identification and mapping of five classes of land within the RFDA with graduated levels of ecological sensitivity based on the constraints mapping;
- **Field Management Protocol –** development of a field management protocol which describes the nature of development which may be undertaken within each of the constraints classes, the process to settle the specific location of the development within each constraints class having regard to the ecological values of the area and mitigation measures;
- **Indicative Field Development Plan –** identification of a field development plan (FDP) for the RFDA with preliminary locations for the wells and associated infrastructure;
- **Supplementary Impact Assessment -** an evaluation of potential impacts on ecological values of the development of the CSG fields based on three scenarios derived from implementation of the field management protocol to the field development plan;
- **Mitigation Measures –** identification of mitigation measures additional to measures outlined in the EIS; and

- **Offset Strategy –** outlining the basis of an Environmental Offset Management Strategy to offset ecological values impacted by the GLNG Project by offsite measures (such as property acquisition, covenants and reserve dedications).

6.5 Surface Water

6.5.3 Regulatory Framework

Respondent Comment

Department of Environment and Resource Management states detailed information should be provided illustrating how the proponent will ensure the outcomes outlined in Section 8 of the Water Resource (Great Artesian Basin) Plan (2006) will be met.

Santos Response

Section 8 of the Water Resource (Great Artesian Basin) Plan (2006):

Outcomes, including ecological outcomes, for the plan area include:

a) *To protect the flow of water to springs and baseflow to watercourses that support significant cultural and environmental values;*

b) *To provide for the continued use of all water entitlements and other authorisations to take or interfere with water;*

c) *To reserve water in storage in aquifers for future generations;*

d) *To ensure a reliable supply of water from the plan area; and*

e) *To make water available for new users.*

Santos has identified the principal issues of concern with respect to potential risks to groundwater arising from CSG activities, which include reduced access to groundwater resources supplying stock, domestic and other licensed uses, potential impacts to shallow groundwater, springs and seeps and potential impacts to groundwater quality (especially to shallow groundwater resources) associated with an uncontrolled release of poor quality water.

These issues are also amongst the primary concerns of local bore owners and the regulators. To address these high priority concerns, Santos has adopted a combination of preventative actions and “make good” options to reduce the likelihood of adverse impacts occurring, or to assist those affected if impacts to environmental values of the groundwater resource do arise as a result of CSG operations.

Refer to **Attachment D2** for further details on risk mitigation actions.

Respondent Comment

Department of Environment and Resource Management requested that reference to the Water Resource Calliope River Basin Plan 2006 and detailed information should be provided showing how the project is consistent with the plan.

Santos Response

The Calliope River Basin Plan 2006 has been prepared to define the availability of water and to provide a framework for sustainably managing water and the taking of water (including overland flow) within the

Calliope River catchment. Santos understands that a licence would be required to draw any water from within the Plan area. Santos does not foresee a requirement to take water from within the area covered by the Calliope River Basin Plan at this time.

Project activity within the area covered by the Calliope River Basin Plan 2006 involves the construction and operation of the gas transmission pipeline. Water will be required for:

- Construction activities such as dust suppression and soil compaction;
- Vehicle and plant wash down to prevent the spread of weeds;
- Assistance with horizontal directional drilling (HDD), as a component of the drilling fluid and the production of concrete;
- Hydrotesting of the pipelines; and
- Domestic uses at worker and accommodation facilities.

These water requirements will be supplied by water sources outside the Calliope River Basin Plan area.

Associated water from the CSG fields will be used for dust suppression and as the hydrotest water used to pressure test the pipeline. Associated water will be used to test short sections of the pipeline (5 – 50km) at a time depending on differences in elevation. Upon completion of one section, the water will where possible be recycled and used for the next section; otherwise, hydrotest water will be disposed of at appropriate locations in accordance with the relevant environmental authority conditions.

It is proposed that due to the limited local water supplies, other water demands for construction and operation of the pipeline will be imported to the site from local municipal water supplies located along the length of the gas transmission pipeline.

If potable water services are not available, it will either be trucked to the site or raw water will be sourced locally and treated on site. Non-potable and raw water will be sourced from local water sources and bores under permit. In the event that raw water is required from local water sources Santos will apply for a licence in accordance with the requirements identified in the Calliope River Basin Plan 2006.

Respondent Comment

Queensland Primary Industries and Fisheries (Department of Employment, Economic Development and Innovation) requests the proponent should note the following approvals required for development of this project: the QPIF Code for Self Assessable development - Temporary waterway barrier works Code number WWBW02, may be applicable for the construction of temporary waterway barriers associated with the proposal.

Santos Response

Should there be a requirement for approvals under the Temporary Waterway Barrier Works Code for the establishment of temporary waterway barriers applications will be prepared and submitted with the appropriate supporting documentation.

6.5.4 Existing Environmental Values

6.5.4.1 Study Area

Respondent Comment

Department of Environment and Resource Management states that catchment references should be the Upper Dawson catchment, the Comet catchment, the Moonie Catchment, and the Condamine-Balonne-Culgoa catchment in Queensland.

Santos Response

The Moonie Fields (PLs 1-3, 17 and EPC 937) have been removed from the GLNG Project. The Moonie Catchment is not part of the study area for the CSG fields which form the GLNG Project. The other catchments have been considered in the EIS process.

6.5.4.2 Catchment Overview

Respondent Comment

Department of Environment and Resource Management requested to clarify the statement in paragraph 2: "…it is expected that the same environmental values will apply to all streams in the catchment". This is also reflected in Table 6.5.1, but conflicts with the statement in Sect. 6.5.6 Summary of Findings (p6.5.21): "…baseline assessment has indicated that the existing water quality of surface waters is variable…"

Santos Response

The statement provided in Section 6.5.6 refers to streams across all CSG catchments whilst the text and data provided in Table 6.5.1 refers to streams within a catchment.

Respondent Comment

Department of Environment and Resource Management states that the categories in Table 6.5.1 should be called Protection of disturbed aquatic ecosystems (not habitat).

Santos Response

Santos notes your comment.

6.5.5 Potential Impacts and Mitigation Measures

Respondent Comment

Department of Environment and Resource Management requested the proponent should install strategically located gauging stations upstream and or downstream of discharge points.

Santos Response

Santos will develop a Water Monitoring Strategy as is contemplated in part 11.16.12 of the CSG field EMP and the AWSP (see Part 5 of **Attachment D3**). As part of this strategy, gauging stations will be

strategically located upstream and downstream of discharge points to enable the monitoring of flows and water quality upstream and or downstream of any discharge points.

Respondent Comment

Department of Environment and Resource Management requested further information on how "background" levels will be determined for discharge to Bungil Creek (or other creeks) and appropriate discharge limits (or approaches if this is to be determined at a future date) that should be adopted for both water quality concentrations and discharge rates.

Santos Response

Santos will develop a Water Monitoring Plan as is contemplated in Part 11.16.12 of the CSG field EMP and the AWSP (see Part 5 of **Attachment D3**). This strategy will specify the requirements for a baseline monitoring programme and this programme will be implemented by Santos to determine "background" levels for Bungil Creek (or other creeks). The AWSP (section 3.3.4) includes a summary of potential impacts for last resort discharge to surface water and helps guide the development of water quality concentrations and discharge rates for such discharges.

Respondent Comment

Department of Environment and Resource Management states that in relation to hydrostatic testing the background water quality, hydro test water characteristics, water quality indicators, limits and proposed monitoring should be discussed and defined.

Santos Response

It is proposed that associated water from the CSG fields will be used for the hydrostatic testing. It will be used to test short sections of the pipeline (5-50 km) at a time depending on elevation. Upon completion, the water will, where possible, be recycled and used for the next section. Otherwise, the hydrotest water will be disposed of at appropriate locations in accordance with the relevant environmental authority. Prior to discharge hydrotest water will be tested to ensure compliance with environmental authority requirements.

Respondent Comment

Department of Environment and Resource Management states that evidenced based reasoning for the siting of the water quality monitoring station downstream of the discharge.

Santos Response

Surface water quality monitoring locations have been chosen at locations upstream and downstream of CSG field areas. These locations have been chosen based on their suitability for continuing monitoring, and as areas that can be accessed safely. Monitoring at these sites against the WQO will provide sufficient information to detect any potential impacts on surface and their dependent ecosystems. The identified sites incorporate locations identified in the GLNG EIS – refer Figure 6.5.2 (Roma CSG field), Figure 6.5.3 (Fairview CSG field) and Figure 6.5.4 (Arcadia Valley CSG field).

6.5.6 Summary of Findings

Respondent Comment

Department of Environment and Resource Management states that the conclusions and findings of the report about water quality condition in ephemeral streams in the study area should be based on suitable reference data. Any limitations in available reference data should be acknowledged. The collection of relevant reference data should be considered for locations where there is a potential risk from the activity on surrounding environmental water quality.

Santos Response

The data sources used in the assessment of baseline water quality in the study area are discussed in section 6.5.4.5 of the EIS. They comprise available DERM spot and continuous water quality data, QMDC community monitoring program data, data collected by other consultants and data collected for the EIS (spot and continuous data).

There are limitations in the reference data including:

- There is insufficient data available in the Murray-Darling region for appropriate reference values to be derived; and
- The datasets are limited in spatial coverage and appear to have been subject to variable quality control requirements.

Santos will develop a Water Monitoring Plan as is contemplated in part 11.16.12 of the CSG field EMP which will involve the selection of appropriate monitoring points to enable baseline characterisation and evaluation of changes to surface and ground water quality and quantity in the vicinity of the GLNG CSG operations and receiving water resources. This will refine the reference data.

6.5.7 Potential Impacts and Mitigation Measures

Respondent Comment

Queensland Primary Industries and Fisheries (Department of Employment, Economic Development and Innovation) requested that a condition be imposed by the Coordinator General to ensure no discharge of contaminated water capable of adverse impact upon the health of fish or the health of any receiving waterway or water body. To reinforce this, QPIF would support the recommendations of Department of Environmental and Resource Management in regard to the water quality criteria.

Santos Response

Santos notes your comment for the Coordinator-General.

6.6 Groundwater

Respondent Comment

Department of Environment and Resource Management requested that to ensure that environmental values of Groundwater Dependent Ecosystems (GDEs) are recognised, potential impacts are fully assessed and appropriate mitigation measures are adopted, a comprehensive whole-of-project GDE assessment is required to include the identification of all types of GDEs, description of the values of identified GDEs, description of likely impacts, options to avoid or mitigate these impacts, and details of proposed monitoring for each identified GDE.

Santos Response

Groundwater dependent ecosystems (GDEs) can be defined as those ecosystems whose ecological processes and biodiversity are wholly or partially reliant on groundwater. The extent of GDE dependency on groundwater can range from being marginally or episodically dependent to being entirely dependent on groundwater (SKM, 2001)[5].

Examples of GDEs include:

- Terrestrial vegetation supported by shallow groundwater;
- Aquatic ecosystems in rivers and streams that receive groundwater base flow;
- Wetlands, which are often established in areas of groundwater discharge;
- Springs and associated aquatic ecosystems in spring pools; and
- Aquifers and caves where stygofauna (groundwater-inhabiting organisms) reside.

The *Hydrogeological Framework Report for the Great Artesian Basin Water Resources Plan Area (2005)*[6] includes a discussion of the two types of GDEs that are most relevant to the GLNG Project area:

- Springs, including mound springs of the Great Artesian Basin (GAB); and
- Rivers receiving baseflow.

Artesian spring communities that are reliant on the artesian discharge of GAB groundwater are listed as a threatened ecological community (*The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin*) under the EPBC Act.

Studies for the EIS have determined that:

- Numerous springs exist within the Upper Dawson, Condamine–Upper Balonne catchments (Appendix N-4).
- The major river systems associated with the GLNG Project area include the Upper Dawson River, which transects the Fairview CSG Field, and the Condamine–Upper Balonne Rivers, which cross the Roma CSG fields. Ecological surveys carried out by URS (2009) identified established aquatic ecosystems associated with major rivers, some of which are sustained by baseflow.

Springs investigated along the Dawson River within the Arcadia Valley CSG field (URS 2008)[7] clearly exhibit characteristics of RE 11.10.14 (Springs associated with sandstone). Recharge springs are generally associated with outcropping sandstone, which can form rugged landscapes with springs often situated in gullies and providing the source for streams. Recharge springs are not included in the EPBC-listed threatened community definition.

Golder (2009)[8] was engaged to evaluate and document the potential impacts to the water resources affected by CSG development in the three RFDAs of the GLNG Project area (**Attachment D2**). The assessment of groundwater impacts included:

- Review of existing studies and associated relevant literature (including legislation);
- Development of a conceptual hydrogeological model for each of the three CSG Fields;

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[5] SKM, 2001. *Environmental Water Requirements of Groundwater Dependent Ecosystems*. Technical Report Number 2, Sinclair Knight Mertz for Environment Australia.

[6] Queensland Department of Natural Resources and Mines, 2005, H*ydrogeological Framework Report for the Great Artesian Basin Water Resource Plan Area*.

[7] Appendix O1 of the GLNG EIS.

[8] Attachment D2 of the EIS Supplement

- Detailed risk assessment of the various activities associated with CSG production in the Project area;
- Identification of the environmental values relevant to the GLNG Project area;
- Discussion of the potential groundwater impacts associated with CSG activities, and the relative risks to environmental values in each Field;
- Discussion of risk control measures adopted or developed to address the principal risk issues associated with CSG activities;
- Discussion of the Water Monitoring Strategy and Associated Water Management Strategy developed for the GLNG Project; and
- Development of recommendations to address data gaps, manage risks or reduce uncertainty in the analysis of potential impacts.

The study included a comprehensive assessment of potential impacts to GDEs within the CSG fields.

Results of groundwater modelling by Golder (2009) include a finding that groundwater extraction at the Arcadia and Fairview CSG Fields is not expected to significantly alter the baseflow contributions to the perennial portion of the Dawson River, or the groundwater discharge volumes to springs located in the vicinity of the Fairview Field. Therefore, GDEs will not be significantly impacted by groundwater extraction.

Strategies to minimise impacts include the preparation of an Associated Water Management Strategy (AWMS) which address the challenges with associated water produced during CSG activities. In addition, a comprehensive Water Monitoring Plan (WMP) for the GLNG Project is being developed. This will act as a specification for establishing the specific water monitoring requirements for each element of project (including gathering, ponds, treatment facilities, environmental assets etc). Water monitoring will provide a mechanism for early identification of potential impacts associated with coal seam depressurisation, so that contingency actions, if warranted, can be implemented in a timely manner.

Constraints mapping (**Attachment D5**) conducted for the CSG fields has been undertaken to provide a framework for the planning of field development and management of impacts to ecological values. The GDEs identified within the RFDAs are surface features; aquatic ecosystems in rivers and streams that receive groundwater base flow or the recharge springs that provide the baseflow. Constraints mapping for the CSG fields has identified such ecosystems as Class B areas. Strict protocols have been developed for Class B areas, including;

- Class B areas will be avoided where possible at the planning stage for the siting of wells, access routes and associated infrastructure. If the Class B area cannot be avoided through relocation at the planning stage, then well sites or associated infrastructure, will be sited in previously disturbed areas if possible, or in locations least likely to cause significant impacts based on the pre-construction surveys below;
- No disturbance is proposed to occur in any areas within 50 m of waterways wherever feasible and within 200 m of mapped wetlands; and
- A pre-construction ground survey will be undertaken to confirm that vegetation mapping associated with the planned sites is accurate and to confirm the localised ecological values. The ground survey will identify specific locations of 'Endangered' REs and EPBC-listed communities in the area of the proposed development.

The CSG EMP (**Attachment B1**) outlines a range of strategies to be employed to further minimise impacts to ecological values including aquatic ecosystems.

Respondent Comment

Department of Environment and Resource Management states that monitoring reports should be made available to the Queensland Department of Environment and Natural Resources upon completion.

Santos Response

In accordance with Sections 252 to 257 of the *Petroleum and Gas (Production and Safety) Act 2004* (refer **Attachment D2**, Section 2.1.6), Santos will prepare an annual monitoring report, including a factual summary of all monitoring activities and results performed over the year, and interpretation of the results relative to the assessment criteria and extended monitoring triggers. In the event of a specific contamination event, a summary report providing details of the event and mitigation measures undertaken will be provided as soon as practicable following the event. Refer to **Attachment D3**, (Section 5.1) for further details.

This report will be provided to DME and it is Santos' understanding that DERM will assist DME with the technical review.

Respondent Comment

Department of Environment and Resource Management states that the proponent needs to recognise that Queensland Department of Environment and Natural Resources currently has an allocation policy for groundwater in the Central Highlands declared area. The policy uses a volume per hectare calculation to determine entitlement and protect existing users. The policy does allow for larger allocations where the proponent is prepared to complete a hydro geological report and construct a monitoring network. Impacts on existing users and Queensland Department of Environment and Natural Resources policy in relation to the Interim Management Policy should be considered by the proponent.

Santos Response

Attachment D2 (Coal Seam Depressurisation (Section 8.3)) includes an assessment of the hydro-geological connections for the CGS fields. It identified that inter-aquifer transfer related to coal seam depressurisation may result in a localised reduction in the available water column for bores screened within the affected aquifers; notably, the Precipice Sandstone in the vicinity of the Fairview and Arcadia CSG extraction bore fields. The relative impact to bore owners in the CSG fields will depend on the location of the bores relative to the CSG operations and associated cone of depression in the affected aquifer. The modelling results predicted that depressurisation effects within the Precipice Sandstone would extend beyond the perimeter of the Fairview and Arcadia CSG fields due to the relatively high transmissivity value assigned to the Bandanna Formation. In contrast, due to lower estimated transmissivity values the effects of depressurisation of the Walloon Coal Measures in the Roma Field were predicted to be constrained to the immediate vicinity of the production area, with minor resultant inter-aquifer transfer from the underlying Hutton Sandstone. Hence, water supply bores completed within the primary aquifer formations in the vicinity of the Roma CSG field operations are predicted to face only a minor risk from loss of available drawdown.

Water supply bores within and in close proximity to the CSG operations will need to be monitored as CSG production develops, such that potential losses resulting from a reduced water column in the bores can be identified and appropriately compensated, if warranted.

Santos will implement Trigger Levels for water action management to guide it on when additional action may need to be implemented where the trigger (related to the inter-aquifer transfer) is likely, the action may include Make Good Actions, should CSG dewatering operations unduly impact bore owners (Section 9.5).

Respondent Comment

Queensland Health acknowledges the proponent's commitment to monitor and assess groundwater levels and water quality, as well as implementing mitigation measures. Measures include reducing the quantity of water withdrawn, drilling new bores outside the zone of influence, seeking alternative water supplies, and recharging treated water to groundwater supplies.

Santos Response

Santos has identified the principal issues of concern with respect to potential risks to groundwater arising from CSG activities, which include reduced access to groundwater resources supplying stock, domestic and other licensed uses, and potential impacts to groundwater quality (especially to shallow groundwater resources) associated with an uncontrolled release of poor quality water.

These issues are also amongst the primary concerns of local bore owners and the regulators. To address these high priority concerns, Santos has adopted a combination of preventative actions and "make good" options to reduce the likelihood of adverse impacts occurring, or to assist those affected if impacts to environmental values of the groundwater resource do arise as a result of CSG operations.

Refer to **Attachment D2** which outlines the mitigation measures, the investigation triggers and the make good measures (Section 9) for these types of impacts.

Respondent Comment

Wildlife Preservation Society of Queensland - Policy and Campaigns Manager states that contamination of shallow or deep groundwater aquifers is not acceptable. It is appreciated that significant monitoring programs are to be put in place. It is recommended that public access to those programs is considered so that there is confidence in any reports. Furthermore such monitoring should be undertaken by independent authorities and not any companies linked to the proponents (also include in Section 6.6 and 7.6).

Santos Response

Santos will develop a Water Monitoring Plan as is contemplated in part 11.16.12 of the CSG field EMP and the AWSP (see Part 5 of **Attachment D3**). It will enable evaluation of changes to surface and groundwater quality and quantity in the vicinity of the CSG operations and receiving water resources. Refer **Attachment D3** (Section 5.1) for further details.

In accordance with Sections 252 to 257 of the *Petroleum and Gas (Production and Safety) Act 2004* (refer **Attachment D2**, Section 2.1.6), Santos will prepare an annual monitoring report and submit it to DEEDI, including a factual summary of all monitoring activities and results performed over the year, and interpretation of the results relative to the assessment criteria and extended monitoring triggers. In the event of a specific contamination event, a summary report providing details of the event and mitigation measures undertaken will be provided as soon as practicable following the event.

The monitoring will be implemented on behalf of Santos by a suitably qualified and experienced third-party contractor/consultant, who will analyse the data, interpret the results with regards to the water management objectives for the project, and prepare an annual report for submission to the regulatory authorities as proscribed in the legislative requirements.

6.6.1.3 Regulatory Framework

Respondent Comment

Department of Environment and Resource Management state that the following items should be considered as 'key legislation':

- *Water Resource (Condamine and Balonne) Plan 2004.*
- *Water Resource (Moonie River) Plan 2003.*

Relevant details of the above plans should be provided, including, respectively:

- *Condamine and Balonne Resource Operations Plan, finalised in December 2008, for the upper and middle parts of the Plan, including the Roma Gas fields.*
- *Moonie Resource Operations Plan finalised in January 2006, including the Eastern Surat Gas fields.*

Santos Response

The key legislation outlined by DERM has been considered in **Attachment D2** (Section 2) with a discussion included on

- Water Resource (Condamine and Balonne) Plan 2004 (Section 2.1.3); and
- Water Resource (Moonie River) Plan 2003 (Section 2.1.5).

Respondent Comment

Department of Environment and Resource Management states that provisions of the P&G Act require the holder of petroleum tenure to lodge regular monitoring reports, and review reports, on groundwater conditions of the tenure. Details of monitoring to be undertaken to fulfil these requirements should be provided.

Santos Response

In accordance with Sections 252 to 257 of the *Petroleum and Gas (Production and Safety) Act 2004* (refer **Attachment D2**, Section 2.1.6), Santos will prepare an annual monitoring report, including a factual summary of all monitoring activities and results performed over the year, and interpretation of the results relative to the assessment criteria and extended monitoring triggers. In the event of a specific contamination event, a summary report providing details of the event and mitigation measures undertaken will be provided as soon as practicable following the event.

Santos will develop a Water Monitoring Plan as is contemplated in part 11.16.12 of the CSG field EMP. It will include a specification for establishing the specific water monitoring requirements for each element of project (gathering, ponds, treatment facilities, environmental assets). Water monitoring will provide a mechanism for early identification of potential impacts associated with coal seam depressurisation, so that contingency actions, if warranted, can be implemented in a timely manner. The suite of water monitoring requirements are set out in table 9-1 of the **Attachment D2** and will be incorporated in the Water Monitoring Plan.

Respondent Comment

Department of Environment and Resource Management states that detailed information and an assessment of the environmental values, potential impact and appropriate mitigation measures to prevent and or minimise impacts on the environmental values identified be provided.

Santos Response

As part of the EIS Supplement, Santos undertook additional assessment of groundwater and associated water impacts. This additional work is demonstrated in **Attachment D2** and **D3**. It includes an assessment environmental values, potential impacts and appropriate mitigation strategies with relevance to the GLNG Project area.

Respondent Comment

Department of Environment and Resource Management states that a triggered dewatering result will require shutting down of any wells that have lead to impacts on groundwater aquifers, and should form part of the water replacement plan.

Santos Response

Shutting down production wells would be unlikely to have the desired management effect on adjacent aquifers within a practical time frame, refer to **Attachment D2** (Section9.4) for details.

Information on the trigger thresholds at which groundwater impact might result in the need for groundwater management plans to be implemented by the CSG operator is contained in **Attachment D2** (Section 9.4).

Attachment D2 also discusses the time lag between coal seam depressurisation and the associated response in adjacent aquifers affected by induced inter-aquifer leakage.

Attachment D2 also outlines the mitigation measures, the investigation triggers and the make good measures (Section 9) that would apply in such circumstances.

6.6.2 Groundwater (Deep Aquifer Modelling)

Respondent Comment

Department of Environment and Resource Management requested to clarify this section in view of the following comments:

1) *It is not clear whether the trigger levels identified are in the context of the requirement under the P&G Act.*
2) *The mitigation measures section should be separated in the context of the shallow groundwater and the deep groundwater. This section is difficult to understand. The report needs to identify that the shallow and deep aquifers may be connected.*
3) *The references to monitoring are not clear and consistent between the text in this section, Table 6.6.1 and 6.6.2 and the reports provided in Appendix P.*
4) *There seems to be no discussion on monitoring of the Gubberamunda Sandstone. The report in Appendix P2 indicates that the Gubberamunda Sandstone should be monitored.*

Santos Response

1) Under the *Petroleum & Gas (Production and Safety) Act 2004*, Part 9, Division 3, Subdivision 1 (Sections 252 to 255), the trigger value is defined as "the water level drop in the aquifers that the Chief Executive considers would be a level that causes a significant reduction in the maximum pumping rate or flow rate of the existing *Water Act 2000* bores in the area affected by the exercise of the underground water rights". In accordance with guidance recently provided by DERM, Santos proposes to adopt the following starting position for trigger thresholds with respect to water levels for aquifers potentially affected by CSG activities:
   - Consolidated Aquifers (including sandstone and all other non-alluvial aquifers): the lesser of a 5 m decline in water level, or a 10% reduction of the available water column; and
   - Surficial Alluvial Aquifers: the lesser of a 2 m decline in water level, or a 10% reduction of the available water column.

   Refer to **Attachment D2** (Section 9.4) for further information.

2) Santos notes your comments.

3) Santos notes your comments.

4) The Upstream GLNG Environmental Monitoring Strategy is currently being developed and will enable baseline characterisation and evaluation of changes to surface and groundwater quality and quantity in the vicinity of the CSG operations and receiving water resources. Groundwater monitoring will include (but is not limited to) the Precipice Sandstone, Gubberamunda and Hutton Sandstone. Refer to **Attachment D3** (Section 5.1), for further details.

Respondent Comment

Department of Environment and Resource Management requested to clarify comments in this section related to deep groundwater considering that Section 6.6.1 is to address shallow groundwater issues, whereas deep groundwater is discussed in Section 6.6.2.

Santos Response

EIS Section 6.6.1 addressed groundwater (shallow) concerns and EIS Section 6.6.2 addressed groundwater (deep) concerns to the extent that the management of impacts is interrelated and they have been included in both sections.

Respondent Comment

Department of Environment and Resource Management states that a detailed assessment of the potential impacts to groundwater resources should be provided. The proposed mitigation measures, to prevent and or minimise the impacts, should include the following:

- *A monitoring program for identified aquifer systems to be approved by Queensland Department of Environment and Natural Resources; and*
- *A review of the existing groundwater model using the monitoring data to verify impact predictions should be completed and provided in the Supplementary EIS.*

Santos Response

Santos has undertaken further groundwater assessments, including groundwater monitoring, model review and additional modelling which are contained in **Attachment D2**. The following is also contained in **Attachment D2**:

- Risk based impact assessment (Section 7);
- Water monitoring plan (Section 9.5); and
- Deep aquifer groundwater modelling (Section 6).

Santos will develop a Water Monitoring Plan as is contemplated in part 11.16.12 of the CSG field EMP .It will include a specification for establishing the specific water monitoring requirements for each element of project (gathering, ponds, treatment facilities, environmental assets). Water monitoring will provide a mechanism for early identification of potential impacts associated with coal seam depressurisation, so that contingency actions, if warranted, can be implemented in a timely manner. The suite of water monitoring requirements is set out in table 9-1 of the **Attachment D2** and will be incorporated in the Water Monitoring Plan.

Respondent Comment

Department of Environment and Resource Management states that the EIS should identify and describe GAB dependent springs and base flow watercourses dependent on the GAB that maybe affected by the project, both on and off the CSG field tenure areas. The environmental values of these springs and watercourses should be fully described.

Potential impacts should be identified (preferably using the study described in Section 6.4 and using the models in Appendix P2) and appropriate mitigation measures described.

Santos Response

Attachment D2 (Section 4.7) indicated there no GAB dependent springs in the GLNG Project area of influence. Conservative modelling results indicate that no impact is expected for the springs from Hutton Creek to Dawson River. For further details refer to **Attachment D2**, Section 4.4.6 for recharge and discharge; Section 4.7.1 for springs and Section 8.1 for environmental values and Section 8.3.2 for a discussion on the potential impacts.

Respondent Comment

Department of Environment and Resource Management states that monitoring methods, capable of detecting or predicting changes in spring flows should be more fully described. This could include using an adaptive management framework containing groundwater pressure monitoring, modelling and frequent review. Mitigation measures, for example the reinjection of treated water into affected aquifers before there is any detectable change in spring flow, should be proposed that are consistent with this adaptive management approach.

Santos Response

Santos is currently developing a more sophisticated numerical model, designed to more accurately represent the conceptual hydrogeological model for the combined Project areas, and hence provide a better simulation of the hydraulic response to CSG activities within the Project area. The new modelling will comprise a finite element model with a domain that includes all of the Santos GLNG CSG fields as well as the Spring Gully operations. This modelling will also be used to simulate the recovery timeframe for the affected aquifers following completion of CSG activities. This will provide a more reliable outcome than the conservative modelling that has been used to date.

Water supply bores within and in close proximity to the CSG operations will need to be monitored as CSG production develops, such that potential losses resulting from a reduced water column in the bores can be identified and appropriately compensated, if warranted.

Refer to **Attachment D2** for further details on Coal Seam Depressurisation (Section 8.3) and Make Good Actions, should CSG dewatering operations unduly impact bore owners (Section 9.5).

Respondent Comment

Western Downs Regional Council states that the EIS indicates that the proposed CSG operations will impact the Great Artesian Basin (GAB), but GAB aquifer is very slow moving, so impacts may not be seen until 20-50 years or even longer. There are many communities that are heavily dependent on the GAB water. Therefore any loss or depletion in this resource is considered totally unacceptable.

Santos Response

Attachment D2 (Coal Seam Depressurisation (Section 8.3)) includes an assessment of the hydro-geological connections for the CGS fields. It identified that inter-aquifer transfer related to coal seam

depressurisation may result in a localised reduction in the available water column for bores screened within the affected aquifers; notably, the Precipice Sandstone in the vicinity of the Fairview and Arcadia CSG extraction bore fields. The relative impact to bore owners in the CSG fields will depend on the location of the bores relative to the CSG operations and associated cone of depression in the affected aquifer. The modelling results predicted that depressurisation effects within the Precipice Sandstone would extend beyond the perimeter of the Fairview and Arcadia CSG fields due to the relatively high transmissivity value assigned to the Bandanna Formation. In contrast, due to lower estimated transmissivity values the effects of depressurisation of the Walloon Coal Measures in the Roma Field were predicted to be constrained to the immediate vicinity of the production area, with minor resultant inter-aquifer transfer from the underlying Hutton Sandstone. Hence, water supply bores completed within the primary aquifer formations in the vicinity of the Roma CSG Field operations are predicted to face only a minor risk from loss of available drawdown.

Water supply bores within and in close proximity to the CSG operations will need to be monitored as CSG production develops, such that potential losses resulting from a reduced water column in the bores can be identified and appropriately compensated, if warranted.

Santos will implement Trigger Levels for water action management to guide it on when additional action may need to be implemented where the trigger (related to the inter-aquifer transfer) is likely, the action may include Make Good Actions, should CSG dewatering operations unduly impact bore owners (Section 9.5).

Respondent Comment

Western Downs Regional Council states that the groundwater modelling undertaken by Santos has been undertaken in isolation and does not adequately consider the cumulative affect of all CSG developments in the area.

Santos Response

The groundwater model developed by MatrixPlus for the EIS (refer Appendix P) was completed in two parts; one as the Comet Ridge Groundwater Model, which incorporates both the Fairview and Arcadia Fields (as well as the Origin Spring Gully Field, which is not a Santos operation but is located adjacent to the Fairview Field and was included for analysis of cumulative affects), and the second as the Roma Groundwater Model. The key findings of the MatrixPlus modelling are set out in section 6 of **Attachment D2**.The areal extent of any drawdown effect will be limited to the immediate vicinity of the CSG fields (based on the findings in **Attachment D2**). There will be no overlap with the Queensland Curtis CSG fields which will be 50 - 100 km away. The EISs for both CSG projects indicate that the groundwater impacts will be limited to the immediate locality of each project site. Both projects are proposing mitigation and monitoring strategies to minimise any impacts. Accordingly, other than the Origin Spring Gully Field as modelled, there is not expected to be any cumulative impacts on the groundwater from the other CSG development.

Respondent Comment

Western Downs Regional Council states that despite Santos promises that there is no risk of migration of water between aquifers, the likelihood of some leakage is very high, modelling has not considered the impact of inter-aquifer leakage, which can result from the drilling process.

Santos Response

Attachment D2 (Coal Seam Depressurisation (Section 8.3)) includes an assessment of the hydro-geological connections for the CGS fields. It identified that inter-aquifer transfer related to coal seam depressurisation may result in a localised reduction in the available water column for bores screened

within the affected aquifers; notably, the Precipice Sandstone in the vicinity of the Fairview and Arcadia CSG extraction bore fields. The relative impact to bore owners in the CSG fields will depend on the location of the bores relative to the CSG operations and associated cone of depression in the affected aquifer. The modelling results predicted that depressurisation effects within the Precipice Sandstone would extend beyond the perimeter of the Fairview and Arcadia CSG fields due to the relatively high transmissivity value assigned to the Bandanna Formation. In contrast, due to lower estimated transmissivity values the effects of depressurisation of the Walloon Coal Measures in the Roma Field were predicted to be constrained to the immediate vicinity of the production area, with minor resultant inter-aquifer transfer from the underlying Hutton Sandstone. Hence, water supply bores completed within the primary aquifer formations in the vicinity of the Roma CSG Field operations are predicted to face only a minor risk from loss of available drawdown.

Water supply bores within and in close proximity to the CSG operations will need to be monitored as CSG production develops, such that potential losses resulting from a reduced water column in the bores can be identified and appropriately compensated, if warranted.

Santos will implement Trigger Levels for water action management to guide it on when additional action may need to be implemented where the trigger (related to the inter-aquifer transfer) is likely, the action may include Make Good Actions, should CSG dewatering operations unduly impact bore owners (Section 9.5).

Respondent Comment

Western Downs Regional Council states that the council believes that the amount of monitoring proposed may be insufficient given the magnitude of the development and the impacts on the GAB, and that there must be a process that reviews the monitoring data and independently interprets that data on a regular and timely basis to ensure that any trends are identified early. Council believes also that that increased water quality monitoring from CSG wells should also occur.

Santos Response

Santos will develop a Water Monitoring Plan as is contemplated in part 11.16.12 of the CSG field EMP and the AWSP (see Part 5 of **Attachment D3**). In accordance with Sections 252 to 257 of the *Petroleum and Gas (Production and Safety) Act 2004* (refer **Attachment D2**, Section 2.1.6), Santos will prepare an annual monitoring report, including a factual summary of all monitoring activities and results performed over the year, and interpretation of the results relative to the assessment criteria and extended monitoring triggers. In the event of a specific contamination event, a summary report providing details of the event and mitigation measures undertaken will be provided as soon as practicable following the event.

All monitoring, data analysis and interpretation, and reporting will be independently verified by suitably qualified and experienced personnel external to the GLNG Project.

Respondent Comment

Western Downs Regional Council states that the proposed strategies are inadequate given the GAB is such an important resource and the fact that the resource is contained in aquifers that are very slow to respond to changes.

Santos Response

Santos has undertaken further investigations into the GAB and Santos' potential impact on local towns/communities that rely on GAB water as a resource. Refer to **Attachment D2** (Section 8) for details.

Attachment D2 also contains a discussion on the time lag between coal seam depressurisation and the associated response in adjacent aquifers affected by induced inter-aquifer leakage (Section 8.3) and information on the trigger thresholds at which groundwater impact might result in the need for groundwater management plans to be implemented by the CSG operator (Section 8.13).

Respondent Comment

Maranoa Regional Council states that the council's position that the State Government must ensure that the supplies are safeguarded by one of two measures:

- *Augmentation of the supply infrastructure to increase the factor of safety in terms of storage and supply capacity, or*
- *Conditions of approval that reflect the potential severity of impact and impose tighter control on any activity in the vicinity of urban water supply aquifers, and*
- *Conditions of Approval to require the use of independent third party monitoring and assessment of the Santos "early warning" system to ensure that decision making processes cannot be compromised.*

Santos Response

1) **Attachment D3** (Section 3.3.3) addresses the supply of infrastructure to increase the factor of safety in terms of storage and supply capacity.
2) Santos proposes a number of beneficial uses of associated water (**Attachment D3** (Section 5.4)) which have the potential to reduce the current reliance on groundwater for water supply. Also refer to **Attachment D3** (Section 5.1) for details on the monitoring proposed.
3) All monitoring, data analysis and interpretation, and reporting will be independently verified by suitably qualified and experienced personnel external to the GLNG Project.

6.6.2.5 Potential Impacts and Mitigation Measures

Respondent Comment

Department of Environment and Resource Management recommends an assessment of the potential impacts on the Mooga and Gubberamunda sandstone aquifers be undertaken as shown in Appendix P2 (refer Case 1, Case 2). Mitigation measures should be provided to avoid and or minimise potential impacts on the identified environmental values.

Santos Response

Santos has adopted a combination of preventative actions and “make good” options to reduce the likelihood of adverse impacts occurring, or to assist those affected if impacts to environmental values of the groundwater resource do arise as a result of CSG operations.

Refer to **Attachment D2** (Section 8.10) for further details on risk mitigation actions.

6.6.2.6 Summary of Findings

Respondent Comment

Department of Environment and Resource Management requested that regular reporting of monitoring results should be provided to DERM.

Santos Response

In accordance with Sections 252 to 257 of the *Petroleum and Gas (Production and Safety) Act 2004* (refer **Attachment D2**, Section 2.1.6), Santos will prepare an annual monitoring report, including a factual summary of all monitoring activities and results performed over the year, and interpretation of the results relative to the assessment criteria and extended monitoring triggers. In the event of a specific contamination event, a summary report providing details of the event and mitigation measures undertaken will be provided as soon as practicable following the event. Refer to **Attachment D3**, (Section 5.1) for further details.

This report will be provided to DEEDI and it is Santos' understanding that DERM will assist DEEDI with the technical review.

6.7 Associated Water Management

Respondent Comment

Department of Environment Water Heritage and the Arts considers that there is a lack of specific information on associated water. It states a commitment to develop plans at a later stage does not give us information for our assessment before commencement of action.

Santos Response

The Associated Water Management Plan (**Attachment D3**) builds upon the Associated Water Management Strategy presented in the GLNG EIS (Appendix Q), and provides further detail in relation to the management of associated water.

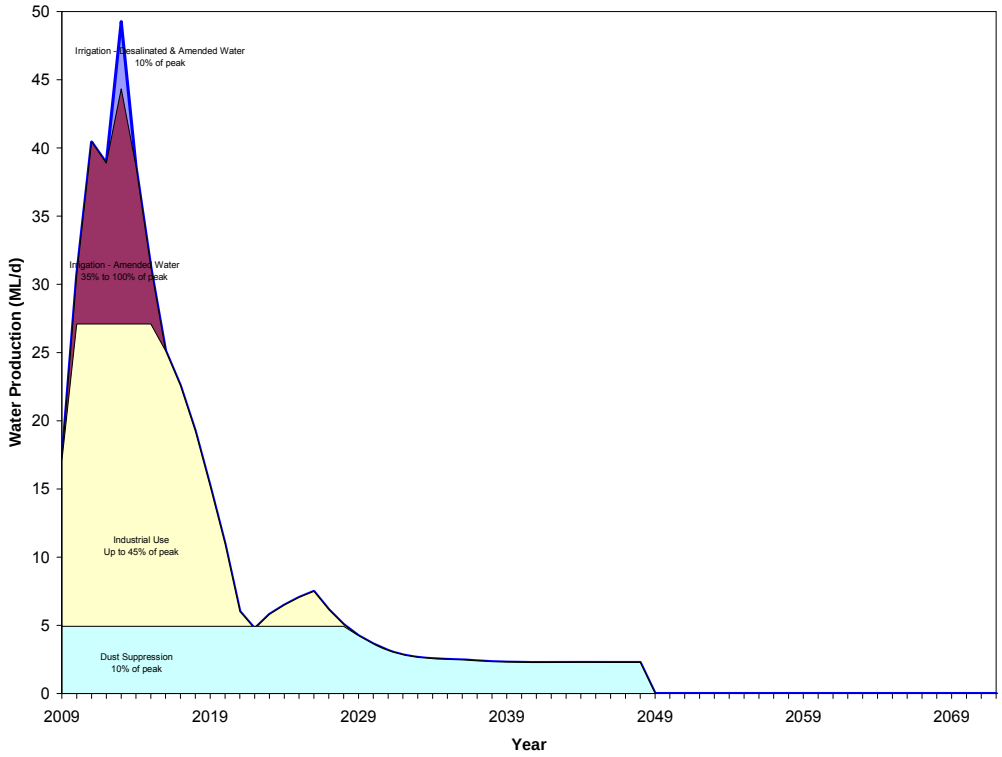
Respondent Comment

Western Downs Regional Council is concerned that Santos does not yet have a comprehensive management plan that clearly identifies where the projected quantities of water will be produced, stored, managed and reused or disposed of.

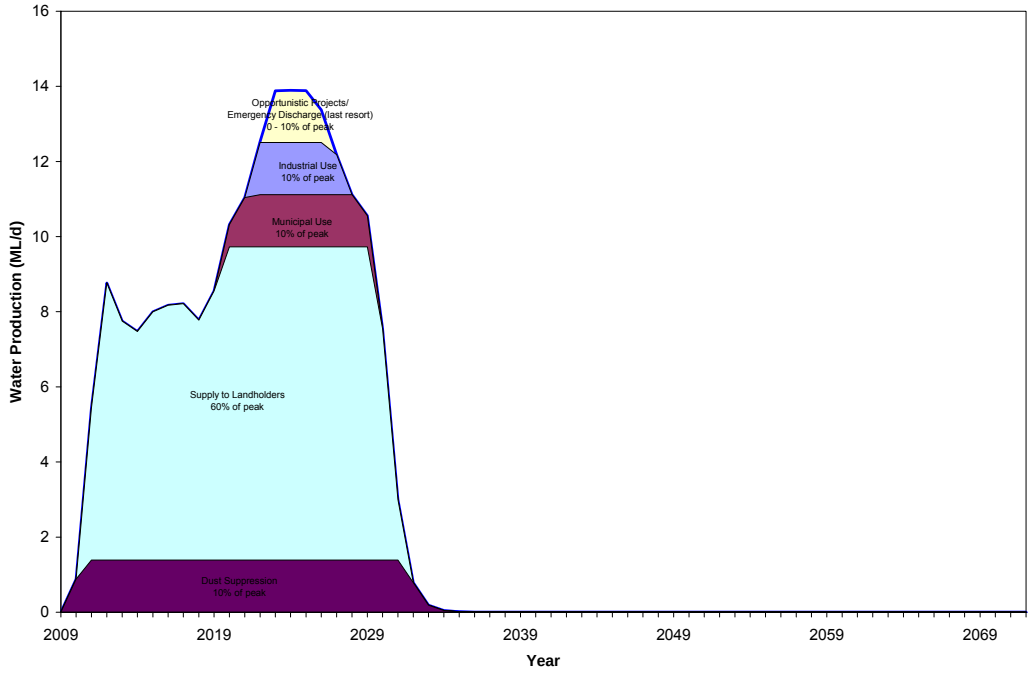
Santos Response

A summary of the associated water management plan for each field is presented below (refer to **Attachment D3** (Section 4) for further details. The diagrams below show the likely method for dealing with the AW having regard to the projected quantity for each field:

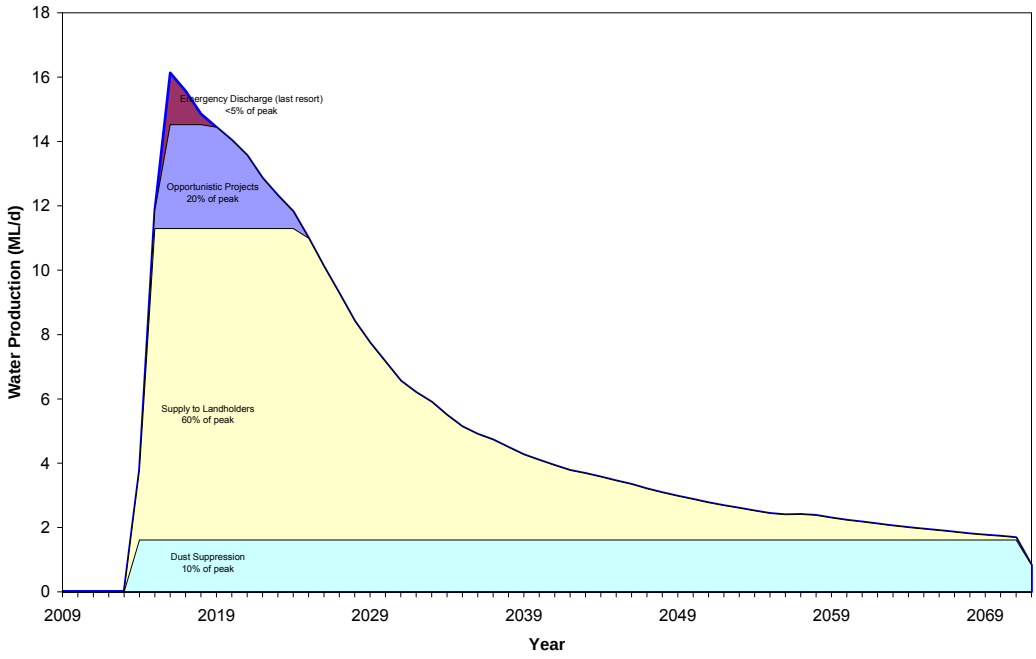
- For Fairview, the AW management options consist of (in order of preference): dust suppression, industrial supply (via discharge of desalinated water to the Dawson River for downstream industrial users), irrigation of tree plantations using amended water and irrigation of forage crops using desalinated and amended water.



- For Roma, the AW management options consist of (in order of preference): dust suppression, supply of desalinated and/or amended water to local landholders, municipal use, industrial use, opportunistic projects, and as a measure of last resort, discharge of desalinated water to Bungil Creek.



- For Arcadia, the AW management options consist of (in order of preference): dust suppression, supply of desalinated and/or amended water to local landholders, opportunistic projects and as a measure of last resort, discharge of desalinated water to Lake Nuga Nuga.



Respondent Comment

Department of Environment and Resource Management requests the inclusion of details on the engineering and design standards to be applied to containment structures and for the decommissioning treatment of the reverse osmosis concentrate ponds.

Santos Response

All brine containment ponds will meet the regulatory design and performance criteria necessary to obtain the appropriate environmental authorities. The final decommissioning plan will be developed in consultation with regulators. The decommissioning plan will be commenced at least five years prior to decommissioning.

These are detailed in section 8 and 9 of **Attachment D2**.

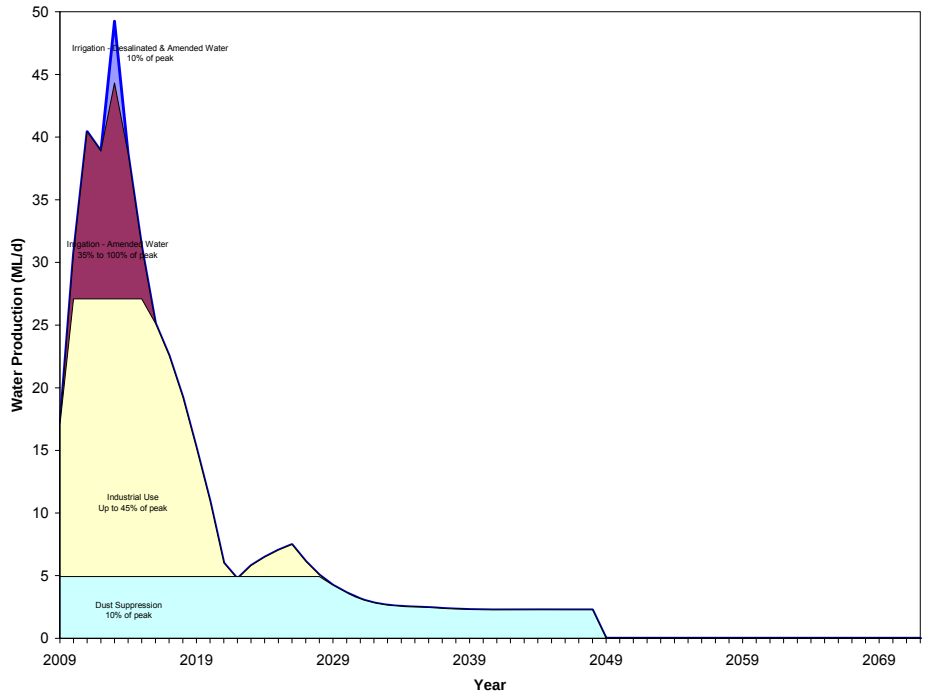
Respondent Comment

Department of Environment and Resource Management requested that the proponent provide more detailed information on the feasibility of the proposed associated water management options to deal with the entire volume of associated water to be produced in the RFD. Standards and risk minimisation measures relating to reverse osmosis concentrate storage structures and encapsulation methods must be provided. The proponent should fully assess the disposal of salt and other contaminants.

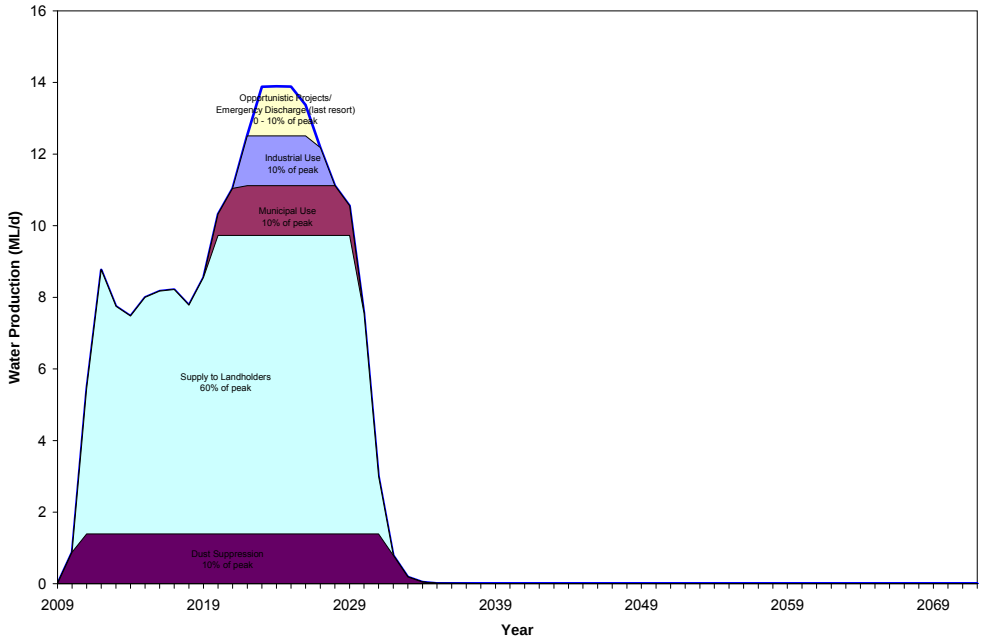
Santos Response

A summary of the associated water management plan for each field is presented below (refer to **Attachment D3** (Section 4) for further details. The diagrams below show the likely method for dealing with the AW having regard to the projected quantity for each field.

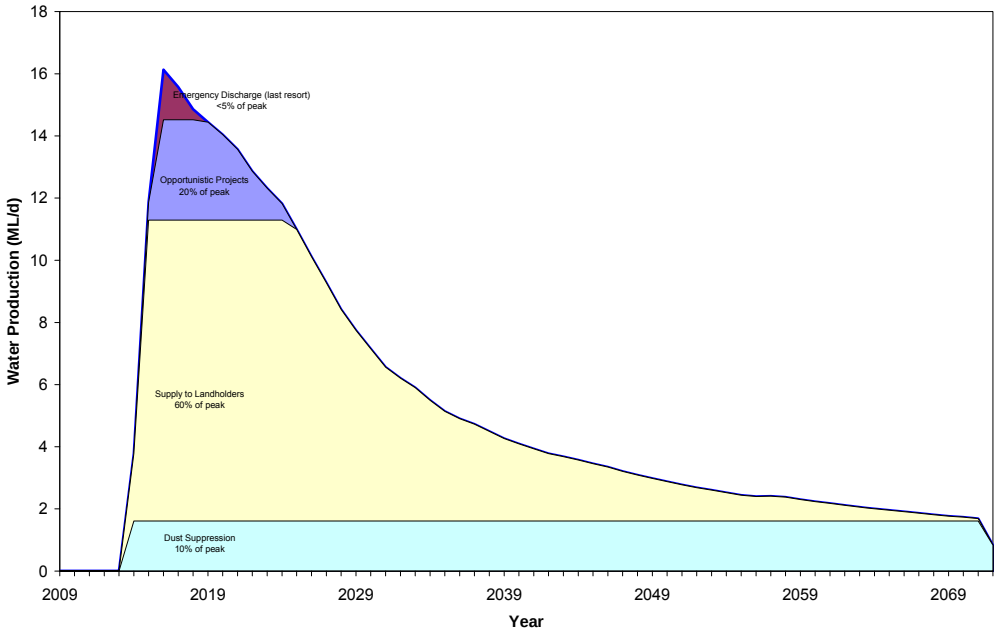
- For Fairview, the AW management options consist of (in order of preference): dust suppression, industrial supply (via discharge of desalinated water to the Dawson River for downstream industrial users), irrigation of tree plantations using amended water and irrigation of forage crops using desalinated and amended water.



- For Roma, the AW management options consist of (in order of preference): dust suppression, supply of desalinated and/or amended water to local landholders, municipal use, industrial use, opportunistic projects, and as a measure of last resort, discharge of desalinated water to Bungil Creek.



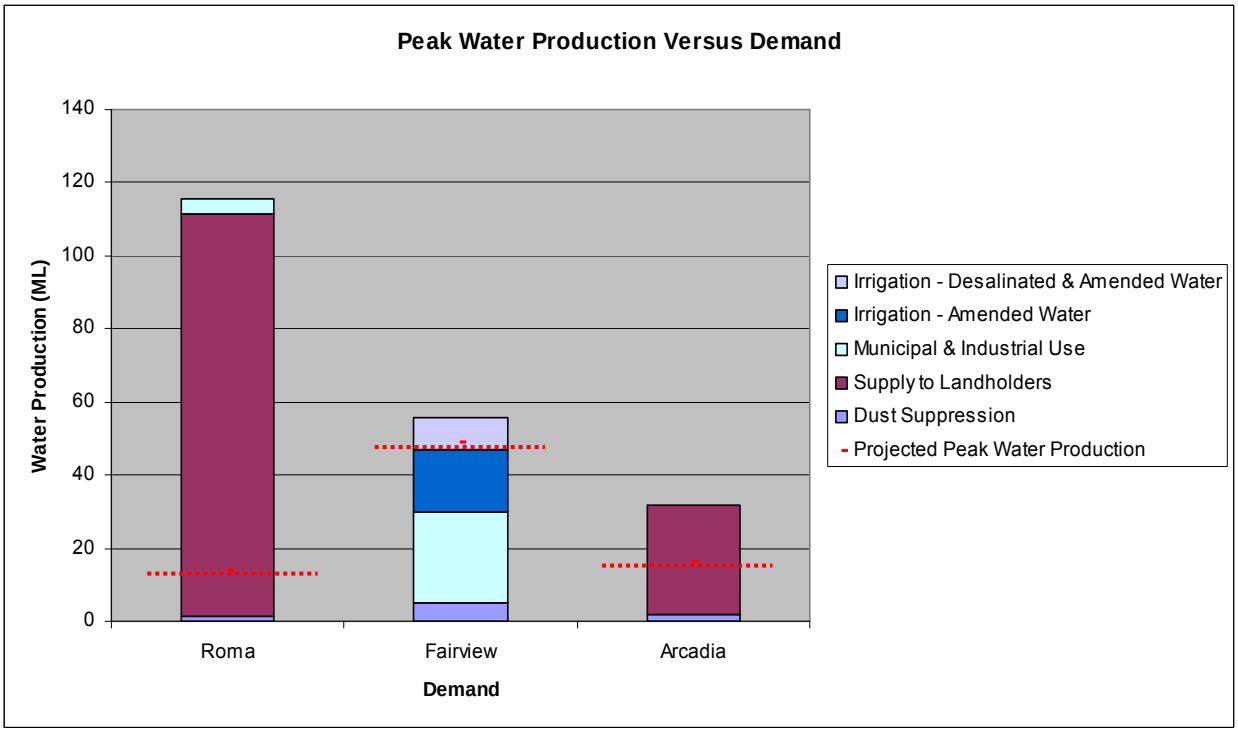
- For Arcadia, the AW management options consist of (in order of preference): dust suppression, supply of desalinated and/or amended water to local landholders, opportunistic projects and as a measure of last resort, discharge of desalinated water to Lake Nuga Nuga.



The impact assessment that has been undertaken and is set out in **Attachment D2** (Sections 8 & 9) and **Attachment D3** (Section 3) was undertaken to determine whether the selected management options are viable (including their priority of use) having regard to the impacts and their management.

The reports have concluded that they are subject to the conditions and mitigation measures that are set out in those documents.

The graph below compares the expected demand for AW (amended and desalinated) against peak production of AW for each CSG field, and demonstrates that significant demand exists (in excess of the peak supply of AW).



Brine containment ponds will be utilised for containment then disposal of brine produced as a by-product of reverse osmosis water treatment. A definitive final containment option has not been selected for brine management. A series of final containment options are currently proposed and are subject to further investigation (refer to **Attachment D3**, Section 3.4). These include:

- Inject brine into suitable underlying (basement) formations or preferably depleted coal seams, where technically and economically the best option; otherwise,
- Brine evaporation (or crystallisation) using the storage ponds, and encapsulated or transferred to a registered landfill site.

Where any ponds built and operated over the life of the project trigger regulated dam criteria, the regulated dam decommissioning guidelines will be implemented upon closure of the pond.

Respondent Comment

Department of Environment and Resource Management states that the EIS should address the "Watercourses as Conduits Interim Policy".

Santos Response

The Associated Water Management Plan for the Fairview CSG field consists of (in order of preference): dust suppression, industrial supply (via discharge of desalinated water to the Dawson River for downstream industrial users), irrigation of tree plantations using amended water and irrigation of forage crops using desalinated and amended water (refer to **Attachment D3**, Section 4 for further details).

The opportunity to provide industrial supply via discharge of desalinated water to the Dawson River to downstream users would require the use of the Dawson River as a conduit. A detailed water balance for this scheme is currently under development, as is work on the discharge and transport arrangements and discussions with DERM on policy aspects of such a scheme (including Watercourses as Conduits Interim Policy).

Respondent Comment

Department of Environment and Resource Management states that the proponent should be aware that any overland flow dams constructed within the Fitzroy catchment need to be constructed in accordance with the Water Resource (Fitzroy Basin) Plan 1999. The plan does allow for the construction of works that are for stock and domestic, of a capacity no greater than 5ML or to meet the requirements of an Environmental Authority.

There is a current exemption for the take of overland flow for activities authorised under the Petroleum Act 1923 or the P&G Act. However, the Water Resource (Fitzroy Basin) Plan 1999 is currently under review. This review may result in possible amendments to the overland flow provisions during the life of the project development.

Santos Response

Water storage ponds constructed to contain associated water, amended water, desalinated water and brine will be designed as ring tank or horse-shoe shaped embankments, with no external catchment and diversion of any upstream catchment in a manner that will not cause erosion.

Respondent Comment

Department of Environment and Resource Management states that the proponent should place a high constraint for treated discharge to surface water, related to anticipated high volumes being discharged to ephemeral streams, particularly for the Roma Gas fields.

Santos Response

Santos considers the discharge of desalinated water to surface water as the least preferred (last resort) option for disposal of associated water. However, the discharge of some desalinated water to surface water is considered a potentially necessary contingency for the overall management of associated water because:

- At Roma, and possibly Arcadia Valley, there is a small possibility of periods where the supply of associated water suitable for irrigation and to municipal and industrial supply (desalinated and amended) exceeds the demand;
- At Roma and Arcadia Valley, and to a lesser extent at Fairview, seasonal demand may have a significant impact on the amount of AW that will be taken up by irrigation practices (and in the case of Roma, municipal requirements);
- At Fairview, it is almost certain that the available space for tree plantations will constrain the amount of AW that can be amended and put to trees in the medium to long term; and
- There still remains uncertainty in the likely AW production from all three CSG fields, and even allowing for the scalable nature of this plan, “safety release” discharge pathways may need to be provided for the appropriate disposal of even desalinated water should local demands not meet supply.

Surface water studies are currently being undertaken to locate suitable candidate locations for contingency discharge of desalinated AW to surface water, refer to **Attachment D3** (Appendix D) for further details.

The impact assessment set out in **Attachment D2** (Sections 8 & 9) and **Attachment D3** (Section 3) was undertaken to determine whether the selected management options are viable (including their priority of use) having regard to the impacts and their management including discharge to surface waters.

Respondent Comment

Wildlife Preservation Society of Queensland - Policy and Campaigns Manager states that Santos Limited and its partners have made considerable effort to address the challenges and threats this project presents and have operated within the guidelines provided or permitted by government agencies. However some of the practices in place associated with the extraction of CSG pose questions as to if the imminent risks to biodiversity and the environment can be reduced to reasonable levels. Already some surplus extracted waters with extremely poor water quality are being reinjected into aquifers housing waters of far better quality. Other surplus waters following treatment are being used to irrigate introduced pasture plants that have a known ability, if not adequately controlled, to invade natural ecosystems disrupting the balance and impacting on native habitat.

Santos Response

Water chemistry studies to assess the potential impacts and mitigating strategies relating to geochemical reactions caused by the mingling of injected and receiving waters, are currently being undertaken. Stage 1 of these studies has been completed already and indicates that:

- With respect to potential re-injection of permeate (i.e. desalinated water) to the water supply aquifers supplying Roma town, this should probably only occur to the Gubberamunda Aquifer and not the Mooga Sandstone; and
- With respect to injection of brine to either depleted coal seams or other deeper aquifers (which currently contain water that is not suitable for beneficial use), injection to spent coal seams will be acceptable from a geochemical viewpoint, but there is potential for minor long term loss of near-bore permeability from geochemical interactions for injection to the Timbury Hills formation. This later impact will be studied further including continuation of detailed monitoring already underway. If such impacts become an issue, brine re-injection can be diverted to the coal seams if that is the option that is pursued for brine disposal.

Santos has developed a Water Monitoring Plan that covers all aspects of the water cycle, facilities monitoring and performance and sustainability monitoring. This strategy includes a detailed specification for monitoring of water chemistry and injection well performance that will be applied to continuously monitor the performance and impacts of brine and/or permeate re-injection.

Prior to irrigating with amended AW, Santos proposes to undertake detailed soil survey to establish the soil chemical and physical characteristics of properties and to identify soil types/land units which are suited for irrigation with amended associated water or desalinated associated water.

Depending on the results of the soil survey, an accredited independent technical specialist / agribusiness consultant will be commissioned to use soil survey information, crop suitability and profitability information and other whole property development planning information to prepare a property specific Business Plan.

Depending on the results of the Business Plan, the following plans and applications are also required to be prepared and approved (separate to the EIS process):

- Land and Water Management Plan;
- Resource Utilisation Plan; and
- Beneficial Use Application.

Ongoing monitoring of the performance of irrigation and the effectives of environmental management controls, will also be undertaken for the duration of water supply.

For the potential impacts and mitigation measures associated with associated water irrigation, refer to **Attachment D3** (Section 8.7) and Irrigation Management Plan (Section 8.10.3).

Respondent Comment

Queensland Primary Industries and Fisheries (Department of Employment, Economic Development and Innovation) supports the use of existing or future infrastructure (i.e., abandoned pipelines) to transport associated water for beneficial re-use, provided that these are free from any contaminants that may alter the quality of the water transported though them.

Santos Response

Santos proposes to use fit for purpose infrastructure for the management of associated water, amended water, desalinated water and brine.

Santos has not identified any opportunities to date to use existing or future infrastructure.

6.7.4.2 Management Options

Respondent Comment

Queensland Primary Industries and Fisheries (Department of Employment, Economic Development and Innovation) supports the provision of treated water for beneficial re-use in the condition that water is suitable for the proposed use and that any application has regard to avoiding soil/groundwater degradation (i.e. water quality is consistent with Conservation Council (ANZECC) Water Quality Guidelines).

Queensland Primary Industries and Fisheries (Department of Employment, Economic Development and Innovation) supports the reinjection of surplus associated water and brine into disused wells, or geological formations respectively, provided that it can be clearly demonstrated that this process will not affect the water quality of surrounding aquifers.

Santos Response

Santos has adopted water quality objectives for water treatment for each beneficial use option, refer **Attachment D3** (Section 3.2.4).

Water chemistry studies are currently being undertaken to assess the potential impacts and mitigating strategies relating to geochemical reactions caused by the mingling of injected and receiving waters. Stage 1 of these studies has been completed already) and indicates that:

- With respect to potential re-injection of permeate (i.e. desalinated water) to the water supply aquifers supplying Roma town, this should probably only occur to the Gubberamunda Aquifer and not the Mooga Sandstone; and
- With respect to injection of brine to either depleted coal seams or other deeper aquifers (which currently contain water that is not suitable for beneficial use), injection to spent coal seams will be acceptable from a geochemical viewpoint, but there is potential for minor long term loss of near-bore permeability from geochemical interactions for injection to the Timbury Hills formation. This later impact will be studied further including continuation of detailed monitoring already underway. If such impacts become an issue, brine re-injection can be diverted to the coal seams if that if the option that is pursued for brine disposal.

Santos will develop a detailed Water Monitoring Plan that covers all aspects of the water cycle, facilities monitoring and performance and sustainability monitoring. This strategy includes a detailed specification for monitoring of water chemistry and injection well performance that will be applied to continuously monitor the performance and impacts of brine and/or permeate re-injection.

6.7.3 Regulatory Framework

Respondent Comment

Department of Environment and Resource Management states that the following items should be considered as 'key legislation':

- *Water Resource (Condamine and Balonne) Plan 2004.*
- *Water Resource (Moonie River) Plan 2003.*

Relevant details of the above plans should be provided, including, respectively:

- *Condamine and Balonne Resource Operations Plan, finalised in December 2008, for the upper and middle parts of the Plan, including the Roma Gas fields.*
- *Moonie Resource Operations Plan finalised in January 2006, including the Eastern Surat Gas fields.*

Santos Response

The key legislation outlined by DERM has been included in **Attachment D2** (Section 2) with a discussion included on:

- Water Resource (Condamine and Balonne) Plan 2004 (Section 2.1.3); and
- Water Resource (Moonie River) Plan 2003 (Section 2.1.5).

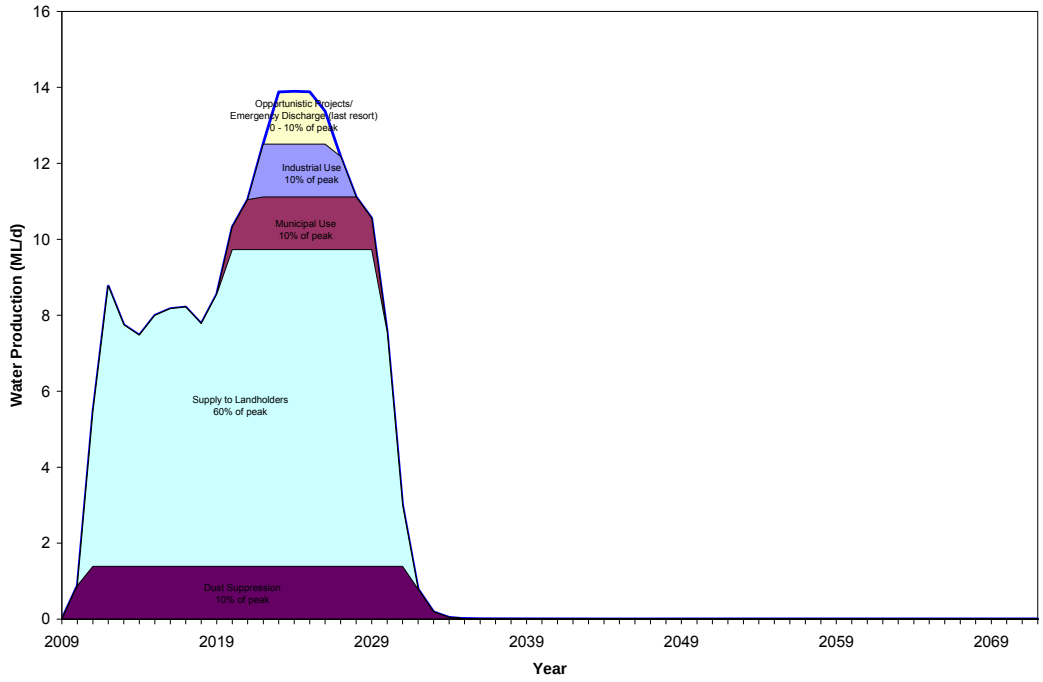
6.7.4.4 Roma Water Strategy Overview

Respondent Comment

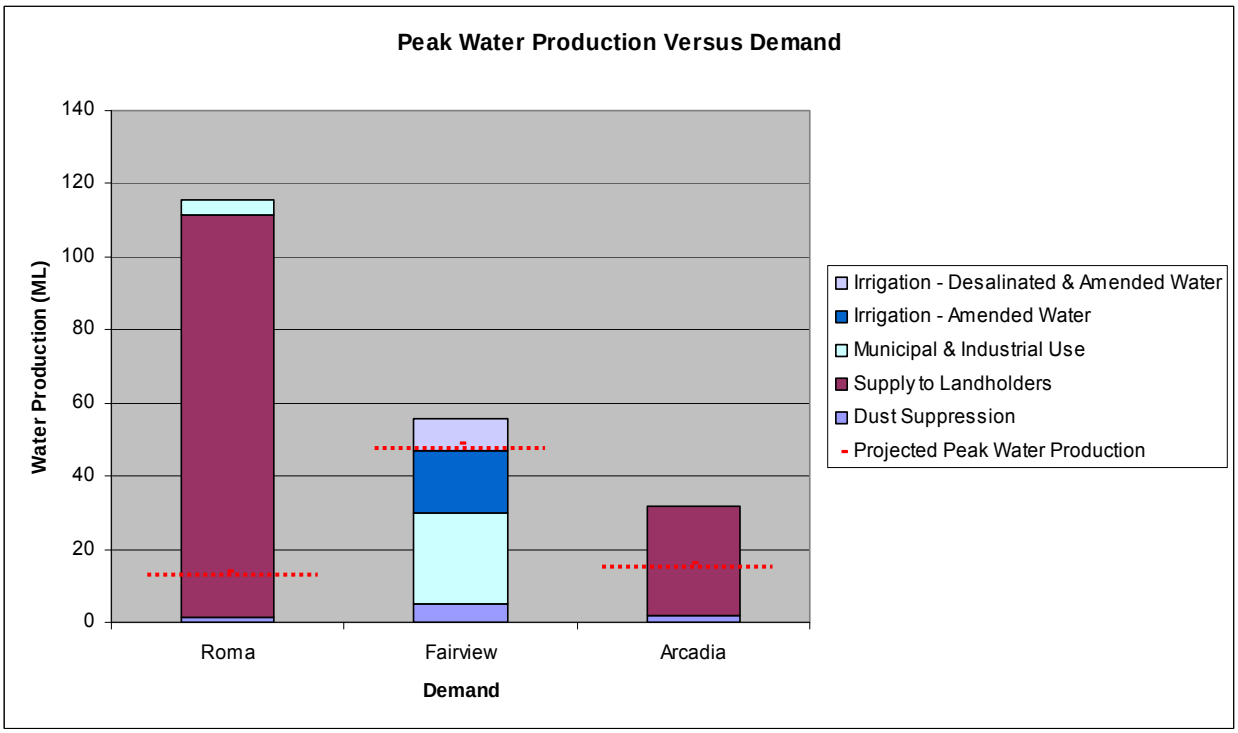
Maranoa Regional Council considers that the Roma Fields - Associated Water Management (Table 6.7.2 of the EIS) preferred option and alternative 1 are unlikely to proceed. Alternative 2 will depend entirely on the availability of water at a price that encourages agricultural investment. Maranoa Regional Council is concerned that unless rapid progress is made on this option, then discharge to watercourse will be the only remaining option in the short term.

Santos Response

For Roma, the AW management options consist of (in order of preference): dust suppression, supply of desalinated and/or amended water to local landholders, municipal use, industrial use, opportunistic projects, and, as a measure of last resort, discharge of desalinated water to Bungil Creek.



The graph below compares the expected demand for AW (amended and desalinated), determined from a water demand study which identified and assessed potential end users at local and regional scales, against peak production of AW for each CSG field, and demonstrates that significant demand exists (in excess of the peak supply of AW).



6.7.4.5 Fairview Water Strategy Overview

Respondent Comment

Department of Environment and Resource Management requested to include Selenium as a potential contaminant in water quality investigations conducted for the project.

Santos Response

Selenium has been included in the monthly surface and groundwater monitoring suites and will be monitored in line with the frequencies specified in the Water Monitoring Plan. Upon receipt of data from the laboratory results are reviewed and validated against water quality objectives. Refer to **Attachment D3** (Section 5.1) for further details.

Respondent Comment

Department of Environment and Resource Management states that further investigation is required into the risks associated with salt movement from the irrigated areas to surface drainage and water courses. A suitable model should be used to assess the potential movement. The EIS should describe the model type, parameters used and outputs from the model. The proponent should also include details of any similar existing schemes and monitoring results of salt loads in soils. The mitigation measure should be revised following the detailed investigation.

Santos Response

The irrigated crop areas in the Fairview field are located on plateaus that lie above the ephemeral streams that rise in surrounding escarpments and 50-60m above surrounding valleys which drain into either Baffle or Hutton Creeks which join the Dawson River in the northeast and southeast portions of the Fairview Project Area. The irrigated plateau areas are underlain principally by varied Evergreen stratigraphies with some Hutton formation in the south. The Precipice geologic formation which includes the major aquifer in the area is found between 135 – 145m below the plateau surfaces. Fairview Plateau is approximately 80m higher than Springwater plateau surfaces. Tree plantation areas have unirrigated tree, grass and in some cases remnant forest buffers between the extremities of irrigation zones and escarpments, run-off flow paths/drainage lines which lead to waterways or the headwaters of defined waterways or ephemeral streams.

To monitoring surface water, groundwater and soils in the region of the irrigation area, Santos currently has the following detailed monitoring being undertaken:

- Ephemeral streams are monitored continuously for water level, flow volume (by calculation), conductivity, total dissolved solids (by calculation) and temperature. Water sampling from ephemerals for laboratory analysis is event triggered. These samples are analysed for turbidity, suspended solids, dissolved oxygen, pH and major nutrients.
- Springs are monitored continuously for water level, flow volume (by calculation), conductivity, total dissolved solids (by calculation) and temperature. Water samples for laboratory analysis are manually collected every six months and analysed for pH, major nutrients and micronutrients.
- Perennial streams are monitored continuously for water level, flow volume (by calculation), conductivity, total dissolved solids (by calculation) and temperature, pH, turbidity and dissolved oxygen. Water sampling from perennials for laboratory analysis is event triggered. These samples are analysed for suspended solids and major nutrients.
- In addition to key surface water flow paths, it is possible that water may also seep from the escarpments at various times of the year. To capture this possible surface water flow, escarpments are visually inspected on at least a quarterly basis with a systematic and GPS referenced sequence of digital photography.

- Bores with operating submersible pumps on Santos properties and surrounding landholder properties are monitored continuously for water level, flow (extraction) volume, conductivity, total dissolved solids (by calculation) and temperature. Water sampling is carried out on a six monthly basis. These samples are analysed for pH, dissolved oxygen, major nutrients and hydrocarbons.
- Mechanical pump bores are monitored continuously for flow (extraction) volume. Water sampling is carried out on a six monthly basis. These samples are analysed for pH, dissolved oxygen, major nutrients and hydrocarbons.
- Observation bores on Santos properties and surrounding landholder properties are monitored continuously for water level, conductivity, total dissolved solids (by calculation) and temperature. Water sampling is carried out on a six monthly basis. These samples are analysed for pH, dissolved oxygen, major nutrients and hydrocarbons.
- Vibrating wire piezometers are monitored continuously for groundwater pressure in the geological strata at representative sites on each plateau.
- TriScan probes and soil moisture and conductivity probes are monitored continuously for soil volumetric moisture content and volumetric ion content at each profile sampling depth which provides, through laboratory sample calibration, reliable dynamic estimates of soil solute salinity.
- Water samples are collected from one third of soil solute samplers each month, such that all solute samplers are sampled over the period of each quarter. At each sampling, every third set of samples are collected, so that an even distribution of samples is taken from across the entire irrigation area. In the event of high salinity readings from soil conductivity probes, targeted interim soil solute samples may be collected. At each sampling, all the solute samplers for a given sampling point are collected (i.e., all depths at a given site). Soil solute samples are analysed for conductivity, TDS (by calculation), pH, cations, anions, SAR and Langelier index (calculated). Expected soil equilibrium ESP will be estimated from long-term average soil solute SAR. This is compared against direct soil measurement results.
- One soil core is drilled using a solid flight auger every two irrigation zones (approximately 32 ha) on an annual basis. Soil core samples are taken in the near vicinity of soil moisture probes in order to enable correlation with soil moisture/conductivity probe and soil solute data. Sampling of irrigation zones rotates on an annual basis, so that while soil coring and analysis is carried out every year, a soil core is drilled in any specific zone every ever two years. More frequent soil coring and analysis may be carried out on a targeted basis if suggested by soil moisture/conductivity probe data. Soil cores are analysed for each profile depth sampled. All profile depths are analysed for physico-chemical properties, cations, anions and water holding properties. In addition, the surface sample from each profile is analysed for macros and micronutrients and organic carbon.

Further to the detailed monitoring regime currently being undertaken, a two-dimensional, transient, unsaturated-saturated finite-element numerical model has been developed to estimate the potential impact of increased water seepage on the groundwater regime under irrigated areas. The models were based on generalized stratigraphy and material properties were chosen to represent an average of the materials that underlie the plateau areas. A range of vertical hydraulic conductivities of 10-8 to 10-10 m/s, porosities of 5% and degree of anisotropy (horizontal to vertical hydraulic conductivity) of 1 to 100 were used for this modelling exercise. In addition, three different deep seepage rates of 1, 31 and 62 mm/y were modelled dependent on irrigation mechanism simulated (uncultivated, drip irrigated and pivot irrigated). Model simulations did not identify seepage at the edge of the plateau area during any simulation run. Further, the Evergreen Formation did not saturate under most simulation conditions for the porosity and the permeability range assumed for the material. In general, all water that could be conveyed into the model was quickly dispersed through unsaturated (negative pressure) flow. At the lower range of modelled permeability, some ponding did occur at the bedrock interface. Adding a more permeable soil/regolith layer to the model above the bedrock resulted in a return to unsaturated conditions as excess water was stored in the available porosity of the soil/regolith layer. Currently the modelling results are being verified using results from field and laboratory tests carried out on Evergreen Formation samples from irrigation plateaus.

Respondent Comment

Maranoa Regional Council considers that (as with the Roma field options) council prefers the options that promote economic growth and diversification. The proposal to use treated water for irrigation of Chinchilla White Gum is of significant concern to Council. Changing the use of productive grazing land to hardwood forest is a long term commitment with no ultimate guarantee of a beneficial outcome. In the short to medium term, the change will reduce the value of the regional product and in the long term (20 years plus) will only make a positive contribution is the scale of the operation is sufficient to guarantee the viability of a local hardwood milling industry.

Santos Response

Santos currently has approval to irrigate 2,000 ha of Chinchilla white gum with amended associated water for a ten year period. This is being undertaken on Santos owned land within the Fairview CSG field. Within eight years of initial establishment of the tree plantation, cattle grazing will be re-established within the plantation area. This is expected to increase the land value, along with the ability to support cattle grazing.

In the Roma and Arcadia Valley areas, amended AW will be made available to local landholders for the 1-2 year establishment irrigation of salinity-tolerant forage crops (predominantly leucaena) or forest species. Santos does not expect that commercial-scale tree plantations will occur on non-Santos land.

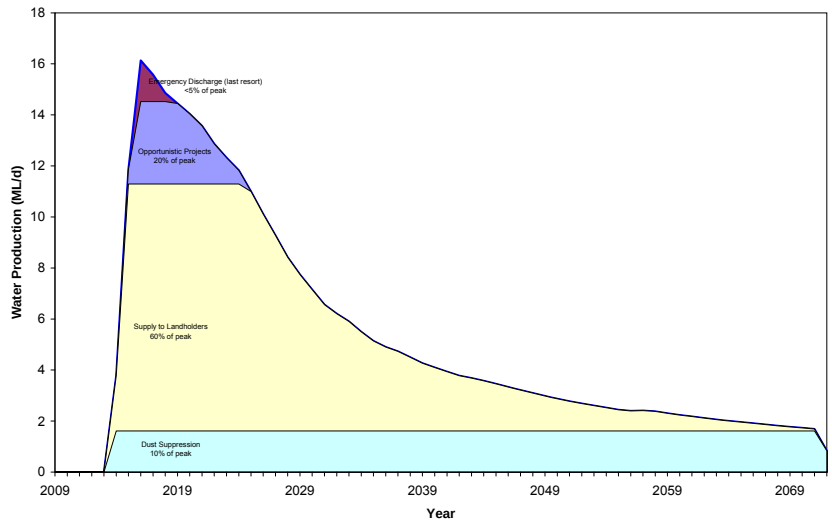
6.7.4.6 Arcadia Water Strategy Overview

Respondent Comment

Maranoa Regional Council supports the preference for irrigation and also recognises that the option to discharge on an occasional basis to Arcadia Creek is of benefit principally to sustain Lake Nuga Nuga. The EIS identifies that discharge at grade is not sustainable for other than short periods and it is on this basis that it would be supported by Maranoa Regional Council.

Santos Response

For Arcadia Valley, the AW management options consist of (in order of preference): dust suppression, supply of desalinated and/or amended water to local landholders, opportunistic projects and as a measure of last resort, discharge of desalinated water to Lake Nuga Nuga.



6.7.5 Potential Impacts and Mitigation Measures

Respondent Comment

Department of Environment and Resource Management requested that mitigation measures should be developed that clarify responsibility for the safe removal of salts and other contaminants prior to transfer of reverse osmosis concentrate containment storages to landholders.

Santos Response

Initially brine containment ponds will be constructed to temporarily store brine prior to development and approval of the agreed approach for brine disposal. These ponds will be designed and management to meet the following key performance indicators:

Seepage to the shallow groundwater system must be restricted such that:

- With respect to water quality:
  - There is no statistically significant change to mid to long-term water table level;
  - The underlying water table exhibits no increase in salinity greater than 10% above seasonal norms;
  - The water quality at the water table remains suitable for all beneficial uses to which it was previously suited (e.g. stock water, irrigation of crops); and
  - There is no measurable or predicted impact on local surface water quality.
- With respect to soils and land use:
  - The projected depth of increase in soil salinity during operation of the pond must not be greater than 1 m. Failure to meet this target would result in the affected land being placed on the contaminated lands register; and
  - The land occupied by the water management pond must be returned to such a state that it supports the same use at the completion of its use and subsequent rehabilitation.
- With respect to monitoring:
  - All water management ponds shall have water table and soil moisture monitoring installed at locations suitable to enable characterisation of the water table and soil water quality both prior to and post pond remediation.

A definitive final containment option has not been selected for brine management. A series of final containment options currently include:

- Inject brine into suitable underlying (basement) formations or preferably depleted coal seams, whichever is technically, environmentally and economically the best option; otherwise
- Brine evaporation (or crystallisation) using the storage ponds, and encapsulated or transferred to a registered landfill site.

The final containment options will be consistent with industry best practice guidelines, policies and procedures referred to in the CSG Fields EMP, EA conditions and long term monitoring requirements.

Respondent Comment

Department of Environment and Resource Management suggested adopting the following Mitigation Measures:

- *A gauging station upstream from Surat must be located so as to not cause backwater effects at the junction on Bungil Creek and the Balonne River;*

- *Any alterations to the Lake Campbell embankment and spillway must comply with the provisions of the Water Resource (Condamine Balonne) Plan 2004.*

Santos Response

Santos will develop a Water Monitoring Plan as is contemplated in part 11.16.12 of the CSG field EMP. It will include a specification for establishing the specific water monitoring requirements for each element of project (gathering, ponds, treatment facilities and environmental assets). The suite of water monitoring requirements is set out in table 9-1 of the **Attachment D2** and will be incorporated in the Water Monitoring Plan. The location of the water monitors will be agreed upon.

Respondent Comment

Gladstone LNG Project Advisory Agency comments that in terms of pond construction, QPIF supports the recommendations/conditions of DERM, such as the lining of temporary dams to avoid any impacts on the surrounding soil and groundwater, all of which may sterilise those resources for agricultural purposes during operations or in the future.

Santos Response

Water storage ponds constructed to contain associated water, amended water, desalinated water and brine will be designed and management to meet the following key performance indicators:

Seepage to the shallow groundwater system must be restricted such that:

- With respect to water quality:
  - There is no statistically significant change to mid to long-term water table level;
  - The underlying water table exhibits no increase in salinity greater than 10% above seasonal norms;
  - The water quality at the water table remains suitable for all beneficial uses to which it was previously suited (e.g. stock water, irrigation of crops); and
  - There is no measurable or predicted impact on local surface water quality.
- With respect to soils and land use:
  - The projected depth of increase in soil salinity during operation of the pond must not be greater than 1 m. Failure to meet this target would result in the affected land being placed on the contaminated lands register; and
  - The land occupied by the water management pond must be returned to a state that it supports the same use at the completion of its use and subsequent rehabilitation.
- With respect to monitoring:
  - All water management ponds shall have water table and soil moisture monitoring installed at locations suitable to enable characterisation of the water table and soil water quality both prior to and post pond remediation.

6.7.5.1 Cumulative Impacts

Respondent Comment

Department of Environment and Resource Management states that the cumulative impacts of associated water production should be further detailed incorporating the findings of the APPEA study. The viability of industry wide aggregation systems should be discussed.

Santos Response

The APPEA study does not address cumulative impacts of the CSG industry, but instead is a desk-based study of the potential economics of a range of candidate aggregation schemes.

Santos considers that the use of industry-wide aggregation systems is not a viable or necessary option due to the economic constraints associated with establishment and operation of a suitable distribution network and the financial burden this imposes on the sale of the supplied water. The APPEA study has identified order of magnitude costs (over and above the costs of gathering and treatment) for the delivery of treated water to large scale demands including broad acre farming near Dalby and connection to the south east water grid. It is clear from the results of the study that Santos is unlikely to be able to participate and still create a commercially viable project.

Attachment J includes an assessment of the cumulative impacts arising from associated water management for the proposed CSG projects (where information is available).

For the Queensland Curtis LNG Project the current estimates predict the total volume of AW to peak at approximately 180 ML/day, with average production in the order of 160 ML/day. The majority of the AW is saline and will require some treatment prior to beneficial use. The preferred option is for desalination of a proportion of the AW followed by concentration and evaporation of brine produced through the desalination process. In the short to medium term, evaporation ponds may be used. Longer term, the preferred set of beneficial use options include stock or domestic purposes, tree or crop irrigation, supply of water to mines, surface water discharge or reinjection.

The Queensland Curtis LNG CSG fields have been divided into three separate areas and the peak AW production rates for each area are as follows:

- Northern (centred around Wandoan) – 40 ML/day;
- Central (south of Miles) – 61 ML/day;
- Southern (west of Dalby) – 110 ML/day.

The northern area of the Queensland Curtis CSG fields is more than 60 km away from the Fairview and Arcadia Valley fields of the GLNG Project. At that distance there is unlikely to be any significant overlap in the AW demand areas. Furthermore the AW production rate from the Queensland Curtis northern area is the smallest (40 ML/day) of their three areas. Hence there should be no significant cumulative AW impact in this area.

The central area of the Queensland Curtis CSG fields is approximately 20 km away from the eastern extremity of the Roma field. At this distance there may be some overlap in AW demand areas. However there is significant spare capacity for additional AW consumption in the Roma area. Hence, should there be a need there is adequate capacity for some of the Queensland Curtis AW to be disposed of in the Roma area.

The southern area of the Queensland Curtis CSG fields is approximately 80 km from the GLNG Roma field and at that distance no significant overlap in the AW demand areas is expected.

No data is yet available on the AW production rates from the Australia Pacific LNG Project. Its CSG fields are adjacent to the eastern boundary of the Roma fields and hence there may be some overlap in demand areas. However, there is significant available demand in the Roma area even allowing for the GLNG Project, and hence there is likely to be capacity to accept at least some of the Australia Pacific Project's demand if necessary.

Based on the assessment methodology given in **Attachment J**, the significance of the overall cumulative impact from the proposed CSG projects on associated water is assessed as low.

6.8 Air Quality

6.8.5 Potential Impacts and Mitigation Measures

Respondent Comment

Department of Environment and Resource Management states that the following information related to the CSG field developments should be provided:

- *Predicted locations of the compressor engines and generators;*
- *NOx concentration in term of mg(N)/m3 (dry) at 3% O2; and*
- *The generators stack specifications and fuel type.*

Santos Response

Field infrastructure locations will be determined using the mitigation as outlined in **Attachment D5** and CSG field EMP **(Attachment B1)**. Equipment, including compressor engines and generators, will be selected during detailed design. The table below provides typical compressor engine specifications.

Stack parameter	Specification
Fuel type	Natural gas
Stack diameter	0.45 m
Stack height	9.3 m
Exhaust velocity	17 m/s
Exhaust temperature	470 ^{o}C
Exhaust gas flow rate	167 m^{3}/min
NOx	0.88 g/s

6.9 Greenhouse Gas Emissions

No submissions have been received on this section.

6.10 Noise and Vibration

Respondent Comment

Department of Environment and Resource Management requested that the proponent should provide detailed information regarding the source and impacts of the machinery noise on values provided. If the machinery noise is of a temporary nature, information on the predicted noise levels inside the residence without this machinery noise should be provided.

Santos Response

In order to determine the existing ambient noise environment in the vicinity of the proposed LNG facility, the gas transmission pipeline and CSG fields, long-term unattended ambient noise monitoring was undertaken at 15 representative locations in the surrounding communities. All measurements were taken externally and data analysed to determine operational noise criteria for the project.

Of these 15 locations, noise loggers were set up at a distant from homesteads at the following four (4) locations:

- Gas and Pipeline 2;
- Gas and Pipeline 5;
- Gas and Pipeline 6; and
- Gas and Pipeline 9.

At these four (4) locations, it was not ideal to locate noise monitoring equipment within close proximity to the homestead due to interference in ambient noise levels from extraneous noise sources. As the basis for the ambient noise monitoring was to measure background noise levels at a representative location, monitoring at a particular homestead which had elevated background noise levels due to extraneous noise sources was not recommended.

For this reason, where extraneous noise sources were either observed or comments where made by a land owner noting that extraneous noise sources were likely to occur during the monitoring period, noise loggers were set-up at a distant away from the homestead so as extraneous noise sources were inaudible and measured background noise levels were unaffected and typical of that area.

As a result all ambient noise measurements are considered to be unaffected by extraneous noise sources.

Respondent Comment

Queensland Health recommends that:

- *Blasting should occur between 9:00 am and 3:00 pm Monday to Friday, and 9:00 am to 1:00 pm on Saturday as recommended by DERM.*
- *Buffer distance should be calculated to increase noise attenuation for sleeping areas.*
- *Affected sensitive receptors should be consulted and a joint complaint management / resolution strategy should be implemented (also include in sections 7.10 and 8.10).*

Santos Response

The CSG field Environmental Management Plan has been updated with the following text.

Noise and Vibration (11.16.21)

- If blasting is required for the project the following mitigation strategies will be implemented:
  - Blasting should occur between 9:00 am and 3:00 pm Monday to Friday, and 9:00 am to 1:00 pm Saturday as recommended by DERM;
  - Buffer distance should be calculated to increase noise attenuation for sleeping areas; and
  - Affected sensitive receptors should be consulted and a resolution strategy developed.

6.10.3 Regulatory Framework

Respondent Comment

Department of Environment and Resource Management states that the proponent should base noise planning criteria (for both construction and operation phases of the project) on the limits specified in the table (see DERM submission number 23, issue 23.91 for table).

If these limits cannot be met, alternative arrangements may be agreed to between the proponent and affected landholders during the construction phase of the project (also include in 7.10.3 and 8.10.3).

Santos Response

Santos will work with DERM and landholders to ensure that noise limits are satisfactory for all parties.

In establishing noise criteria for the construction and operational phases of the GLNG Project the following relevant legislative and guideline documents have been reviewed and considered:

- EP Act;
- *Environment Protection (Noise) Policy 1997* & *2008*; and
- EcoAccess Guidelines;
  - Planning for Noise Control Guideline (EPA 2004); and
  - Assessment of Low Frequency Noise (Draft).

It is noted that the relevant Queensland legislation for construction and operational noise and vibration control is provided by the *Environmental Protection Act 1994* (EP Act). The EP Act aims to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (being ecologically sustainable development).

Compliance with the relevant project specific noise criteria documented in the EIS will adequately address noise impacts from the GLNG Project.

6.11 Land Use and Infrastructure

Respondent Comment

Department of Environment and Resource Management states that the proponent should note that the Regional Plan has been renamed as the "Draft Maranoa-Balonne Regional Plan" and that Miles Town is no longer included in this plan.

Santos Response

Santos notes your comment.

Respondent Comment

Department of Environment and Resource Management requested to include GQAL data from the former Tara Shire Planning Scheme.

Santos Response

There are no datasets available from the former Tara Shire Planning Scheme. Overlay Map 1 depicts large tracts of land classed as being Good Quality Agricultural Land (GQAL). However, impacts to these areas from the project is unlikely. Santos will employ mitigation measures outlined in EIS Sections 6.11.5.1 and 11.16.1 and **Attachment D5** to ensure that impacts to GQAL are minimised.

Respondent Comment

Department of Environment and Resource Management notes that:

- *Roma Regional Council is now Maranoa Regional Council; and*

- *Dalby Regional Council is now Western Downs Regional Council.*

Santos Response

Santos notes your comment.

Respondent Comment

Department of Environment and Resource Management requested to include relevant details of the Stock Route Network as illustrated in Figs 6.11.9a and 6.11.9b. Appropriate mitigation measures should be provided to prevent and or minimise the potential impacts on environmental values. Include information on how the project satisfies the requirements of the Land Protection (Pest Management and Stock Route Management) Act 2002. Consider the impacts of activities of CSG field developments on management and operation of the Stock Route Network, in view of the following comments:

- *The stock route network comprises declared stock routes, reserves for travelling stock and other relevant land. The main use is for travelling stock while the network has multiple uses;*
- *The relevant DERM Senior Lands Officer (Stock Routes) and Local Government stock route officer must be consulted from the early planning stage of activities that may impact on the Stock Route network;*
- *Associated infrastructure, (fences, watering facilities, access) must be maintained and managed in good condition, and be available for public use;*
- *Options for temporary diverting stock that may be considered unsafe to travelling stock and drovers (as well as the travelling public) will not be supported; and*
- *Affected parts of the Stock Route network are to be reinstated upon completion of the activities that may interfere with any part of the network.*

Santos Response

Santos will ensure that all impacts to stock routes from the development of the CSG fields and associated pipeline infrastructure will be mitigated through a consultative approach with relevant state government agencies including the DERM (Senior Lands Officer (Stock Route Management)) prior to undertaking any activities that may pose impacts occurring. Santos understands that a program aimed at identifying and protecting stock routes throughout Queensland has been recently completed and will undertake to liaise with the appropriate government representatives regarding any and all impacts that may result from the GLNG Project.

Respondent Comment

Department of Environment and Resource Management notes the following:

- *That the Forest Products Section of DERM is the administering authority, not Queensland Primary Industries and Fisheries;*
- *The proponent should note that if insufficient notification is provided to DERM to survey and remove millable timber prior to clearing, then compensation for destroyed timber may be required.*

Santos Response

Santos notes your comment.

Respondent Comment

Department of Environment and Resource Management states that the proponent should note that this Plan has been renamed as the "Draft Maranoa-Balonne Regional Plan"

Santos Response

Santos notes your comment.

Respondent Comment

Department of Environment and Resource Management states that the proponent should identify the applications that will be assessed under the IPA.

Santos Response

Santos is developing a program to manage all authorities, approvals, licences, and permits necessary for the construction and operation of the GLNG Project. This program will include reference to those aspects of the project that may not be mentioned in the EIS due to their reliance on overarching approvals required prior to the grant of approvals for ancillary activities related matters still subject to final design. It will have regard to, amongst other things, the interaction between the *Integrated Planning Act 1997*, the *Petroleum and Gas (Production and Safety) Act 2004* and the *Petroleum Act 1923*.

Respondent Comment

Wildlife Preservation Society of Queensland – Policy and Campaigns Manager states that the project need is established primarily on relatively short term economic gain. It is acknowledged that LNG is capable of meeting some energy needs with reduced greenhouse gas outputs. Has the long term loss of prime agricultural land to produce food and fibre been adequately considered?

Santos Response

Santos commits to progressively rehabilitating land over the life of the project to pre-development capability. For further information please refer to EIS Sections 6.11, 7.11 and 8.11 on Land Use and Infrastructure and EIS sections 6.16.3; 7.16.3 and 8.16.3 on Rehabilitation and Decommissioning.

6.11.3.1 Regional Planning Framework

Respondent Comment

Fitzroy Basin Association states that their comments generally relate to the CQSS2; a copy of the CQSS2 is available on the FBE website at www.fba.org.au. As the project is likely to affect the condition of many regional assets and therefore also impinge on meeting targets within the plan, we request that the EIS include consideration of impacts on targets and that the likely effect be documented in the EIS.

Santos Response

The project traverses several regions included within the Central Queensland Strategy for Sustainability (CQSS) Plan area and although for the most part the extent of development will have a minimal impact it is appropriate to address this strategy document. The EIS introduces this Plan as a component of the planning framework with further assessment of the policies discussed in Section 6. The strategy is a plan for the integrated management of those natural, cultural and environmental resources that have been

identified as key assets for the region. Its purpose includes the determination of which assets are critical to the long-term health and viability of the region as well as addressing pressures on these assets and the environment.

The CQSS goals are as follows:

- Improve the health and maintain the functioning of our natural systems, and conserve the region's biodiversity;
- Develop a diversity of economically viable industries that support vibrant regional communities and use the region's natural resources in an ecologically sustainable way;
- Integrate natural resource and environmental management, economic development and community development within the region;
- Share decision-making for the allocation of natural resources and the management of the region's environment across all stakeholders; and
- Ensure the costs and benefits of achieving sustainable systems are shared equitably across the regional community.

These goals must be seen as a package where no one goal takes precedence over the others (CQSS2).

The project's impacts on regional assets will extend to the three main project components:

- Gas field development;
- Gas fields (wells, water storage and treatment, and the pipelines (water and gas));
- Pipeline corridor;
- Pipelines from the gas fields to Curtis island;
- LNG facility; and
- LNG plant, transport infrastructure, marine facilities (including the product offloading facilities).

The regional assets identified in the plan are as follows:

- Land;
- Ecosystem Health and Biodiversity;
- Water;
- Cultural Heritage and Native Title;
- Economy;
- Social; and
- Regional Coordination.

With the exception of Regional Coordination, which is perhaps relating more to the EIS process Santos are undertaking at present, the remaining broad asset categories are the subject of detailed studies contained within the EIS document; wherein a comprehensive assessment of the potential impacts to the regional assets are discussed for each project component. The CQSS2 was developed over five years ago and though still relevant as a strategic planning framework for the region it does not fully address the rapid shift in the energy resource sector currently underway with the development of coal seam gas resources. Santos is proposing to undertake a national and internationally significant 'clean' energy development within the region with a minimal impact to the regional assets identified in CQSS2 but with a significant benefit to rural communities within and external to the region.

Respondent Comment

Fitzroy Basin Association states that this particular EIS is an exceptionally lengthy document with many tiers throughout the sections and appendices that cover the 3 areas of the project; the LNG facility, the Gas Transmission Pipeline and GLNG Gas Field Development. The exceptional length of the document makes it difficult for community groups to read the whole submission and be abreast of all potential issues relative to their interest; community groups generally do not have the staff resources or time availability required to properly evaluate and make submission on such an extensive and large project.

Santos Response

Santos acknowledges your feedback regarding the structure of the EIS document. The EIS structure was designed so interest groups would be able to locate information within each of the project components. Information covered in the Appendices was summarised within the body of the EIS for easy reference with the Appendices available if further information was required.

Respondent Comment

Fitzroy Basin Association would like to offer support to the content of the Capricorn Conservation Council's submission, particularly their supporting information document procedure on Avian (bird) species that are endangered, vulnerable or rare under state legislation.

Santos Response

Santos notes your support for the Capricorn Conservation Council's submission.

6.11.3.2 State Planning Provisions

Respondent Comment

Central Highlands Regional Council states that riverine flood or localised flooding is not identified as a risk to this project. Indeed one of the criteria for selection of the pipeline route is avoidance of flood prone land and as the majority of the projects infrastructure is underground or in a closed system so it is not as prone to flood hazard as are other types of development. However Santos will be reviewing material related to inundation and the Council has a very keen interest in the results of such studies. All material prepared by Santos in compliance with SPP 1/03 should be made available to Council to assist it in preparation of community counter disaster planning.

Santos Response

Santos will provide Council with the results of inundation studies undertaken for the project infrastructure.

6.11.5 Potential Impacts and Mitigation Measures

Respondent Comment

Department of Environment and Resource Management requested to provide survey information detailing the millable timer to be cleared as a result of the project.

Santos Response

The clearing requirements that affect millable timber for the CSG field development, pipeline route construction and LNG facility is at present unknown. Whilst Santos will endeavour to reduce the footprint of its construction and operational activities for the Project no accurate assessment of the clearing requirements for millable timber can be made. The impacts on vegetation of significance are provided within the EIS Section 6.4. The principal contractor for construction activities will be required to provide this level of detail prior to gaining approval for work outside of the activities allowed within the *Petroleum and Gas (Production and Safety) Act 2004* and the *Petroleum Act 1923.*

6.11.5.1 Impacts on Existing Land Use

Respondent Comment

Central Highlands Regional Council states that the State has set out a procedure in SPP 1/03, namely a Bushfire Management Plan that includes site measures to reduce the risk of fire and forward planning to ensure rapid response to a fire. Consideration should be given to requiring the preparation of such a plan for the pipeline and infrastructure associated with the CSG field.

Santos Response

Santos refers to EIS Section 6 (6.11.3.2, 6.11.4 and 6.11.5.5), the *State Planning Policy SPP1/03* and EIS Section 10. EIS Section 10 further investigates the requirements for specific risk management plans for the project. Although the GLNG Project is still within the FEED stage Santos is required under the *Petroleum and Gas (Production and Safety) Act 2004*, the *Petroleum Act 1923* and, the *Workplace Health and Safety Act 1995* to ensure all relevant provisions for safety and hazard management are complied with. Santos is developing an EHSMS and a principal hazard management plan for the construction and operation phases of the project. Fire hazard is one element of these plans and will fully comply with the requirements of the SPP 1/03.

6.12 Visual Amenity

No submission have been received on this section

6.13 Cultural Heritage

Respondent Comment

Department of Environment and Resource Management states that the proponent should provide a clear process by which identified potential sites which were not located, recorded and assessed in field surveys can be assessed and can be considered in the planning phase of the project, with particular reference to the gas pipeline corridor.

Santos Response

A non-indigenous cultural heritage assessment will be undertaken by Santos cultural heritage field personnel in conjunction with the Aboriginal cultural heritage survey prior to undertaking activities which have the potential to impact cultural heritage. Santos cultural heritage personnel are responsible for recording non-indigenous cultural heritage site details and reporting to DERM.

Respondent Comment

Wildlife Preservation Society of Queensland - Policy and Campaigns Manager states that Santos is to be commended on its approach to indigenous cultural heritage. There are other organisations more appropriate to comment on this aspect than Wildlife Queensland.

Santos Response

Santos appreciates your recognition for our project processes.

6.14 Social and Community

Respondent Comment

Submitter number 10 states that cattle and cattle people were not mentioned in the report. Considering a large part of Santos' activities will involve negotiations with cattle people, they should learn more about the impact of noise, light, dust, and traffic etc. on cattle and cattle people.

Santos Response

Santos has been working with the rural communities located in the Maranoa region for over 50 years. Santos continues to track landholder concerns relating to noise, dust and impacts on cattle along with a range of other issues. Santos' compensation model is based around these impacts and is consistent with Santos' obligations under the *Petroleum Act 1923* and *Petroleum and Gas Production and Safety Act 2004*. This model incorporates compensation for loss of cattle production as well as losses for other business activities. Santos will continue to work in collaboration with landholders into the future.

Respondent Comment

Submitter number 10 considers that the EIS report does not contain information on how small businesses (e.g. eco-tourism) will be protected in the area.

Santos Response

Santos seeks to work in collaboration with small business on many facets of the project, including but not limited to procurement of local goods and services as an example. Santos does not anticipate significant negative impacts to small businesses in the area as a result of the project requirement for workers. Santos anticipates a large imported workforce will be required because of the low unemployment level in the area (<2%) and the experiences with the Fairview operation; which currently offers similar employment opportunities as the GLNG Project and requires imported workers to operate.

Respondent Comment

Queensland Department of Communities states that there is need to maintain an open dialogue with the residents and businesses in the various areas to keep them informed and consulted where appropriate.

Santos Response

Santos has an ongoing community engagement plan that it will maintain throughout the life of the project.

Respondent Comment

Queensland Department of Communities states the department has reviewed the EIS and notes that the proponent should continue to monitor the following as per the stated intention of Section 9 Community Consultation.

That the project presents an opportunity to provide valuable training and work experience for certain groups in the community such as Indigenous peoples, people with disabilities and unemployed youth, among others.

Santos Response

Santos has designed an apprenticeship program which is focused on recruiting and retaining local potential human capital from a diverse talent pool and subsequently providing regional and corporate benefits. The Program is proposed to be implemented in Queensland, specifically in the Roma and Fairview districts with the continued primary goal of providing permanent jobs for fully-trained apprentices.

The apprenticeship will encompass nationally recognised and accredited training and on-the-job work over a period of up to four years via full-time, part-time or school-based means.

Respondent Comment

Maranoa Regional Council considers that the Social Impact Statement provided as part of the EIS is unsatisfactory. While there are no issues of concern regarding the demographic information compiled as part of the SIA, the argument employed in establishing a level of impact is simply not credible. It would appear that in preparing the EIS, Santos has solely focussed on mitigating or defending potential negative impacts. This approach has precluded any assessment or recognition of the potential positive social impacts of the project other than the direct economic benefit. Maranoa Regional Council is of the belief that one of the best opportunities for mitigating negative impact is through planning the project in a way that optimises the potential positive impacts.

Santos Response

Santos will continue to work with Maranoa Regional Council, key stakeholders and local business groups to maximise positive impacts where possible. Santos is committed to becoming an active member of the community and will work to maintain open lines of communication to address changes in the community on a regular basis.

The SIA focussed primarily on assessing the negative effects as they are the impacts of concern. However, there are references to positive impacts including employment, economic and training opportunities, population growth, a more diverse population which may help retain temporary workers in other industries, and more opportunities which may help attract workers to other industries that currently struggle to attract staff.

It is important to note that Santos shares the view with Maranoa Regional Council and would like to see the project result in more people moving to the area; however, Santos data from the Fairview operation does not support that outcome therefore Santos assessed what is likely to occur, not what it preferred. Santos, Maranoa Regional Council and the vast majority of key stakeholders interviewed view population increases associated with the project as positives for the area. Santos will work with council and key stakeholders to explore ways to help attract and retain workers to the area throughout the project. This is more the case for the operations workforce who will be active in the area longer.

The social supplement examines potential positive and negative impacts associated with the project based on additional information, updated workforce numbers and case studies of the Fairview operation

and MAC camp interaction with local communities in the Moranbah area. The details and findings can be found in **Attachment D1** of the EIS Supplement.

Respondent Comment

Maranoa Regional Council states that rather than providing a best guess analysis of the whole workforce, the report focuses on the staff for the Roma office that will make up about 3% of the workforce. The logic is flawed. To suggest that this is a reasonable sample size or that the impacts will be representative of the whole project is incomprehensible and treats the reader with contempt.

Santos Response

The Roma office assessment was not presented as a sample of the whole workforce, but rather as an assessment of the office itself. As indicated in Section 9.1.2 of the SIA, the Roma office was assessed because its staff will be housed in Roma, whereas the imported workforce for the CSG Field will be accommodated in temporary accommodation facilities (TAFs). The assessment looked at a 100% imported workforce scenario and a 100% locally sourced scenario for the office to give an indication of the potential impacts that could arise from the Roma office. Both scenarios indicated a minimal increase in population as a result of the Roma office.

Santos communicated with Maranoa Regional Council about the phased approach to the CSG field development throughout the community consultation process of the EIS. This phased approach can be found in the project description. The SIA was assessed based on a prescribed Santos policy for accommodation facility site selection and a policy restricting workforce access to communities. These policies remain unchanged, and therefore it is not necessary to assess the effects of increased access on the community when this is not anticipated to occur.

In addition, Fairview temporary accommodation facility provided no indication there would be a measurable positive or negative social impact to the community if the same site selection criteria and access policies are followed for the GLNG CSG field development.

The social supplement examines an imported workforce migration scenario (scenario) based on the experiences with the Fairview operation east of Injune. The assessment of this scenario determined potential impacts to the community would remain low due to the estimated relatively small population increases associated with the project. The supplement maintains the requirement for TAFs for the imported workforce due to the size and logistics of accommodating and transporting the workforce. Alternative housing options may be considered throughout the CSG Field construction and operations on a case-by-case basis.

Respondent Comment

Queensland Police Service states that the EIS will need to scope the requirement for additional police resources, including staffing increases to the Central Police Region, new police stations, specialist resources and other equipment required.

Santos Response

Santos will continue to consult with QPS on potential population increases, demographic changes and police incidents associated with the project. Should additional police resources be identified as required to meet changes in the community associated with the project, Santos will work with QPS to discuss options with the State Government.

Respondent Comment

Queensland Health states that the proponent should consult with the local Health Service Districts (South West Health Service District, Central Queensland Health Service District) to discuss the capacity of health services to meet the expected demand for medical and emergency services.

Santos Response

Santos will work closely with local Health Service Districts to discuss capacity of health services to meet expected GLNG Project demand for medical and emergency services.

Respondent Comment

Queensland Health states that the proponent should have in place a procedure or protocol to identify and expeditiously notify Queensland Health where an incident occurs that is likely to impact upon public health and safety.

Santos Response

Santos will work with Queensland Health to ensure appropriate procedures are in place to notify Queensland Health of incidents which are likely to impact upon public health and safety.

As part of the Social Management Plan development, Santos will consult with the Central Queensland Health Service District and the area hospitals for identifying direct potential impacts from the project. For indirect impacts Santos will consult with Queensland Health and area health service providers where practicable to monitor changes in community health and wellbeing associated with the project. Correlations between health and wellbeing and other factors including stresses due to changes in the community may be considered in the design.

Respondent Comment

Queensland Health recommends that the proponent undertake a needs analysis to determine suitable social activities that promote interaction with the local community.

Santos Response

The EIS social impact assessment (EIS Appendix Z) discusses ways in which Santos personnel could interact with the local community, although this interaction is likely to be minimal as the workforce accommodation areas will be self sufficient. The social supplement examined the key themes experienced in the Moranbah area with camp accommodated workers and found that increasing social interaction between imported workers and the local community would have positive impacts on both.

Santos will continue to promote local events and programs and will incorporate their imported workforces into such as events where appropriate. Santos recognises the relationship between the imported workforce and the community and will explore programs to enhance that relationship.

Respondent Comment

Queensland Health recommends that the proponent develop an Alcohol Management Plan to encourage safe and responsible consumption of alcohol.

Santos Response

Santos workforce accommodation facilities will not provide alcohol on site.

EIS Section 8.14 outlines some of Santos mitigation measures towards anti-social behaviour such as drug and alcohol abuse.

- Dismissal and disciplinary action for anti-social behaviour;
- Close liaison with the community, police and other stakeholders to monitor and manage anti-social behaviour;
- On-site accommodation facilities; and
- Fly in/Fly out arrangement.

Respondent Comment

Queensland Health recommends that:

- *Each accommodation camp should be designed to either be smoke free environment, or provide for a single smoking area that is located in such a location that it will not impact on other residents at the camp.*
- *Quit Smoking programs be offered to camp residents to assist in helping them to stop smoking.*

Santos Response

Santos notes your comment and will consider this as part of the social assessment.

6.14.5 CSG Field Workforce

Respondent Comment

Queensland Department of Infrastructure and Planning states that provision of water and sewerage facilities to field based camps is important and has not been investigated in detail at this stage. The proponent should enter into discussions with local government and other service providers at an early stage to determine potential requirements.

It is important that existing infrastructure is not adversely affected by these communities and that appropriate assistance is provided to local governments and other service providers to maintain this infrastructure to a standard acceptable to the affected parties.

Santos Response

The temporary accommodation facilities will be located near the work fronts throughout the construction phase and will be self contained and not dependent on any services from the local governments.

The permanent accommodation facilities will be located near the compressor stations on Santos owned land and will be self contained and not dependent on local government services.

All accommodation facilities will be compliant with local government, state government and federal government permits and regulations.

Respondent Comment

Queensland Department of Infrastructure and Planning states that the strategy adopted appears to be to locate the majority of workers in temporary accommodation facilities to reduce the physical and social impacts on nearby communities. This strategy may assist to reduce some of the physical infrastructure impacts but it will not ameliorate the potential social impacts. The department needs to be satisfied that the project will not result in detrimental social impacts on the existing communities and address the issues raised at the Dalby resources summit.

Santos Response

The Dalby resource summit notes indicate a number of issues relating to social impacts were discussed primarily concerned with mining but often relevant to the project. Santos believes the SIA addresses the concerns identified at the summit, and maintains an open line of communication with landholders, councils, and key stakeholders in order to address ongoing concerns. As this is a relatively new industry in the area, Santos is aware of the need to maintain consultation with potentially affected parties. Santos has an office to maintain an active presence in the community and there are currently 25 people employed by Santos in Roma.

Santos is also committed to maintaining a close working relationship with councils in the area to assess potential impacts on an ongoing basis as the project develops and as communities in the area evolve and change over time.

There is no indication of detrimental social impacts occurring to local area communities from oil and gas development activity in the area over the past 50 years based on the information available from the level of social impact associated with the Fairview temporary accommodation facility. This is addressed in more detail in the CSG field Social EIS Supplement (**Attachment D1**). Mitigation and management strategies will therefore be designed to maximise potential opportunities while minimising potential negative impacts. In order to achieve this Santos is committed to working with councils and key stakeholders to enhance the study area communities.

The social supplement examined the key themes experienced in the Moranbah area with camp accommodated workers and found that increasing social interaction between imported workers and the local community would have positive impacts on both. Fostering a positive relationship between the imported workforce and the communities is a key objective of Santos for the GLNG Project. Paramount to this relationship is an understanding in the community as to why an imported workforce is required and why housing them in TAFs is the most feasible option at present. This is addressed in the social supplement (**Attachment D1**). The requirement for an imported workforce is due to the relatively small population in the area in combination with the low level of unemployment (< 2 %). In addition there are already similar operations in Fairview, Roma and Wallumbilla that require imported workers because the positions cannot be filled locally. The requirement to accommodate the workers in TAFs stems from the health and safety issues and logistics of transporting hundreds of workers daily throughout the CSG Fields if they were accommodated in local communities. The local communities do not have the housing stock or capacity to build sufficient numbers of houses for the project. In addition, this is not a sustainable practice since the current population growth in the area could not accommodate the annual changes in workforce numbers from the project. The result would create huge boom and bust scenarios in local housing markets. Santos will consider locating TAFs close to existing communities on a case-by-case basis depending on the distance to the work area and what can be defined as a reasonable daily commute for workers.

Respondent Comment

Queensland Health states that construction camps should be considered a sensitive receptor as the residents should be afforded the same air, acoustic and vibration goals as other residents.

Santos Response

Santos does consider the workforce accommodation facilities to be sensitive receptors. Santos will implement appropriate mitigation measures to ensure that Santos personnel are provided with facilities that are comfortable for our personnel.

Respondent Comment

Queensland Health states that provision of food to the workforce must be in compliance with the Food Act 2006, administered by Local Government.

Santos Response

The CSG field, gas transmission pipeline and LNG facility EMPs have been updated with the following text:

Social and Community (11.16.25, 12.16.18 and 13.16.14)

- Provision of food in the workforce accommodation facilities will be in compliance with the *Food Act 2006*, administered by Local Government.

Refer to **Attachment B** for all revised EMPs.

6.14.6.4 Impact on Housing and Accommodation

Respondent Comment

Central Highlands Regional Council states that the workforce accommodation needs were described for the construction phase of pipeline however the pipeline operational and both the CSG field establishment and operational workforce is not clearly set out.

There is a qualitative difference between transiting construction workers and permanently based maintenance workers in the operational phase and this should be reflected in the standard and location of the latter's housing.

Santos Response

The total pipeline operations workforce is anticipated to be less than 20. Any social impacts associated with the operational workforce would be low and therefore do not warrant additional assessment.

All CSG Field workers (construction and operation) will be housed in temporary accommodation facilities regardless of the project phase. There will be TAF policies regarding worker code of conduct and access to the community. These policies are consistent with the Fairview temporary accommodation facility currently operating east of Injune. Experiences at this site indicate that impacts on the neighbouring community are low. Refer to EIS Section 9.2 (Appendix Z) for further information. This is further assessed in the CSG Field social supplement **(Attachment D1)**.

Respondent Comment

Central Highlands Regional Council states that as the proposed size and location for the construction workers' camps are not known at this point, the Council would appreciate further contact with Santos when they are selecting workers' camp locations.

Santos Response

Potential temporary accommodation facility (TAF) locations have been identified. The next stage of the project, EPC (Engineering Procurement and Construction), will determine the preferred worker accommodation facility locations where applications will be made for any necessary approvals for infrastructure sites outside the pipeline corridor. Santos will continue to consult with local councils during this process.

6.15 Economics

6.15.5 Potential Impacts and Mitigation Measures

Respondent Comment

Queensland Department of Employment, Economic Development and Innovation states that subject to a recommendation by the Coordinator-General that the proposed development should proceed, it is recommended that the proponent liaise with the Department of Employment, Economic Development and Innovation in relation to employment strategies and support. A key focus of the project should be the maximization of employment opportunities for local disadvantaged job-seekers, under-employed people and indigenous people including support for job preparation and training.

Santos Response

Santos is committed to working closely with the Department of Employment, Economic Development and Innovation in relation to employment strategies and support.

Within each of the Social and Community sections of the EIS it outlines Santos commitment to employ locally where practicable.

EIS Section 6.14.6.2 states:

"Santos' policy aim is to employ locals wherever possible, and it will implement a five days on, two days off roster where practicable to provide opportunities for locals, while monitoring any impact that this may have on existing local employers."

EIS Section 7.14.6.2 states:

"Santos' policy aim is to employ locals wherever possible. For the construction of the gas transmission pipeline, there may be opportunities for local employment for some components, like traffic controllers, graders, plant equipment operators, and general labourers. The exact numbers and types of employment opportunities for people in the corridor region will be dependent on the selected contractor requirements and in-house capabilities. Santos will encourage the selected contractor to employ locally whenever possible."

EIS Section 8.14.6.2 states:

"Santos' policy will be to hire locals first where practicable. The workforce profile of Gladstone and the greater region (based on industry of employment and occupation) generally matches the skills required of the Santos workforce.

The range of skills required, will provide opportunities for unemployed workers to gain employment. Workers have the opportunity to develop skills with the available training courses proposed to be provided. Santos intends to develop training and skills development programs in conjunction with education institutions such as TAFE, and existing employment and training programs provided by government and local economic groups".

6.16 Rehabilitation and Decommissioning

Respondent Comment

Department of Environment and Resource Management states that the proponent should develop schedules of disturbance for all aspects of the project in accordance with the DERM guideline – Financial assurance for petroleum activities. Information demonstrating that the financial assurance estimates will be adequate for worst-case scenarios (including maximum possible areas of disturbance, maximum proportion of problem soil areas and maximum proportion of environmentally sensitive areas) should be provided.

Santos Response

Schedule of disturbance will be documented in the CSG field development plans. Disturbances relating to the pipeline, plant and marine infrastructure will be detailed in the construction EMPs and lodged as supporting documents within the statutory approvals process. Financial assurance will be calculated in accordance with published DERM guidelines.

Respondent Comment

Department of Environment and Resource Management states that any dams that are constructed for petroleum activities under an environmental authority should be removed post project unless written agreement is provided from the landholder and the administering authority; and the dam meets the requirements provided for in the Fitzroy Water Resource Plan in relation to overland flow.

Santos Response

Santos will ensure that any dam that does not conform to the requirements of the Fitzroy Water Resource Plan with regard to overflow will be decommissioned. Mitigation measures for decommissioning have been provided in the EIS at Section 6.5 (Table 6.5.5), they include:

- Implementing and maintaining a decommissioning EMP;
- Applying sediment and erosion control measures prior to earth moving activities commencing;
- Developing and implementing an EMP and water supply strategy, including licenses required to extract water;
- Developing and implementing and appropriate purging procedure; and
- Developing a Decommissioning Management strategy (including replanting of riparian and other erosion sensitive zones).